THE EFFECTS OF FERTILIZERS ON THE YIELD AND COMPOSITION OF FORAGE CROPS WITH SPECIAL REFERENCE TO SODIUM

by

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A thesis submitted to the University of Glasgow for the Degree of Doctor of Philosophy in the Faculty of Science.

June, 1958.

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ACKNOWLEDGEMENTS

The work described in this thesis has been carried out in the Agricultural Chemistry section of the Chemistry Department in the University of Glasgow between 1954 and 1957 under the supervision of Professor J.M. Robertson, F.R.S. I should like to record my thanks to him for the many facilities provided.

The investigations would not have been possible without the ready cooperation and understanding of several farmers who have generously provided sites for the field experiments and who have undertaken the necessary cultivations.

I am grateful also for technical assistance from Mr A. Rowley in the layout and harvesting of the grass experiments and to Miss M. Perry who has typed the manuscript.

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INTRODUCTION.

There is a very large literature regarding the possible value of sodium as a plant nutrient. Only however in the case of a few crops has it been shown to have any consistent or economic value. Sodium tends to be regarded as a beneficial rather than an essential nutrient. The idea has long been held, and still persists, that its action on plants is indirect by virtue of its supposed effect in liberating potassium from the exchange complex of the soil, thereby increasing its availability to plants. Many workers however, hold the view that it has a direct influence on the yield of certain crops and that true sodium deficiency can occur.

In view of the similarity between sodium and potassium, much work has been done regarding comparisons of the two elements on the growth of plants and attempts have been made to classify crops according to their responses to sodium in relation to their need for potassium. One such classification by Harmer and Benne (1945) working mainly on potassium deficient peat soils, but including results of other workers, groups crops according to their responses to salt at different potassium levels. Omitting vegetable crops of minor importance, their conclusions were as follows:

A. Benefit from sodium when potassium is deficient.

1. Little or none. Maize, Potato, Rye.
2. Slight to medium. Barley, Broccoli, Brussel Sprouts, Carrot, Cotton, Flax, Millet, Oats, Peas, Tomato and Wheat.

B. Benefit from sodium when potassium is sufficient.

1. Slight to medium. Cabbage, Kale, Mustard, Rape.

2. Large. Mangolds, Sugar Beet, Fodder Beet, Table Beet, Celery and Turnips.

They concluded that crops would respond to sodium if they had naturally (a) a high sodium content, or (b) a narrow $^{Na}/K$ ratio, wide ratios indicating no response.

Lehr (1953), as a result of comparative experiments with sodium, potassium and calcium nitrates, grouped crops according to their capacity to absorb sodium in replacement of potassium.

A. Large replacement of potassium by sodium.

1. Large benefit from sodium. Fodder Beet, Sugar Beet, Mangolds, Table Beet, Spinach.

2. Smaller benefit from sodium. Cabbage, Cotton, Kale, Oats, Turnips.

B. Smaller replacement of potassium by sodium.

Little benefit from sodium. Barley, Flax, Grass, Millet, Wheat, Rape.

C. Little replacement of potassium by sodium.

No benefit from sodium. Maize, Rye.

Comparable reviews differing only in detail have been put forward by Truog et al (1953), Kennedy et al (1953) and Larson and Pierre (1953) and others.

Although produced from different points of view and from both field and pot experiments, these groupings are essentially similar. A range of crops, (the Chenopodiacea) including sugar and fodder beets and mangolds respond well to sodium and have been extensively studied. Some, such as rye, potatoes and maize, fail to show any yield increment from sodium. A very wide range - including the Brassica family and perhaps the cereal crops - may perhaps be increased in yield by sodium under particular circumstances.

Boyd, Garner and Haines (1957) have recently summarized the results of a comprehensive series of over 200 field experiments in Britain to investigate the value of salt as a fertilizer for sugar beet. Salt at 5 cwt. per acre consistently increased the sugar yield by a similar figure. The sodium could partially or wholly replace potassium and yield increments obtained from salt were greater and less variable from year to year than from potassium chloride. There were large negative interactions for sugar yields between salt and potassium chloride. Soil analysis for readily soluble potassium predicted the possibility of a response to salt in the same manner as it did for potassium chloride. The responses to salt were similar in all soils except those from the fens, where smaller returns were obtained. The extra response from potassium chloride when salt was also applied was scarcely enough to repay its cost, but salt increased yields very profitably even when the supply of potassium in the soil was good. Analysis of the crop (unpublished) indicated that salt did not increase the potassium uptake, indeed, over a period of 5 years there was a slight tendency for it to be reduced.

There has not been the same urgency in Continental experiments regarding the use of salt for sugar beet, but the value of the salt in the high proportion of low grade potassium fertilizers used is well appreciated. There is thus wide-scale recognition of the value of sodium as a nutrient for sugar beet and extensive propaganda for its use. Hale, Watson and Hull (1946) and Wallace (1951) have described symptoms regarded as true sodium deficiency.

Although the published work is not so voluminous as for sugar beet, it is generally accepted that sodium is of equal value for mangolds and fodder beet and applications of salt are given as routine procedure. For example, Crowther and Benzian (1945) reported that sodium nitrate was 47% better than ammonium sulphate supplying equal nitrogen for mangolds, and the classical mangold experiment on Barnfield, Rothamsted shows consistent increments from sodium.

Apart from the above, the only other crop for which there is conclusive information that sodium may be of use generally from an economic point of view is cotton. Holt and Volk (1945), Lunt and Nelson (1950), Lancaster et al (1953), Cooper et al (1953), Appling and Giddens (1954), Eaton (1955), and Giddens et al (1956) have all reported that cotton responds to sodium when potassium is deficient. All conclude that a partial substitution of sodium for potassium up to about 50% was possible, but it is not known by the author whether or not the practice is wide spread. Lancaster et al (1953) did however point out that in five experiments where there were significant responses to potassium, that four of them also responded significantly to salt.

Almost every other agricultural and horticultural crop has been investigated for response to sodium and claims have been made either that increases in yield have been obtained or that potassium deficiency symptoms have been reduced in differing circumstances. Virtually all the work has been concerned with substitution of sodium chloride for potassium chloride or in the comparison of sodium and calcium nitrates. Frequently the work has only been done in pot or water culture and many of the experiments have not been repeated under field conditions.

In addition to the responses already quoted, lucerne has been studied by Wallace et al (1948), York et al (1953) and Truog et al (1953) and responses obtained. Various clovers have been investigated by Marshall (1944), Cope et al (1953) and Lehr and Bussink (1954) and more recently by Whehunt et al (1957).

Oats have been shown responsive by Bower and Pierre (1944), Cope et al (1953), Larson and Pierre (1953), Cooper et al (1953), Truog et al (1953), Whehunt et al (1953), Lehr and Bussink (1954) and Giddens et al (1956). Flax gave increased yields with sodium as reported by Molchanov and Dmitrieva (1936), Milnthorpe (1943), Bower and Pierre (1944) and Lehr and Wybenga (1955). Barley has long been reputed to respond to salt especially on potassium deficient chalk soils in southern England, and Truog et al (1953) have shown small yield increments. Kibe et al (1953) found increased yields of wheat in pot experiments and sodium sulphate consistently increases the yield on Broadbalk Field, Rothamsted.

Amongst a wide variety of other crops responding to sodium are carrots [Cooper et al (1953), Truog et al (1953)] : tobacco [Verona (1951), Lehr and Bussink (1954) and McEvoy (1955)] , and potatoes [Verona & Benvenuti (1953), Lehr and Bussink (1954)] .

These examples are by no means exhaustive and the literature is extensive. The findings have not in general been translated into agricultural practice as the effects have usually been small or absent in the presence of a reasonable potassium supply.

Work with sodium has not been entirely confined to determining its effect relative to potassium. Some investigators have been concerned with its influence on soil and plant phosphorus. As long ago as 1906 Wheeler & Hartwell reported that sodium salts increased the phosphorus contents of a variety of crops. Collings (1954) says that, "there is rather general agreement that sodium is valuable ..... to maintain a high degree of availability of phosphorus ...... and there appears to be some evidence that sodium in the soil may increase the availability of phosphorus that is tied up in insoluble form". There have however been few controlled experiments to jusify this.

Herbert(1951) found that sodium nitrate extracted three times as much phosphorus from soils than did calcium nitrate. Using the same salts at concentrations equivalent to the nitrate level in 22 Dutch soils, Lehr and Wesemael (1952) reported that sodium nitrate was superior to the extent of 80 - 90% and that sodium salts leached through the soils maintained a greater and more prolonged release of phosphorus than did calcium salts. In subsequent Neubauer tests (1956) they have found that phosphorus solubility was 64% greater and phosphorus uptake 45% higher if calcium nitrate was replaced with sodium nitrate. Tobia and Milad (1954) found that sodium and potassium carbonates applied to Egyptian alkali soils increased the concentration of water soluble phosphorus whereas calcium and magnesium salts depressed it.

Kibe et al (1953) showed that the available phosphorus in pot experiments with wheat was increased by an application of 0·2% sodium chloride. On the other hand, Scharrer and Schreiber (1944) had found that sodium chloride reduced the uptake of phosphorus by rye seedlings during early growth and McEvoy (1955) showed that both sodium and potassium depressed phosphorus uptake in tobacco. Marshall and Sturgis (1953) indicate that when sodium nitrate is the best nitrogen fertilizer for cotton that the soil is frequently low in phosphorus. More recently Nicholson and Hooper (1957) have suggested that the superiority of sodium or potassium nitrates over other nitrogen fertilizers for cabbage may be due to their effect on soil phosphorus.

Way and Nelson (1954) inhibited the formation of citrate insoluble phosphorus in NP and NPK fertilizers by the addition of 1% sodium chloride to the phosphate rock prior to acidulation. Hamamato & Kawasaki (1956) by treatment of rock phosphate with sodium chloride and steam produced a fertilizer as effective for rice as superphosphate. Butseroga (1954) found that sodium chloride applied to winter wheat and sugar beet created conditions whereby phosphorite meal became equivalent to superphosphate as a source of phosphorus. Andrews (1948) has put forward the view that sodium additions may lead to the formation of sodium fluoride which is leached from the soil, thus reducing the creation of calcium fluoride - containing apatites of low availability.

The recent observations of Boyd et al (1957) who demonstrated the presence of substantial negative interactions between sodium and phosphorus, and sodium, potassium and phosphorus in a comprehensive series of British sugar beet experiments which "were too frequent to be ignored", give added practical support to the evidence that sodium may increase the efficiency of phosphorus utilisation.

With the exception of the work with sugar beet, there has been no reported work regarding the use of sodium on agricultural crops in Britain in recent years. Until the last war, sodium nitrate supplied sodium in appreciable quantities. Its almost complete replacement by synthetic nitrogen fertilizers now makes the application of sodium as the nitrate or chloride a deliberate policy rather than an accidental occurence. Surveys of fertilizer practice show that salt is used mainly on sugar and fodder beets and mangolds, - more recently as a constituent of compound fertilizers, and that it is occasionally used on other crops such as barley, oats and grassland. It is widely reputed to be detrimental to potatoes in view of the ill-effect of chloride.

One object of this present thesis has been to examine the effects of sodium chloride on three agricultural crops of major importance, turnips, kale and grassland. All the work has been done under field conditions.

These three crops have been chosen for a number of reasons. In the first place, two are Brassica crops and earlier work has shown that as a family they may respond to sodium under suitable conditions. Secondly, kale and grassland make excessive demands for soil potassium and sodium might perhaps usefully replace some of this need. Thirdly, the suggestions that sodium may have a beneficial influence on phosphorus uptake by plants can perhaps best be investigated further in turnips.

The second, and major object of this work has been to examine the effect of salt on the mineral composition of these crops, namely the sodium, potassium, calcium, magnesium and phosphorus uptakes. Salt has therefore not been used in isolation in the field experiments but always in association with varying levels of nitrogen, phosphorus and potassium and under differing conditions of soil fertility. In two of the grass experiments magnesium was also applied in conjunction with salt.

There is virtually a complete absence of data in this country regarding the sodium content of these and other crops and of the influence of increased sodium intake on the level of other mineral elements. Equally the effect of added nitrogen, phosphorus and potassium when given in association with sodium is not known. As sodium is absorbed easily by plants, there might be expected to be a number of important ion antagonisms as is the case for example between potassium and calcium, and potassium and magnesium.

Finally, the experiments with kale incidentally provide information regarding the effects of phosphatic and potassic fertilizers on yield and mineral composition. So far as can be ascertained, there are no published data on these aspects of kale nutrition although the effects of nitrogen on yield and protein content have frequently been recorded.

EFFECTS OF SODIUM ON THE UPTAKE OF OTHER CATIONS.

(a) Potassium.

Opinion seems to be equally divided as to whether sodium applications increase or decrease the potassium uptake of plants. Any effects which have been observed have always been small. For example, some workers who have found that sodium promotes increased plant potassium levels, are Marshall (1944) for blue grass and clover, Cooper et al (1953) for a wide variety of crops, Appling and Giddens (1954) for cotton and more recently Whehunt et al (1957) for clover. On the other hand reductions in the potassium content of plants consequent upon sodium applications have been observed, for example by Hartwell and Dawson (1919) with a variety of crops, Wallace et al (1948) and York (1949) with lucerne, Larson & Pierre (1953) with oats and Lancaster et al (1953) and Eaton (1955) with cotton.

Chambers (1953) has attributed the consistently higher yields of the continuous Broadbalk wheat experiment on the plots receiving annual dressings of sodium sulphate to the increased potassium concentration in the straw resulting from the sodium applications, but even in such extreme circumstances the difference in mean potassium contents of the straw is less than 0·2% over the many years for which the experiment has been conducted.

(b) Calcium and Magnesium.

It is generally accepted that the increased potassium content of crops resulting from applications of potassium salts have depressive effects on calcium and magnesium uptakes. There have been very few investigations as to the possibility of similar effects when sodium replaces potassium as a soil amendment. Cooper and Garman (1942) and Lancaster et al (1953) have found that sodium reduced calcium uptake in cotton and thought this beneficial in that it created a more favourable $\frac{Ca}{K}$ or $\frac{Ca}{Na+K}$ balance. Cooper et al (1953) have later reported the possibility of a small decrease in magnesium. Larson & Pierre (1953) reported reductions in both calcium and magnesium levels in oats resulting from sodium and potassium applications. Cope et al (1954) thought sodium and potassium had roughly equal capacities for reducing calcium and magnesium levels in a variety of crops, but Chang and Drenge (1955) working on soils containing 35% exchangeable sodium suggested that sodium was of geater impact in this respect. Lehr and Wybenga (1955) have recently associated the drooping of flax heads at high sodium and potassium levels with calcium deficiency (or alternatively, physiological drought). Reitberg (1954) attributed sugar beet failure after sea water flooding to the four-fold increase in sodium in the plant inducing calcium deficiency.

Hale et al (1946) have reported the possibility of salt-induced magnesium deficiency in sugar beet and McEvoy (1955) has recently reported reductions in both calcium and magnesium levels in tobacco resulting from the addition of sodium to water cultures.

The absence of further references compared to the most extensive potassium/magnesium bibliography is indicative of the fact that few workers have estimated elements other than sodium and potassium in experiments involving salt or sodium nitrate.

ANALYTICAL METHODS.

The main series of experiments have produced some 1,500 samples for analysis for sodium, potassium, calcium, magnesium and phosphorus. It has been necessary to devise and adapt suitable methods to enable quantative determinations to be carried out both rapidly and with reasonable degrees of accuracy. For such purposes, volumetric and gravimetric methods are generally quite unsatisfactory in view of their length and the large number of separate operations involved. All analyses have therefore been performed by either flame photometric or colorimetric methods.

ASHING PROCEDURE.

1g. samples of oven dried plant material have been ashed in silica crucibles at 450 - 500°C for several hours. At this temperature no loss of mineral matter occurs, but overheating must be avoided. After cooling, the ash is slightly moistened with water and 1 ml. of concentrated hydrochloric acid added. The preliminary addition of water is to prevent some small loss of the fine, dry ash which may occur due to the vigorous reaction between the acid and some carbonate-containing ashes. After evaporation to dryness and removal of the hydrochloric acid, the ash is dissolved in warm water and filtered into 100 ml. standard flasks. Complete solution can only be acheived by thorough rubbing of the crucible with a glass rod, and in this respect new silica crucibles are much to be preferred to older ones with slightly roughened interior surfaces.

FLAME PHOTOMETRIC DETERMINATION OF SODIUM, POTASSIUM AND CALCIUM.

The EEL flame photometer (Evans Electro selenium Ltd.) described by Collins and Polkinhorne (1952) has been used throughout. In this instrument, small quantities (about 2 ml.) of solutions containing the elements are atomised into a coal gas/air flame. The light emitted after passage through suitable interference filters falls onto a barrier layer photocell which is connected through a potentiometer to a taut-suspension galvanometer. The galvanometer deflection is followed by means of a reflected light spot which falls onto a scale calibrated from 0 to 100 over a length of about 5 ins.

When used at its greatest sensitivity the instrument has a working range of from 0 to 5 ppm Na, 0 - 10 ppm K and 0 - 50 ppm Ca. The coal gas/compressed air flame results in lower mutual interference effects between alkali metals than would be experienced with, for example, an oxy-acetylene burner. However, it may be more susceptible to reduced emission in the presence of some anions, particularly phosphate. Typical filter curves (supplied by Evans Electro selenium Ltd.) are shown in fig. 1. Potassium is obviously well separated from the other two, but there is some possibility of mutual interference between sodium and calcium at particular concentrations.

The instrument is simple in operation and capable of rapid use, each determination taking about 20 secs. Calibration curves are

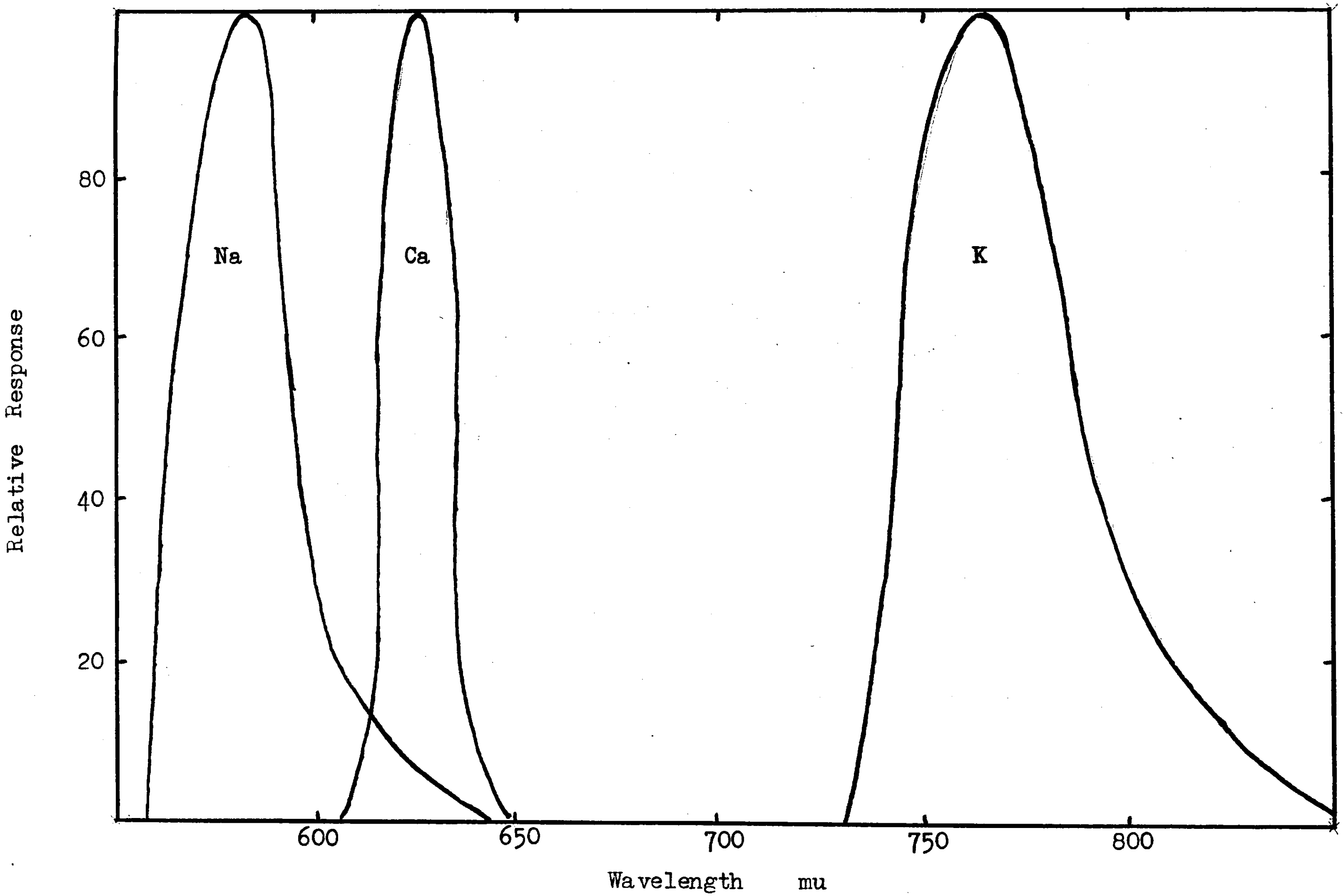


Fig. 1. EEL Flame Photometer. Filter Response Curves

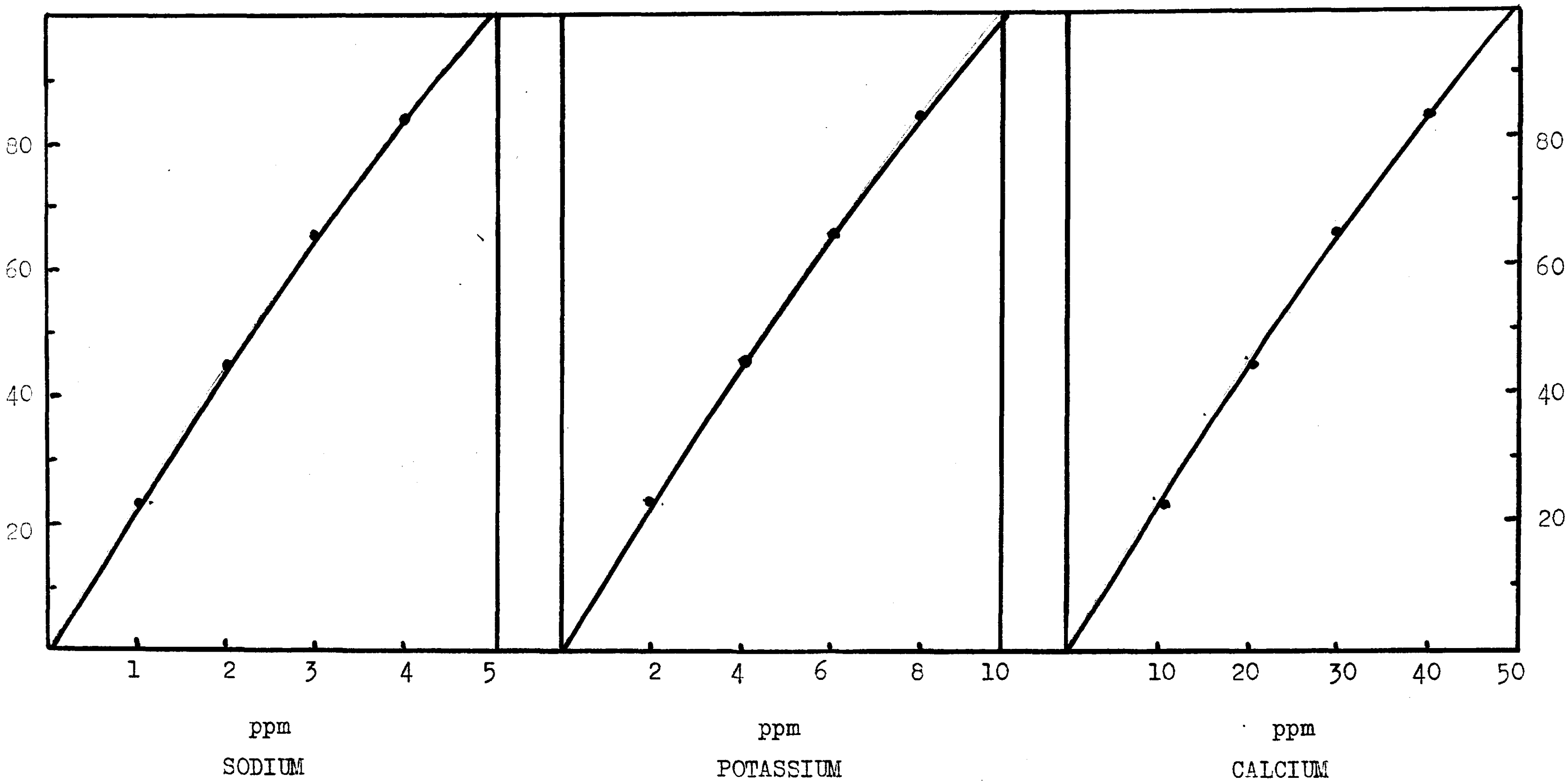


Fig. 2. EEL Flame Photometer Calibration Curves

prepared by spraying distilled water (or an appropriate "blank" solution) to give a reading of 0 and the highest concentration, say 10 ppm K, to give a reading of 100 with the appropriate filter in position. Intermediate points are obtained using suitable dilutions and the calibration curves produced are almost linear, being similar in shape for all three elements (Fig. 2.).

A. CATIONIC INTERFERENCE

Investigations have been made to determine the mutual interfering effects of sodium, potassium and calcium when present in solution in varying amounts (Table 1.). The sodium and potassium solutions were prepared from their recrystallised chlorides. Well washed calcium carbonate dissolved in the minimum volume of hydrochloric acid was used to prepare the calcium standard. In each case, stock solutions of 1000 ppm were prepared and the appropriate dilution obtained.

Table 1. Cation Interference

% Errors in Measurement.

Interfering Ion	ppm	Na 2.5 ppm	K 5 ppm	Ca 25 ppm
Na	5	-	0	0
	25	-	0	+1
	100	-	0	+9
K	5	0	-	0
	25	0	-	0
	100	0	-	0
Ca	5	+1	0	-
	25	+5	0	-
	100	+12	0	-
NH_4	1000	0	0	0

Potassium may thus be determined accurately without interference from either sodium or calcium at all concentrations. Equally, potassium does not in any way modify the true response of the instrument to sodium or calcium.

On the other hand, calcium and sodium are subject to mutual reinforcement in the flame due to the inherent inability of the light filters to exclude unwanted light entirely. Taken over the whole range, the errors are large, but when considered in relation to the more restricted ratio of calcium to sodium in plant material, they are quite small.

Plants contain considerably more calcium than sodium, typical $\frac{Ca}{Na}$ ratios being for a variety of crops, cereal grain 2, cereal straw 10, turnip tops 8, turnip roots 3, grass 3, clover 10, kale leaf 7, kale stem 3.

It can thus be taken that calcium determination may be made without the risk of interference from sodium, which would only cause an error of +1% even if present in equal concentration to that of calcium. There are however other factors which interfere with the determination of calcium which are discussed later.

In the determination of sodium, however, account should be taken of the presence of calcium. At a $\frac{Ca}{Na}$ ratio of 2, the error is +1% increasing to +5% at a ratio of 10. The most convenient method of making allowance for this is to include the appropriate amount of calcium in the sodium solution used to prepare the standard curve. Table 2 indicates that the effect of a given calcium addition is constant over the whole range of sodium and that the calibration curves produced are identical. Thus, by setting the instrument at 0 with the appropriate calcium concentration to be expected and at 100 with a similar concentration plus 5 ppm Na, the same curve may be used throughout.

Table 2. Effect of Calcium Addition to the Sodium Calibration Curve

Na ppm	Flame Photometer Readings Ca. added. ppm.			
	0	5	25	100
0	0*	0*	0*	0*
1	22·5	23·0	23·0	23·5
2	44·0	43·5	44·0	44·5
3	64·0	64·0	63·5	64·0
4	82·0	81·5	82·5	82·0
5	100*	100*	100*	100*

* Fixed instrument settings after adjustment for each vertical series.

Experience showed that in any particular field experiment with either kale, turnips or grass that the amount of calcium in the plant material was very uniform from plot to plot. For example, Table 3 shows the extreme range of calcium contents found in the first three kale experiments each of which consisted of 54 plots with different fertilizer treatments. The great majority of samples were very closely grouped around their respective means.

Table 3. Range of Calcium Contents Found in Each of Three Kale Experiments.

Experiment	Leaf			Stem		
	Min.	Max.	Mean.	Min.	Max.	Mean.
1	1·76	2·60	2·20	0·76	1·01	0·90
2	1·86	2·62	2·19	0·64	0·96	0·78
3	2·00	2·66	2·33	0·62	0·99	0·79

It proved entirely satisfactory to add the appropriate predetermined amount of calcium corresponding to the mean calcium level of all the plots in each separate experiment to the sodium solutions used to set the flame photometer correctly, thus avoiding the necessity of a separate calibration for each sodium determination.

B. ANIONIC INTERFERENCE

1. Sodium and Potassium

Collins and Polkinhorne (1952) have shown that very high concentrations of anions are needed in order to produce interference in determinations of sodium and potassium. Their results are quoted in Table 4.

Table 4. Limiting Anionic Concentrations for Zero Interference.

Interfering Ion	Limiting conc. (ppm) for determination of 10 ppm Na	10 ppm K.
NO_3	40,000	100,000
SO_4	18,000	56,000
Cl	1,400	1,200
PO_4	600	400

These quantities are obviously so very much greater than the amounts present in plant material that their effect on the accuracy of sodium and potassium determinations can be ignored.

2. Calcium

The EEL flame photometer has the very serious drawback in that the calcium emission is reduced in the presence of certain anions. In measuring calcium at a concentration of 50 ppm, chloride and nitrate ions added as their respective acids showed no depressive effect until their strength reached about 0·1 N and sulphate did not reduce the calcium emissiom until present at 0·05 N. These quantities are so very large in relation to 50 ppm of calcium that their possible effect in the analysis of plant material is nothing.

There is however, very serious interference to the calcium emission from phosphate in solution. Table 5 shows the marked depressive effect of even traces of phosphorus. Phosphorus was added to solutions containing 50 ppm of calcium as ammonium phosphate as the ammonium ion is quite without effect on the calcium emission (see Table 1.).

Table 5.

Interference Effect of Phosphate on the Determination of 50 ppm of Calcium.

Phosphate Added ppm P.	0	5	10	15	20	50	200	500
Interference %	0	-14	-32	-47	-64	-75	-80	-83

This loss in emission is due to the formation of calcium phosphate which is not excited to any degree in the coal gas/air flame. The interference is not so severe in flame photometers which burn acetylene or other high temperature flames and in such instruments the phosphate interference rapidly reaches a steady maximum. In these cases, excess of phosphate can be added to the solutions under test in such quantity that further small additions from the plant material would cause no further interference. Brealey et al (1952), Sharrer and Jung (1954) and Leyton (1954), for example, have described suitable methods for a variety of flame photometers burning acetylene. This approach cannot be used for the EEL instrument as the interference due to phosphate does not reach a steady maximum. It is changing rapidly over the normal calcium/phosphorus ratios found in plants and large additions of phosphate would cause too great a loss in sensitivity.

Many methods have been advocated for the removal of small amounts of phosphate from solutions containing calcium in order that subsequent calcium determinations may be made acurately. Chen and Toribara (1953), Powell (1953) and Williams and Morgan (1953) have precipitated calcium as the oxalate and carried out the analysis on the redissolved precipitate. Smith and McCallum (1956) have more recently removed phosphorus from solution before the EDTA method for determining calcium by precipitation with ferric chloride at a suitable pH. Some more rapid method however is needed to remove phosphorus completely in order not to cancel out the speed advantage of flame photometry.

Attempts have been made to precipitate phosphorus present at 50 ppm and under in solutions containing 50 ppm of calcium. A variety of reagents such as lead acetate and zirconium sulphate have been investigated, precipitation of the phosphate under varying conditions being followed by centrifuging. Difficulty was frequently encountered in obtaining clear solutions and in no case did the supernatant liquid give the correct calcium reading. This approach was therefore abandoned.

Investigations have been made to determine whether or not an anion exchange resin (Amberlite 1 R - 400 (OH)) could be used to separate calcium and phosphate. The resin was ground to pass the 60 mesh sieve but be retained by the 120 mesh and packed to a depth of about 5 cms. in a 7 mm. diameter tube. The resin was charged with sodium hydroxide, surplus being removed by thorough leaching with water.

25 ml. quantities of solutions containing varying quantities of calcium and phosphorus were introduced into the columns. The first 15 ml. of leachate was discarded as it was diluted with the water retained in the column after washing. The remainder of the leachate

was retained for flame photometric determination of calcium and the results compared with the original solutions (Table 6.).

Table 6. "Apparent" Calcium Concentration in the Original Solutions (A) and the Leachate (B) from Exchange Columns.

Phosphate added ppm P.	Calcium (ppm) in solution									
	10		20		30		40		50	
	A	B	A	B	A	B	A	B	A	B
0	10	7	20	14	30	21	40	27	50	34·5
10	5	7	8	13	145	22·5	23	27·5	32·5	34
25	4·5	8	6	13	8·5	20·5	11·5	28	12·5	34·5
50	4	7	-	-	-	-	11	28	-	-
100	4	7·5	-	-	-	-	11	26	-	-
Mean Ca recovered.	-	7·3	-	13·3	-	21·3	-	27·3	-	34·3
as % original	-	73·0	-	66·5	-	70·1	-	68·3	-	68·6

Increasing phosphate concentration, because of the depressive effect on calcium emission, produced steadily decreasing "apparent" calcium concentrations in the original solutions (A). The flame photometer readings in the leachate (B) were however reasonably constant over the whole range of phosphate for each vertical series. In each case some 70% of the calcium was recovered.

Experiments with larger volumes showed that phosphate retention was complete. Thus the lower levels of calcium in the leachate can only be explained on the basis that some calcium was retained on the column, most probably as calcium phosphate precipitated under the alkaline conditions. Attempts to improve the recovery rate and its constancy by charging the column with calcium hydroxide in place of caustic soda and altering the flow rate were not successful and this method was not pursued further.

Mason (1952) has used a cation exchange resin (Zeo - Karb 215) in the form of a column to retain calcium free from phosphate, the calcium subsequently being eluted with acid for determination with EDTA. The method finally adopted has been based on this idea.

Preparation of Exchange Columns.

The cation exchange resin used was Amberlite 1R - 120 (H) which was ground to a size that passes the 60 but is retained by the 120 mesh B.S. sieve. This was packed tightly into a 35 cm. length of glass tubing, 7 mm. in diameter and previously tapered at one end. The resin is held in position by two plugs of cotton wool. A suitable depth is 5 cms. The tube should then be capable of holding 10 ml. of water above the resin and this should run through in not less than 20 minutes. The resin is prepared for use by washing with 5N nitric acid and then several times with water. A number of tubes can conveniently be held on a horizontal wooden frame with "Terry" clips spaced at 2½ inch intervals. This allows the columns to be raised and lowered easily and gives sufficient room on the bench for standard flasks, beakers etc.

Retention and Elution of Calcium.

10 ml. of a solution containing 50 ppm of calcium (prepared by

dissolving calcium carbonate in hydrochloric acid and suitably diluting) are introduced into the top of the column and allowed to leach through the resin. The resin is then washed twice with 5 ml portions of water and all the washings are discarded. A 10 ml calibrated flask is then placed beneath the column and the calcium is eluted with 5 N nitric acid until 10 ml of eluate are obtained. Calcium is then determined in this solution by flame photometry, the calibration curve having been prepared from known amounts of calcium in 5N nitric acid. Both retention of the calcium and its subsequent elution are complete, as checked by both flame photometry and an oxalate method. Calcium is incompletely held if the solution under test is more acid than 0·25 N.

5 N nitric acid was chosen to elute the calcium in preference to either sulphuric or hydrochloric acids as it reduces the flame intensity of the calcium emission to the least degree. This is shown by the flame photometer readings for various solutions containing 50 ppm of calcium, i.e. with water as solvent, 100; with 5 N nitric acid, 82; with 5 N sulphuric acid, 67; and with 5 N hydrochloric acid, 65. The calibration curve is prepared by setting the instrument at 0 with 5 N nitric acid and at 100 with 75 ppm of calcium in 5 N nitric acid and then reading a number of intermediate concentrations.

Efficiency of Phosphate Removal.

Table 7 gives the results obtained for calcium determinations on solutions containing various amounts of phosphate added as ammonium phosphate. In each case they were added to the column in 10 ml. of water and eluted with 10 ml. of 5N nitric acid.

Table 7. Recovery of Calcium from Solutions Containing Various Amounts of Added Phosphate

TAKEN. Ca. ppm	P. ppm	EEL FLAME PHOTOMETER READING.*	FOUND Ca. ppm.	RECOVERY %
10	0	15	10.4	104
10	10	14.5	9.7	97
10	25	14.5	9.7	97
10	100	15	10.4	104
20	0	29	20.4	102
20	10	29	20.4	102
20	25	28	19.8	99
20	100	28	19.8	99
40	0	58	40.0	100
40	10	57	39.5	99
40	25	58.5	40.5	101
40	100	57	39.5	99
50	0	69	49.0	98
50	10	69	49.0	98
50	25	70	50.0	100
50	100	72	51.0	102
60	0	85	61.0	102
60	10	84	60.5	101
60	25	83	59.5	99
60	100	84.5	60.5	101
			mean	100.3

* 100 = 75 ppm Ca in 5N nitric acid.
0 = 5N nitric acid.

Elimination of interference due to phosphate is thus complete. The small deviationsfrom 100 % recovery are mainly attributable to inability to read the position of the light spot on the scale to a greater accuracy than ± 0.5 of a division, particularly for the higher readings.

Effect of Other Interfering Ions.

A number of cations can influence the calcium emission. The effects of these have been studied by including them in calcium solutions prior to passing through the exchange colums. The amounts added were in such quantity as may be found in plant material, and additionally, in excessively greater amounts.

Table 8 shows that interference from aluminium, iron, manganese, magnesium and sodium is in each case absent when considered in relation to their concentration relative to calcium in plants.

Table 8. Effect of Various Interfering Ions in the Determination of Calcium in 5N nitric Acid.

Interfering Ion.	ppm.	Calcium Taken. ppm.	Calcium found. ppm*
Aluminium	1	50	50.0
	10	50	49.0
Iron	1	50	50.0
	10	50	51.9
Manganese	1	50	50.0
	10	50	50.0
Magnesium	5	50	50.0
	10	50	50.0
	50	50	51.5
Potassium	50	10	10.0
	500	10	10.1
	50	25	25.0
	500	25	25.2
	50	50	50.0
	500	50	50.5
Sodium	2	10	10.0
	10	10	10.1
	50	10	11.0
	2	25	25.0
	25	25	25.2
	125	25	27.5
	10	50	50.0
	50	50	50.5
	250	50	58.5

* Mean of 3 determinations.

Procedure.

A convenient aliquot (usually 2.5 ml.) of the plant ash (prepared as described from 1g. of material made up to 100ml.) is transferred to the exchange column. After washing twice with 5ml. portions of water to remove phosphate, the calcium is eluted into a standard 10ml. flask with 5N nitric acid. The calcium concentration in ppm is then found by reference to the standard curve prepared from 0 - 75 ppm of calcium. After washing well with water, the column is ready for re-use.

If x ml. of the ash solution are taken and y ppm of calcium found, then the calcium content of the sample will be $\frac{y}{10x}$ per cent. If 2.5ml of solution is used, the range covered is from 0 - 3% Ca. in the plant material.

The procedure is obviously rather lengthy for a single determination, but when done in large batches many analyses may be completed very rapidly. After the initial pipetting into the exchange column, all the operations which are involved are simple washing procedures which can run unattended until the final collection of the 10ml nitric acid leachate. Even this may be simplified by leaching with slightly less than 10ml and then making up to the mark after drainage is complete.

Table 9 shows the good agreement reached between the calcium contents of a variety of plant materials as determined by both flame photometry and the oxalate method described by Marsden (1941).

Table 9. Comparison Between Flame Photometric and Oxalate Methods of Determining Calcium in Plant Material.

	CALCIUM %	
	FLAME	OXALATE
Turnip	.380	.372
Barley straw	.200	.199
Young oats	.382	.366
Seeds hay	.512	.522
Sugar beet pulp	.870	.878
Maize meal	.020	.021
Pea straw	.960	.945
Bean straw	.750	.766
Bracken stem	.220	.220
Potato haulm	1.375	1.370
Mean	.567	.566

Data concerning the accuracy of the method as measured by repeated analysis of the same sample of plant material are presented in a later section.

This method for determining calcium has been published (Hemingway (1956)).

DETERMINATION OF MAGNESIUM

The reaction between Titan Yellow (the sodium salt of the diazoamino compound of anhydrothio-p-toluidene sulphonic acid) and magnesium in alkaline solution to produce a red-orange colloidal lake has frequently been used as a method of determining magnesium.

Cornfield and Pollard (1950) have devised a method whereby there is no necessity for the addition of a protective colloid such as starch to stabalise the dispersion with a consequent drop in sensitivity. The procedure used has been a suitable adaption of this method.

Calcium and phosphate interferein the determination by increasing the development of the dispersion and aluminium by reducing it. These effects can be overcome by the addition of a "compensating reagent" containing these elements in such quantity that further additions from the plant material have no further effect. Manganese also has a reducing effect, but Cornfield and Pollard found that this could be eliminated by the addition of mannitol. Other ions in concentrations likely to be found in plant material have been shown not to interfere.

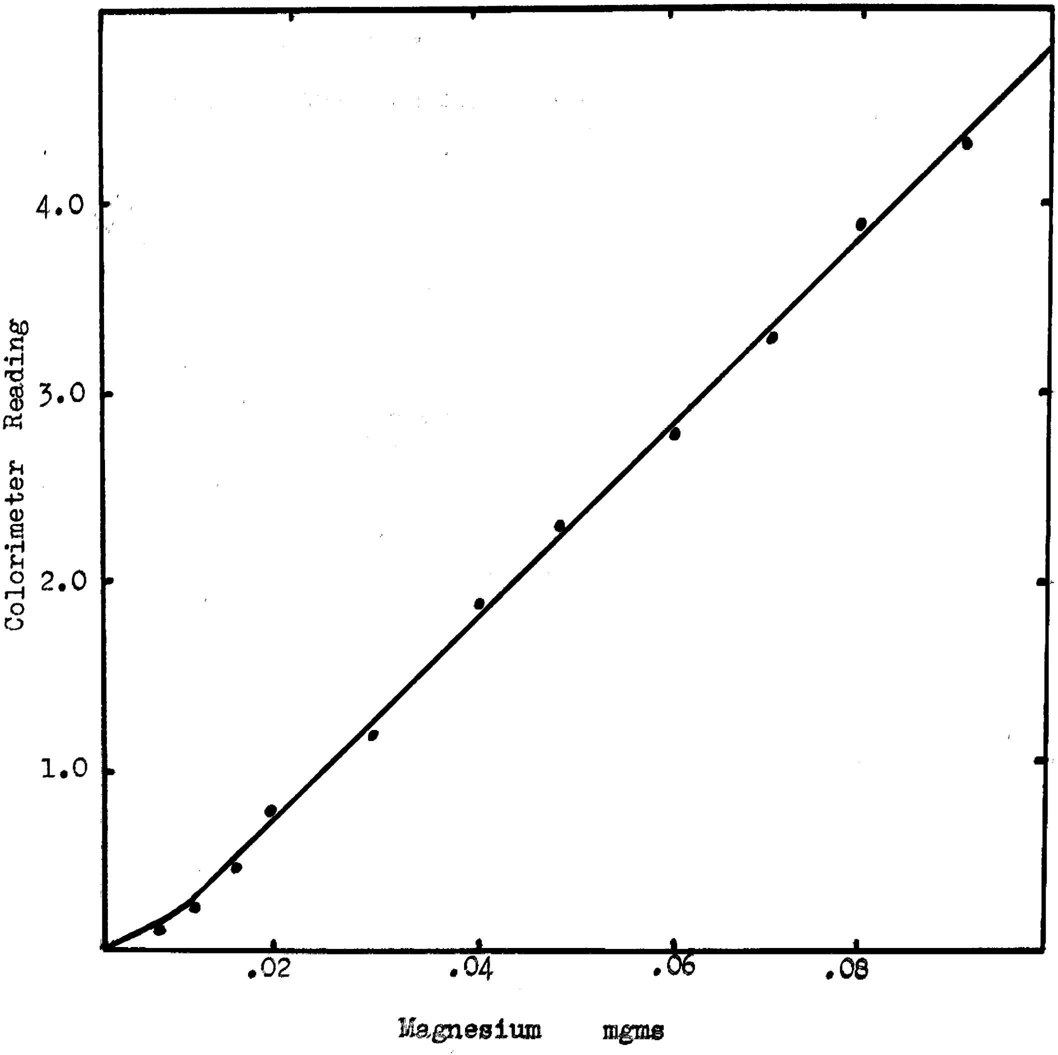
Procedure

The solution containing magnesium (usually 2.5ml of the ash solution prepared as described) is placed in a test tube graduated at 21ml. To this is added in turn;

(a) 1 ml of "compensating solution". This is prepared by dissolving 13.9g anhydrous $CaCl_2$, 0.96g KH_2PO_4 and 0.88g of potassium alum in 1 litre of water.

and (b) 1ml. of a 2.5% aqueous solution of mannitol.

The mixture is then made up to the 21ml. mark, shaken and allowed to stand for 5 minutes. 2ml. of a 0.05% solution of Titan Yellow are added followed by 2 ml. of 3N sodium hydroxide. After shaking well, the tube is allowed to stand for 10 minutes ($\pm$1 min.). During this period the colloidal lake may partially coagulate.



Blank = 0   Green 625 Filter

Fig. 3. Magnesium Calibration Curve

After 10 minutes the tube is vigorously reshaken to ensure complete dispersion and the contents are rapidly transferred to a colorimeter tube to be read immediately in the EEL Colorimeter using the 625 green filter, optimum transmission 540 mu.

A series of standards are prepared in the same manner using from 0 to 0.10mg. of magnesium as magnesium sulphate and a calibration curve obtained, setting the blank at 0 (Fig. 3.). If 2.5ml. of the plant ash solution is used, this corresponds to 0 - 0.40% Mg.

Comparison with a volumetric magnesium ammonium phosphate method (Marsden (1941)) showed very good agreement (Table 10.).

Table 10. Comparison Between Titan Yellow and Magnesium Ammonium Phosphate Methods for the Determination of Magnesium.

	Magnesium %.	
	Titan Yellow	Volumetric
Kale leaf	.090	.098
Kale stem	.146	.150
Grass	.124	.120
Clover	.266	.260
Turnip tops	.210	.204
Turnip roots	.108	.100
Mean	.157	.155

Data concerning the errors of repeated analyses of the same sample are presented in a later section.

DETERMINATION OF PHOSPHORUS.

Phosphorus has been determined by the usual molybdenum blue reaction. 1ml. of the ash extract was pipetted into a 100ml. flask and the blue colour developed after addition of the ammonium molybdate/sulphuric acid mixture and stannous chloride was measured in an EEL colorimeter. The standard curve produced covers the range 0 - 0.05 mg. P, i.e. 0 - 0.5% P.

SCHEME OF ANALYSIS

Having developed these methods, it was of the greatest importance that full advantage should be taken of their speed to determine sodium, potassium, calcium, magnesium and phosphorus in a large number of samples. To this end, a procedure has been devised to cut down the number of operations such as pipetting and the amount of apparatus to the absolute minimum.

In each case, exactly 1g. of sample was weighed out for analysis to avoid the need for subsequent calculations. Samples were analysed in batches of 16 as many of the field experiments had 32 plots. A metal tray to hold this number was made to fit the muffle furnace and after ignition it was transferred to fit over a sand bath for evaporation to dryness with hydrochloric acid. The ash was dissolved in hot water and made up to 100ml. Measured volumes of this solution were taken for analysis as shown in Fig. 4.

In this manner it was possible for one person to complete the analysis of 16 samples for all five elements in a day and this number could perhaps be increased if necessary.

Fig. 4. **Scheme of Analysis.**

1.0 g. of plant material

ashed → 100 ml.

	2.5 ml into exchange column for Ca.	2.5 ml into test tube for Mg.	1.0 ml into flask for P.	1.0 ml diluted to 10 ml for Na. →	1.0 ml diluted to 10 ml for K.*
Range of elements in standard curve	0 - 75 ppm	0 - 0.1 mg.	0 - 0.05 mg	0 - 5 ppm	0 - 10 ppm
% of element in plant material	0 - 3.0	0 - 0.4	0 - 0.5	0 - 0.5	0 - 10

* This diluted solution may, in addition, be used for sodium in those samples where it exceeds 0.5% of the dry matter.

The two 2.5 ml quantities for Ca. and Mg. are most conveniently delivered from a 5 ml graduated pipette. Similarly, a 2 ml pipette can be used for the 1 ml portions for P and Na.

THE ANALYTICAL ERRORS.

The accuracy of this scheme of analysis has been measured by repeated analyses of barley straw, hay and kale leaf. The method used was to weigh out 1g. samples of each and perform the analysis, the process being repeated at weekly intervals over a period of 10 weeks. Table 11 gives the total error from all sources of the separate analyses as measured by expressing the standard deviations as a percentage of their respective means. In each case the mean contents have been compared with values obtained separately by standard volumetric and gravimetric methods and good agreement found. This scheme of analysis has therefore been adopted and used throughout as the errors were considered to be satisfactorily small when associated with the speed and ease of analysis.

Table 11. Replicate Analyses Carried Out Over A Period.

	BARLEY STRAW					HAY					KALE LEAF				
	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
	.055	1.10	.190	.064	.105	.185	2.30	.305	.172	.305	.235	2.10	2.26	.112	.265
	.045	1.10	.200	.068	.115	.180	2.30	.315	.180	.300	.245	2.00	2.38	.100	.275
	.060	1.15	.190	.064	.120	.180	2.35	.315	.168	.310	.245	2.05	2.32	.104	.260
	.060	1.00	.190	.072	.120	.195	2.40	.310	.162	.315	.225	2.10	2.38	.120	.275
	.055	1.05	.190	.060	.100	.190	2.45	.300	.176	.300	.235	2.00	2.38	.116	.265
	.055	1.10	.200	.064	.105	.185	2.45	.310	.176	.305	.240	2.15	2.42	.108	.275
	.060	1.15	.190	.072	.120	.180	2.45	.300	.168	.310	.235	2.00	2.38	.122	.275
	.055	1.05	.190	.064	.100	.190	2.35	.310	.162	.310	.225	2.15	2.06	.102	.265
	.055	1.05	.195	.068	.115	.195	2.35	.295	.168	.310	.230	2.20	2.22	.104	.260
	.060	1.05	.195	.072	.110	.180	2.40	.310	.162	.315	.225	2.15	2.32	.116	.275
Mean	.056	1.08	.193	.067	.110	.186	2.38	.307	.169	.308	.234	2.09	2.31	.110	.269
S. Dev. as % of Mean	8.17	4.44	2.18	6.27	7.96	3.32	2.47	2.21	3.83	1.94	3.31	3.53	4.59	7.16	2.44
Mean of 2 determinations by "standard" methods of analysis	.060	1.10	.195	.065	.107	.182	2.32	.320	.174	.320	.240	2.07	2.33	.106	.275

EXPERIMENTS WITH KALE

There have been a variety of recorded results regarding the use of nitrogen on kale. Earlier work showed that 1 cwt. of ammonium sulphate produced about 1 ton of extra kale and that the response was almost linear up to 8 - 10 cwt. There were consequent reductions in the dry matter %. Within recent years opinions have been expressed that responses to nitrogen are not now so large and are more irregular from site to site. A search of the literature has revealed no records of controlled experiments with phosphorus and potassium, although compound fertilizers have been used at different rates.

There has been no systematic investigation into the effect of salt on kale, but Harmer & Benne (1945) have reported large increases in the yield of cabbage. Lehr (1953) has quoted the results of a trial in Ireland where salt reduced the yield of kale on a potassium deficient soil, but stimulated it when a suitable potassium application was also given. Pizer (1954) has summarised the available evidence regarding the salt tolerance limits of various crops on land flooded with sea water. Those withstanding 0.3% NaCl, (the highest) include kale, swedes, rape, mustard, rye, barley and rye grass. Oats and lucerne tolerate 0.2% and red and white clovers, timothy, wheat, cocksfoot, peas and beans fail at about 0.1%.

Experiments which have been made with nitrogen fertilizers have usually shown increases in the protein content of the crop, but there have been no investigations regarding the effect of fertilizers on the mineral composition of kale.

In the present work, six field experiments have been completed with kale. Four have been with marrow stem kale and two with the thousand head variety.

Two experiments (Kale 1 and Kale 2) with marrow stem kale were laid down in 1954. Each conformed to a similar design with the following treatments.

Ammonium Sulphate	0, 4 and 8 cwt./acre (N0,N1, N2)
Superphosphate	0, 3 and 6 cwt./acre (P0, P1, P2)
Potassium Chloride	0, 1½ and 3 cwt./acre (K0, K1, K2)
Salt	0 and 4 cwt./acre (S0, S1)

The basic layout of each was a standard 3 x 3 x 3 design of 27 plots in 3 blocks of 9 plots with the NPK interaction confounded between blocks. Salt was applied to a random half of each of the main NPK treatments.

One further experiment of this type (Kale 3) was carried out in 1955, only with thousand-head in place of marrow stem kale.

The partition of the degrees of freedom for the analysis of variance in the above design is as follows.

Main Plots		d. of f.	Split Plots		d. of f.
Blocks		2	Main Effect	S	1
Main Effects	N	2	Interactions	NS	2
	P	2		PS	2
	K	2		KS	2
Interactions	NP	4		NPS	4
	NK	4		NKS	4
	PK	4		PKS	4
Residual		6	Residual		8
	Total	26		Total	27

The second experiment in 1955 (Kale 4) on marrow stem kale used a simpler design involving only phosphorus, potassium and salt. The treatments were;

Superphosphate	0, 3 and 6 cwt./acre	(P0, P1, P2)
Potassium Chloride	0, $1\frac{1}{2}$ and 3 cwt/acre	(K0, K1, K2)
Salt	0, 3 and 6 cwt./acre	(S0, S1, S2)

Each plot in addition received 6 cwt. of ammonium sulphate per acre.

Two further experiments (Kale 5 and Kale 6) were laid down in 1956, the first with marrow stem and the second with thousand head kale. The treatments were;

Ammonium Sulphate	0 and 6 cwt./acre	N.
Superphosphate	0 and 3 cwt./acre	P.
Potassium Chloride	0 and 2 cwt./acre	K.
Salt	0 and 4 cwt./acre	S.

The various treatments were arranged in a factorial design in 4 blocks of 8 units. The NPKS interaction was confounded in each of the two complete replicates.

The analysis of variance is as follows.

	d. of f.
Replications.	1
Blocks in Reps.	2
Main Effects. (4)	4
Interactions:	
2 Factor (6)	6
3 Factor (4)	4
Residual	14
Total	31

The kale was invariably grown on slightly ridged land, the ridges being about 27 inches apart. The fertilizers for each plot were thoroughly mixed and sown by hand to the ground after the first harrowing but before the final seed bed preparations. In this way they were well intermixed with the soil during subsequent cultivations. Normally about a week elapsed between the date of fertilizer application and the sowing of the seed.

Only half of the total ammonium sulphate dressings of 6 and 8 cwt. per acre were given in the seed bed. For these high rates, half was applied at sowing time and the remaining half top dressed at singling.

The experimental areas were in each case sited in convenient positions in fields of kale on various farms. They were cultivated, sown, singled and weeded etc. at the normal times in conjunction with the remainder of the field by the farmer. Harvesting took place in late October and early November before the onset of serious frosts.

Plot Size.

In each experiment the plot size used has been 0.01 acre. In the first three experiments the main plots were twice this size to allow each half-plot receiving salt to be of similar area. Each plot (or half-plot) was 6 rows wide, generally the spacing being 27 ins., and about 33 ft. in length. The central four rows were harvested for yield determinations and samples for analysis were taken from this area.

Edwards (1954) and Halliday (1954) have both reported satisfactory results from using this size of plot. Halliday found that coefficients of variation in kale experiments using nitrogen were between 7 and 8% for dry matter yields.

Sampling.

The nature of the kale plant is such that fertilizers may alter the leaf/stem ratio and in view of the difference in composition of the separate parts it was decided to obtain separate samples of leaf and stem for analysis.

The kale experiments were singled as well as possible, but inevitably a few pairs or closely spaced plants were left. This naturally leads to the occurence in any one plot of a very small number of plants which are generally quite atypical from the remainder, usually being much smaller and stunted. It is obvious that such plants do not contribute to the total weight in relation to their numbers and that their composition might differ markedly from the remainder.

They must therefore be rejected in sampling and thus the samples taken will not be truly random but restricted to selection from the more normal plants in each plot. In any event, these will be the great majority and the preponderating factor in total yield.

Other workers have adopted the same attitude. Edwards (1945) took six plants per plot and rejected any obviously atypical plants in his "random" selection. Halliday (1954) recommends that a "fixed number" (unspecified) of "typical plants" be taken.

There are obvious limitations to the number of plants which can be taken to form a representative composite sample of kale in view of the bulk of material involved. Investigations have been carried out in areas adjacent to Experiments 1 and 2 to determine a suitable number of plants to be sampled for analysis.

From an area of 0.1 acre, ten groups of 12 plants were taken to represent individually the kale in that area. The plants were cut at about 3 ins. above ground level. Obviously atypical plants were rejected during the selection. The procedure then adopted was to strip the leaves from the stems. During this process three leaves from each plant were collected separately. One was taken from the top third, one from the middle portion and one from the bottom third of each plant. These 36 leaves then formed the laboratory sample for dry matter determination and subsequent analysis. During this separation, any surplus water adhering to the leaves is well shaken off.

The bulked leaves and stems from each group of 12 plants were weighed separately, the sum giving the total fresh weight. The leaf subsample was chopped, reduced in size by quartering, dried at 100°C, reweighed and finally ground. The 12 stems were treated in a similar manner.

Table 12 details the results of these investigations with respect to fresh weight, leaf/stem ratio and % D.M., and Table 13 gives the analyses of the dry matter for the separate samples from the area adjacent to Experiment 1. The analyses were carried out by the methods previously described. Expressed on a % basis, all the errors fall between 7 and 10% of their respective means, with the exception of the dry matter %s which are rather smaller. This order of magnitude is generally acceptable in this type of work and was surprisingly small.

Table 12. Investigations into Sampling Error (Sampling Unit. 12 Plants)

Sample	EXPERIMENT 1.				EXPERIMENT 2.			
	Fresh wt. lbs.	Leaf/stem ratio	% D.M. LEAF	% D.M. STEM	Fresh wt. lbs.	Leaf/stem ratio	% D.M. LEAF	% D.M. STEM
1	30.5	1.44	11.4	10.0	29.0	1.70	12.2	10.0
2	30.0	1.50	11.6	10.5	31.5	1.52	12.4	10.0
3	33.5	1.39	11.8	10.6	33.5	1.62	12.3	10.1
4	30.0	1.40	11.2	10.4	28.5	1.62	12.7	10.4
5	34.5	1.30	11.4	10.2	29.0	1.45	12.5	10.6
6	31.5	1.63	11.7	10.7	27.0	1.30	12.1	10.2
7	30.5	1.26	11.3	10.2	33.5	1.32	12.6	10.7
8	30.0	1.31	11.9	10.8	31.0	1.65	12.7	10.0
9	34.5	1.30	11.2	10.4	29.0	1.50	12.2	10.2
10	34.0	1.19	11.9	11.0	30.5	1.31	12.3	10.4
Mean	31.9	1.37	11.5	10.5	30.3	1.50	12.4	10.3
S. Dev. as % of mean	6.22	9.40	2.38	2.91	7.11	10.00	1.70	2.56

Table 13. Investigations into Sampling Error.

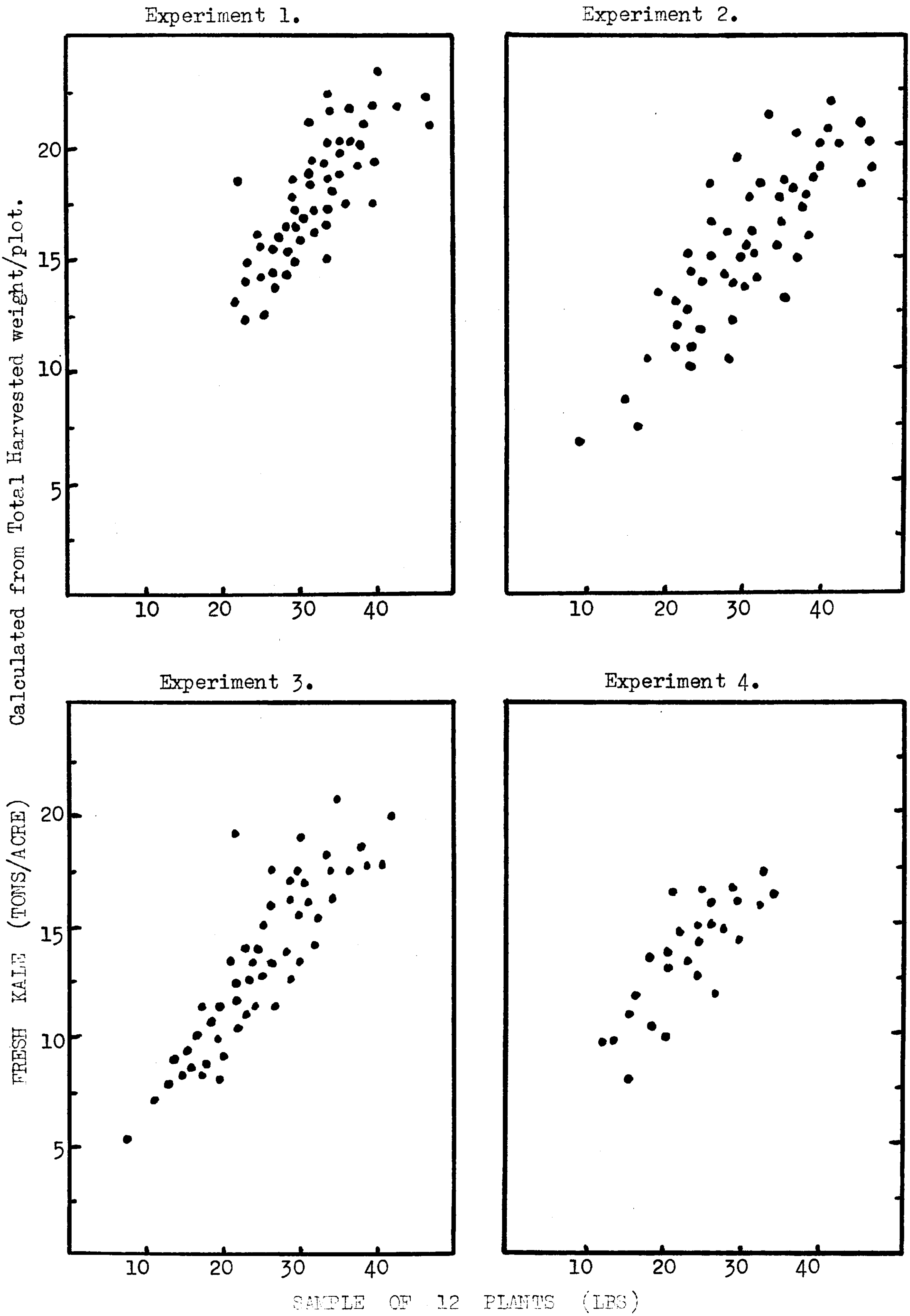
(Sampling Unit, 12 Plants)

% Composition of the Dry Matter.

Sample	LEAF					STEM				
	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
1	.300	2.40	2.70	.116	.275	.350	3.45	.90	.152	.310
2	.265	2.65	2.24	.122	.300	.305	3.65	.96	.138	.325
3	.295	2.50	2.12	.142	.305	.345	3.50	.96	.160	.310
4	.255	2.55	2.06	.126	.290	.300	3.05	.96	.160	.275
5	.270	2.35	2.36	.142	.265	.325	3.25	.80	.166	.280
6	.285	2.40	2.04	.110	.285	.300	3.40	.84	.132	.325
7	.260	2.65	2.46	.146	.315	.340	3.70	.80	.166	.280
8	.295	2.80	2.04	.136	.300	.325	3.75	.96	.132	.270
9	.290	2.30	2.12	.146	.280	.340	3.35	.92	.148	.320
10	.235	2.10	2.20	.122	.305	.285	3.85	.84	.162	.295
Mean	.275	2.47	2.22	.130	.292	.322	3.50	.89	.152	.299
S. Dev. as % mean.	7.74	8.22	9.63	10.15	5.38	7.02	7.14	7.61	8.82	7.22

A further check on the validity of using 12 plants as representative of each plot has been made. For each of the first four experiments, the weight of the 12 plants sampled have been plotted against the total weight of material harvested from each plot. The normal practice was to take 3 plants from each of the four harvested rows. Fig. 4 shows the good general correlation between sample weight and total harvested yield.

KALE SAMPLING EXPERIMENTS.



KALE EXPERIMENT 1. 1954.

Site Balloch, Dunbartonshire.

Soil Red sandstone drift. Freely drained.

Exchangeable	Na	8.0 mgs %	
1% citric sol	P	5.0 mgs %	Deficient
1% citric sol	K	8.5 mgs %	Low
	pH	6.2	

Previous Cropping

1953. Oats. No fertilizer except Nitro-chalk.

1952. Permanent grass.

Variety Marrow Stem.

Fertilizer Treatments and Layout.

The experiment consisted of all combinations of the following treatments;

Ammonium Sulphate	0, 4 and 8 cwt./acre (N0, N1, N2)
Superphosphate	0, 3 and 6 cwt./acre (P0, P1, P2)
Potassium Chloride	0, 1½ and 3 cwt/acre (K0, K1, K2)
Salt	0 and 4 cwt./acre (S0, S1)

The treatments were arranged in a standard 3 x 3 x 3 layout of 27 plots in 3 blocks of 9. The salt treatment was applied to a random half of each plot, giving 54 plots in all.

The crop grew well throughout and the mean yield of fresh kale was 18 tons per acre. There were large increases in yield from both ammonium sulphate and superphosphate.

Data regarding the yield and chemical composition of the crop are presented in the Appendix, Tables A 1 - A 7.

Yields of Fresh and Dry Matter. (A2)

The mean yield of fresh kale was 17.89 tons. Individual plots varied from 12.5 to 23.6 tons. The range of dry matter yields was from 1.477 to 2.628 tons, the mean being 1.989.

Salt significantly increased the yields of both fresh and dry matter by 0.87* and 0.099* tons respectively. In each case there were appreciable negative KS and PS interactions. Salt thus increased the yield by about 1.60 tons of fresh kale in the absence of either superphosphate or potassium chloride but by only about 0.20 tons in their presence. The negative PKS interactions were also considerable. Salt gave appreciably better returns in the presence of ammonium sulphate (1.34 tons fresh and .182 tons dry) than in its absence (0.16 tons and .022 tons respectively).

Ammonium sulphate had large and very significant effects on the yields of both fresh and dry matter. The increases from the 8 cwt. application were 4.29** and .278* tons respectively.

Superphosphate also increased yields significantly. The fresh weight increase was 2.85** tons and the dry matter increment .291* tons.

Potassium Chloride was almost without effect. It increased the yield of fresh kale by only 0.48 ton.

Composition of the Dry Matter.

Sodium (A3)

The mean % Na in the leaf and stem were .383 and .332. Very large variations were found from plot to plot. The lowest values (.110 and .115 respectively) occurred in the N0 P0 K2 plot and the highest (.885 and .820) with the N2 P0 K1 S1 treatment.

Salt had very large and significant effects, the increases in the leaf and stem being .151** and .121** % respectively. Ammonium sulphate and superphosphate had little influence on the effect of salt (although individually they had considerable influences) but potassium chloride much reduced the ability of salt to increase the sodium uptake. Thus, in the leaf, in the absence of potassium chloride salt increased the % Na by .298% but by only .079% in its presence. In the stem the increases were .222 and .053 respectively. These negative KS interactions were both very significant.

Ammonium sulphate increased the % Na by .154** in the leaf and by .210**% in the stem. The increases were reduced in the presence of potassium (.103* and .164**) and correspondingly greater (.251** and .377**) in its absence. The negative NK interaction reached significance at the 5% level in the stem.

Superphosphate also had marked effects. The % Na was increased by .059* in the leaf and by .070** % in the stem.

Potassium chloride greatly depressed sodium uptake. In the leaf, the level fell from .539 to .279 when 3 cwt. per acre were applied. In the stem the fall was from .463 to .247. Both these reductions were highly significant.

<u>Potassium</u> (A4)

The mean % K in the leaf and stem were 2.44 and 3.49 respectively.

The lowest values of 1.85 and 2.90 were found in the NO PO KO S1 plot and ranged up to 3.15% in the leaf and 4.05% in the stem.

Salt reduced the % K in the leaf by 0.12 and in the stem by .03%. The effects of salt in association with other fertilizers were rather irregular but the fall in potassium level was generally less when superphosphate and potassium chloride were given with the salt and greater in the presence of ammonium sulphate. None of the effects and interactions were significant.

Ammonium sulphate depressed the % K in the leaf by $.17^{*}$% but increased it by a small amount (.07%) in the stem.

Superphosphate tended to reduce the potassium levels in both leaf and stem.

Potassium chloride itself significantly increased the potassium content of both leaf and stem, the rises in % K being $.39^{**}$ and $.40^{**}$ respectively. Other fertilizers did not materially influence the main potassium effect.

Calcium (A5)

There was little variation from plot to plot in the calcium contents of either leaf or stem. The mean values were 2.20 and 0.90% respectively.

Salt depressed the level in the leaf by .05% but increased it slightly in the stem by .02%. Neither effect approached significance and the influence of salt was in no way consistent.

Ammonium sulphate had no effect on calcium uptake, the increases in % Ca in leaf and stem being .02 and .04 respectively.

Superphosphate reduced the % Ca in the leaf by 0.10* and in the stem by 0.05%.

Potassium chloride also reduced the calcium levels in leaf and stem by 0.05 and 0.04 respectively.

Magnesium (A6)

The mean % Mg in the leaf was .123 and in the stem, .152. There were no marked influences due to fertilizer treatment.

Salt depressed the level in the leaf by .005% and in the stem by .012%, but neither effect reached significance.

Ammonium sulphate was almost without effect. 8 cwt. reduced the the % Mg in the leaf by .004 and increased the amount in the stem by .002.

Superphosphate tended to depress the magnesium uptake. There were falls from .127 to .124 in the leaf and from .159 to .149 in the stem.

Potassium chloride behaved in a similar manner. There were reductions of .004 in the leaf and .003 in the stem.

Phosphorus (A7)

The mean values of % P in the leaf and stem were .289 and .320.

Salt increased the level in the leaf by .010 and in the stem by .019*%. There were quite large negative PS interactions and in the stem this reached -.043*%. Only in the absence of superphosphate did salt increase the level of phosphorus in the stem and then by as much as .040%. In the absence of both superphosphate and potassium chloride the increase was .072*%.

Ammonium sulphate had the effect of increasing the % P in the leaf by .016% and in the stem by .006%.

Superphosphate itself significantly (P = .05) increased the level in the stem from .272 to .295 and in the leaf from .301 to .332.

Potassium chloride had a small depressive influence of about .008% P in both leaf and stem.

KALE. EXPERIMENT 2. 1954

Site Balfron, Stirlingshire.

Soil Red sandstone/alluvial drift.

Deep, freely drained.

Exchangeable	Na	5.0 mgs %	
1% citric sol.	P	10.0 mgs %	Low
1% citric sol.	K	9.0 mgs.%	Low
	pH	6.8	

Previous Cropping

1953	Oats	No fertilizer except Nitro-Chalk
1952	Potatoes	NPK fertilizer

Variety Marrow stem

Fertilizer Treatments and Layout.

The treatments and design of this experiment were as for Experiment 1, namely; all combinations of 0, 4 and 8 cwt. of ammonium sulphate, 0, 3 and 6 cwt. of superphosphate and 0, 1½ and 3 cwt. of potassium chloride in a 27 plot layout with 4 cwt. of salt applied to a random half of each plot.

The crop grew well throughout the season, the mean yield being 15 tons of fresh kale per acre. Ammonium sulphate gave large yield increments. Some damage occurred in mid-summer due to the action of rabbits and this is reflected in the rather high standard error. It did not in any way obscure the main fertilizer effects. The interior of some of the stems on the plots with the highest nitrogen treatment were hollow and slightly brown, features similar to boron deficiency, but the crop did not seem to be adversely affected.

Tables A8 - A14 present the crop yields and analyses.

Fresh and Dry Matter Yields (A9)

The mean yields were 15.46 tons of fresh kale and 1.882 tons of dry matter. Individual plot yields varied from 6.48 tons (NO PO KO SO) to 21.56 tons (N2 P2 KO S1) primarily as the result of the nitrogen treatment.

Salt significantly increased the yield of both fresh (0.95^{*} tons) and dry (0.099^{*} tons) matter. In each case there were large and significant negative KS interactions; -3.00^{**} tons for the fresh kale and -0.331^{*} tons for the dry matter.

Ammonium sulphate had large effects. The fresh weight increase was 6.23^{**} tons and although there was a fall in dry matter %, the dry weight was also increased by 0.513^{*} tons. These increases tended to be greater in the presence of superphosphate.

Superphosphate also increased the yield of fresh kale by 1.27 tons and of the dry matter by .110 tons. There were quite large negative PK interactions.

Potassium chloride had a smaller influence on yield, the increases being 0.50 tons of fresh material and 0.063 tons of dry matter.

Composition of the Dry Matter.

Sodium (A10)

The leaf had a mean content of .329% Na and that of the stem was .324%. Large variations were found from one treatment to another ranging from .090 and .110% in the leaf and stem of the NO PO KO SO plot to .950 and .875% respectively in the N2 P2 K0 S1 plot.

Salt had a large and consistent influence on sodium uptake. The amounts in both leaf and stem were raised by .164**%. There were also substantial negative interactions with the other three supplied nutrients. None reached significance, but the KS interactions were almost so.

Ammonium sulphate had large and significant effects; the sodium level was raised by .297**% in the leaf and by .286**% in the stem. These increments were even greater in the absence of potassium.

Superphosphate had a much smaller influence. The levels in the leaf and stem rose by .037 and .015 respectively and in each case the NP interaction was +.050.

Potassium chloride markedly and very significantly depressed sodium uptake. The % Na in the leaf fell from .471 to .295 with the $1\frac{1}{2}$ cwt. application and to .221 with the 3 cwt. dressing. In the stem the fall was from .460 to .303 to .208% Na. In both leaf and stem there were large and significant (P = .01) negative NK interactions of -.267** and -.223** respectively. These led to much greater reductions in the % Na from potassium when high nitrogen applications were given, e.g. In the leaf the mean for the N2 K0 treatments had .731% Na, but for the N2 K2 treatments the level was .277% Na.

Potassium (A11)

The mean % K in the leaf and stem was 1.64 and 3.18 respectively. Individual plots varied from 1.10 to 2.40% K in the leaf and from 2.25 to 4.55% in the stem, primarily due to the effect of potassium chloride.

Salt had no influence. It raised the % K in the leaf by .03 and reduced it in the stem by .07%. There was a tendency for the depressive effect to be greater in the presence of superphosphate.

Ammonium sulphate reduced the % K in the leaf by 0.07% but increased it by 0.38% in the stem.

Superphosphate raised the % K in the leaf by 0.17% and in the stem by 0.08%.

Potassium chloride itself had larger and more significant incremental effects. The rise in the leaf was from 1.52 to 1.89 (sig. at 5% level) and in the stem from 3.06 to 3.48. In the leaf the PK interaction (+0.37%) was also significant.

<u>Calcium</u> (A12)

There was little variation in the calcium figures. The mean % Ca of the leaf was 2.19 and of the stem, 0.78%.

Salt depressed the calcium level in the leaf by 0.03% but was without influence on the stem. There were quite large negative KS and PS interactions in the leaf.

Ammonium sulphate reduced the % Ca in the leaf by 0.15 and in the stem by 0.01%. The positive NP interaction of 0.06 in the stem was significant ($P = .05$) but there was a negative one of -0.17% in the leaf.

Superphosphate reduced the % Ca in the leaf by 0.04 and in the stem by 0.05*%.

Potassium chloride had a similar effect to superphosphate, a fall of 0.07% in the leaf and of 0.07*% in the stem. The negative NK interaction in the stem of -0.05% was significant (P = .05).

Magnesium (A13)

The leaf had a mean Mg % of .089 and that of the stem was .133%.

Salt had no overall effect on the magnesium content. It did however tend to increase the % Mg on plots without potassium chloride but to decrease it when given in association with potassium. It also increased the % Mg in the absence of ammonium sulphate, but decreased it in its presence.

Ammonium sulphate increased the % Mg in the leaf from .086 to .095 which was almost significant and in the stem from .126 to .141 which did reach significance at the 5% level.

Superphosphate was without effect.

Potassium chloride reduced the % Mg in the leaf by .012% and in the stem by .010*%.

Phosphorus (A14)

The mean values for % P in the leaf and stem were .310 and .360 respectively. There was considerable variation from plot to plot and ammonium sulphate, superphosphate and salt increased the levels.

Salt increased the % P in the leaf by .014**% and in the stem by .010%. In the leaf there was a negative NS interaction of -.017 and a negative KS interaction of -.027*%.

Ammonium sulphate increased the level of phosphorus but only in the leaf. The rise was .040*%.

Superphosphate itself raised the % P in both the leaf and the stem by .039* and .035*% respectively. In each case there were negative NK and PK interactions.

Potassium chloride did not influence phosphorus uptake.

KALE EXPERIMENT 3. 1955

Site Cochno, Dumbartonshire.

Soil Heavy loam. Poorly drained.

Exchangeable	Na	6.0 mgs %	
1% citric sol.	P	12.5 mgs %	Satisfactory.
1% citric sol.	K	12.5 mgs %	Satisfactory.
	pH	6.8	

Previous Cropping

1954	Potatoes	Poor crop, manuring unknown.
1953	Oats	manuring unknown.

Variety Thousand head

Fertilizer Treatments and Layout.

The design of the experiment was as for Experiments 1 and 2. Three levels of nitrogen, phosphorus and potassium as before were arranged in a 27 plot layout with the salt treatment applied to a random half of each plot, giving a total of 54 plots.

The crop yielded 13.5 tons of fresh kale per acre and ammonium sulphate gave very large increases.

Information regarding the yield and composition of the crop are given in Tables A15 - A21.

Yields of Fresh and Dry Matter. (A16)

The mean yields of fresh and dry kale were 13.6 and 1.87 tons respectively. Ammonium sulphate had a large influence on yield and the fresh weight of individual plots varied from 5.2 to 20.8 tons in consequence.

Salt had significant effects on yield, the fresh weight was increased by 0.97* tons and the dry matter by 0.107* tons. In each case there were negative KS interactions of -0.39 and -0.076 tons respectively, but neither reached significance. There was also a large negative PS interaction for dry matter yields.

Ammonium sulphate increased the yield of fresh kale from 9.44 to 14.19 tons when applied at the 4 cwt. rate and to 17.19 tons at the 8 cwt. level. The increases in dry matter were from 1.446 to 1.972 to 2.193 tons. All the increases were significant. There were small positive NK interactions.

Superphosphate had only a slight effect on yield: fresh and dry matter increases being only 0.34 and 0.096 tons respectively.

Potassium chloride also had little influence. 3 cwt. increased the yield of fresh kale from 13.27 to 13.69 tons and of dry matter from 1.863 to 1.884 tons.

Composition of the Dry Matter.

Sodium (A17)

There were large variations in the % Na resulting from applications of ammonium sulphate, potassium chloride and salt. The mean values for leaf and stem were .270 and .223, but the extreme contents of the leaf varied from .030 (NO PO K1 SO) to .825 (N2 PO KO S1). The corresponding values for the stem were .025 and .800%.

Salt had large and significant effects. In the leaf, the % Na was increased by .064**% and in the stem by .073**%. There were considerable interactions with other fertilizers. The NS, KS and PS interactions were all large and negative: salt itself thus increased the % Na considerably more in the absence of other fertilizers.

Ammonium sulphate progressively and very significantly increased the % Na from .125 to .252 to .434% in the leaf and from .116 to .171 to .382 in the stem. The increases were much greater in each case in the absence of potassium chloride and the negative NK interactions of -.256*% in the stem and -.232**% in the leaf were both significant.

Superphosphate had little influence on sodium uptake. It reduced the level in the leaf by .016 and in the stem by .041%.

Potassium chloride in increasing quantity progressively reduced the level of sodium in the leaf from .434 to .253 to .124% and in the stem from .376 to .210 to .084%. These effects were significant at the 1% level.

Potassium (A18)

The mean % K in the leaf was 2.63 and in the stem 2.84. There were large variations resulting from the application of potassium chloride.

Salt increased the % K in both leaf and stem by 0.10%. Larger increases occurred in the presence of potassium chloride than in its absence.

Ammonium sulphate tended to reduce the potassium level in the leaf, but to increase it in the stem, but the effects were small.

Superphosphate had no effect on potassium uptake.

Potassium chloride itself had large and very significant influences on the % K. From a level of 2.19% in the leaf it was raised to 2.60 by $1\frac{1}{2}$ cwt. and to 3.16 by 3 cwt. In the stem the increases were from 2.36 to 2.88 to 3.28%.

Calcium (A19)

The mean % Ca of the leaf and stem were 2.33 and 0.79 respectively.

Salt reduced the level in the leaf by .02 and in the stem by .05*%. In each case the fall in the calcium level was greatest when salt and potassium chloride were applied together. In the stem, salt reduced the % Ca by .086 in the absence of superphosphate, which was almost significant.

Ammonium sulphate had no appreciable effect on the calcium level in the leaf, but increased it in the stem by .08% which almost reached significance.

Superphosphate did not influence the calcium uptake.

Potassium chloride depressed the calcium level in the stem by .010*% but had no effect in the leaf.

Magnesium (A20)

The magnesium content of the leaf was .152% and of the stem .161%. Potassium chloride and superphosphate tended to reduce the levels and ammonium sulphate to increase them, all by significant amounts.

Salt reduced the % Mg in the leaf and the stem by .011 and .009 respectively. Salt had a greater depressive effect when applied without potassium chloride and the KS interaction of +.027 in the stem was almost significant. Equally, in the stem there was an almost significant PS interaction of -.026; salt only depressed the % Mg in the presence of superphosphate.

Ammonium sulphate increased the % Mg in the leaf from .139 to .160 (sig. at 5% level) but did not affect the level in the stem.

Superphosphate reduced the level in the leaf from .162 to .136 (sig. at 5% level) but did not alter the stem content.

Potassium chloride also reduced uptake in the leaf by .034**% and was without effect on the stem.

Phosphorus (A21)

The mean % P in the leaf was .180 and in the stem, .210. Variations from plot to plot in leaf P were from .125 to .245 and in stem P from .170 to .280.

Salt depressed the uptake by .008*% in the leaf and by .021**% in the stem. In the leaf there was a marked positive PS interaction of .021*%. Only in the absence of superphosphate was salt important in reducing phosphorus uptake.

Ammonium sulphate did not alter the phosphorus levels.

Superphosphate itself significantly increased the % P in the leaf by .015*% and raised it in the stem by .008%.

Potassium chloride also enhanced the phosphorus contents of both leaf and stem. In the former the increase from a 3 cwt. dressing was from .175 to .186 (sig. P = .05) and in the stem from .200 to .227%.

KALE EXPERIMENT 4. 1955.

Site — Balloch, Dumbartonshire.

Soil — Red sandstone drift. Medium loam, freely drained.

Exchangeable	Na	45.0 mgs. %	
1% citric sol.	P	4.5 mgs. %	Deficient.
1% citric sol.	K	11.0 mgs. %	Low.
	pH	6.0	

Previous Croppings

1954	Oats	2 cwt. Ammonium Sulphate
1953	Permanent grass	

Variety — Marrow stem.

Fertilizer Treatments and Layout

The treatments were as follows;

Superphosphate	0, 3 and 6 cwt. (P0,P1,P2)
Potassium chloride	0, $1\frac{1}{2}$ and 3 cwt (K0,K1,K2)
Salt	0, 3 and 6 cwt. (S0,S1,S2)

These were arranged in a standard 3 x 3 x 3 layout of 27 plots in 3 blocks of 9. In addition, each plot received 6 cwt. of ammonium sulphate.

The crop yielded 13.5 tons per acre, superphosphate giving noticeable increases.

Tables A22 - A28 present the yield and composition of the separate treatments.

Yields of Fresh and Dry Matter (A23)

The total mean yield of fresh kale was 13.56 tons and that of dry matter, 1.693 tons. Superphosphate had a large effect on yield.

Salt at 6 cwt. per acre increased the yield of fresh kale by 1.27 tons and of dry matter by .085 tons. There were no marked interactions between salt and other fertilizers except a negative KS interaction of .208 tons of dry matter.

Superphosphate greatly increased both the fresh and dry weight at both rates of application, the former by 4.71** tons and the latter by 0.578** tons. There were appreciable, but non-significant negative PK interactions.

Potassium chloride had only a small effect on yield. 3 cwt. increased the fresh weight by 0.83 tons and the dry matter by only .020 tons.

Composition of the Dry Matter

Sodium (A24)

The mean % Na in the leaf was .477 and in the stem, .582. Very large variations were found from plot to plot, the range in the leaf was from .095 to 1.270% and in the stem from .110 to 1.520%.

Salt had large and significant effects on sodium uptake, The mean % Na of the untreated plots was .249 in the leaf and .300 in the stem. Salt at the double rate increased the levels to .651 and .780% respectively. Both these differences and the smaller ones resulting from the 3 cwt. application were highly significant. There were large and significant negative KS interactions. These resulted in salt exerting a greater influence on the sodium level when applied without potassium chloride. In the leaf the mean % Na rose from .282 to 1.062 in the absence of potassium but from .247 to only .317 in its presence.

Superphosphate had no overall influence on sodium uptake.

Potassium chloride had a large and very significant depressive influence on the sodium % in both leaf and stem. In the leaf the % Na fell from .654 to .318% as increasing amounts of potassium were given. There was a similar fall in the stem from .793 to .332%.

Potassium (A25)

The mean content of potassium was 2.62% in the leaf and 4.14% in the stem. Individual plots varied in analysis from 1.75 to 3.75% in the leaf and from 2.65 to 5.50% in the stem, principally due to the influence of potassium chloride.

Salt generally depressed the potassium content of both leaf and stem by about 0.3% when given at 6 cwt. per acre. This was just significant in the leaf, but not in the stem.

Superphosphate also reduced the potassium by similar amounts.

Potassium chloride itself markedly increased the potassium status. The % K in the leaf rose from 2.18 to 2.66 and 3.03% with increasing levels of applied potassium. In the stem the increases were from 3.70 to 4.31 to 4.41% K.

Calcium (A26)

The mean % Ca in the leaf and stem were 2.65 and 0.91 respectively. Variations from plot to plot were small.

Salt tended to reduce the % Ca in the leaf but by only 0.16% and was without effect in the stem.

Superphosphate did not influence the calcium content of the leaf, but reduced that in the stem by 0.14*% when applied at 6 cwt. per acre.

Potassium chloride reduced the % Ca in the leaf by 0.25*% but was without effect on the stem.

Magnesium (A27)

Both the leaf and the stem had mean magnesium contents of .163%. Variation from plot to plot was not very great. Occasional values as low as .100 and as high as .200% were recorded, but there were no significant trends.

Salt had little effect, the tendency being to reduce the % Mg by less than .010%.

Superphosphate stimulated magnesium uptake in the leaf, the rise from the 6 cwt. application being from .148 to .172% but there was a corresponding reduction in the stem from .168 to .157%.

Potassium chloride reduced the % Mg in the leaf from .172 to .156 but this change reversed in the stem, the increase being from .159 to .168%.

Phosphorus (A28)

The mean % P in the leaf and stem were .212 and .264 respectively.

Salt did not influence the phosphorus uptake.

Superphosphate itself increased the level in the leaf by .024*% and in the stem by .063*% when applied at 6 cwt. per acre.

Potassium increased the % P slightly in the leaf and reduced it similarly in the stem.

KALE EXPERIMENT 5. 1956.

Site Eaglesham, Renfrewshire.

Soil Heavy clay loam. Poorly drained.
Ashgrove series.

Exchangeable	Na	3.5 mgs. %	
1% citric sol.	P	3.5 mgs. %	Deficient.
1% citric sol.	K	5.5 mgs. %	Low.
	pH	6.4	

Previous Cropping Permanent grass. Rather poor.

Variety Marrow stem

Fertilizer Treatments and Layout

The fertilizers used were

Ammonium Sulphate	0 and 6 cwt.	N
Superphosphate	0 and 3 cwt.	P
Potassium Chloride	0 and 2 cwt.	K
Salt	0 and 4 cwt.	S

The treatments were arranged in 4 blocks, each of 8 plots. There were thus two replicates of 16 plots and the NPKS interaction was confounded between each of them.

The mean yield of fresh kale was 14.7 tons per acre. There was a large response to superphosphate and smaller ones to ammonium sulphate and potassium chloride.

The effects of the fertilizers on the yield and composition of the crop are given in Tables A29 - A35.

Fresh and Dry Matter Yields (A30)

The mean yields of fresh and dry kale were 14.70 and 1.793 tons respectively. All fertilizers with the exception of salt had significant effects on yield and in consequence the yields of kale varied from 9.12 to 23.80 tons with different treatments.

Salt had a small effect on yield. It increased the weight of fresh kale by 1.06 tons and of dry matter by .149 tons. Rather larger increases were found when salt was applied in the absence of rather than together with other fertilizers, particularly potassium chloride.

Ammonium sulphate increased fresh and dry yield by 1.93^{**} and $.179^{**}$ tons respectively. There were marked positive NP interactions of 1.69^{*} and .144 tons but the NS and NK interactions were both negative and ammonium sulphate only gave significant yield increases in the absence of either salt or potassium chloride.

Superphosphate had very marked effects on yield. The fresh yield was increased by as much as 7.11^{**} tons and the dry matter by $.814^{**}$ tons. In addition to the positive NP interaction there were also PK interactions of 1.82^{*} tons for the fresh and .173 tons for the dry matter yields.

Potassium chloride also had significant effects on yield; the weight of fresh kale rose by 3.40^{**} tons and of dry matter by $.332^{**}$ tons.

Composition of the Dry Matter.

Sodium (A31)

The mean % Na in the leaf and stem were very similar, .348 and .349

respectively. Large variations occurred from plot to plot. e.g. In the leaf, .065% in an NK plot and 1.070 with the PS treatment. In the stem the amounts were .105 and .850 respectively.

Salt had large and very significant effects on the sodium uptake. The mean increase in the leaf was $.269^{**}$% and in the stem, $.199^{**}$%. In both cases the increments were larger in the presence of superphosphate ($.349^{**}$ and $.259^{**}$) and in the absence of potassium chloride. ($.408^{**}$ and $.309^{**}$) The negative KS interactions of $-.139^{**}$ in the leaf and $-.266^{**}$ in the stem were very large.

Ammonium sulphate had a small but significant depressive effect on the sodium content. The % Na in the leaf fell by $.065^{*}$% and in the stem the reduction was $.060^{*}$%. Rather larger depressions in the stem content were found on plots from which salt or superphosphate had been omitted.

Superphosphate enhanced the sodium uptake by mean amounts of $.124^{**}$% in the leaf and $.115^{**}$% in the stem. Only small and non-significant increases were found from superphosphate when salt was not applied, but they were correspondingly larger when both fertilizers were applied together. Superphosphate also increased the % Na more in the absence of potassium chloride.

Potassium chloride markedly reduced the % Na in the leaf by $-.292^{**}$% and in the stem by $-.266^{**}$%. On plots where salt was also given, the depressions were as high as $-.431^{**}$% in the leaf and $-.376^{**}$ % in the stem, but there were no marked interactions with other fertilizers.

Potassium (A32)

The mean potassium content of the leaf was 2.19% and that of the stem, 3.91%. Considerable variation was found from plot to plot. Levels as low as 1.20% and as high as 2.90% were found in the leaf and in the stem the variation was from 2.60 to 4.80%.

Salt was entirely without influence on the potassium uptake, the mean increases in leaf and stem being only .06 and .12% respectively.

Ammonium sulphate increased the % K in the leaf by $.24^{*}$% and by greater amounts in the absence of either superphosphate or potassium chloride. The level in the stem was raised by 0.57^{**}% K and again larger increases were obtained in the absence of superphosphate and potassium chloride. The negative NP and NK interactions for the stem were both significant.

Superphosphate markedly reduced the potassium levels. The mean falls in % K were $-.41^{**}$% in the leaf and $-.25^{**}$% in the stem. Rather larger depressions ($-.65^{*}$ and $-.47^{**}$%) were found on plots to which ammonium sulphate was also given.

Potassium chloride itself greatly enhanced the potassium uptake. Increases of $.88^{**}$% in the leaf and 1.12^{**}% in the stem were found. In the absence of nitrogen, even greater stimulation was recorded.

Calcium (A33)

The mean % Ca in the leaf was 2.95% and in the stem, 1.07%.

Salt reduced the calcium content of the leaf significantly ($-.27^{**}$%) and even larger reductions were found in the absence of ammonium sulphate or potassium chloride or in the presence of superphosphate. Salt had a smaller and more consistent depressive influence on the % Ca in the stem.

Ammonium sulphate increased the calcium levels of both leaf and stem by .10 and .07% respectively. There were rather larger increases in leaf calcium from ammonium sulphate given in the presence of salt or in the absence of potassium chloride.

Superphosphate increased the % Ca in the leaf by 0.26**%, but was without effect on the stem. There was a significant PS interaction of -.17*% in the leaf.

Potassium chloride did not alter the overall calcium level in the stem, but there was a significant negative PK interaction of -.17**%. It reduced the amount of calcium in the leaf by -.16*%. In the absence of salt the fall was -.39**%, in the absence of superphosphate, -.25*%, and in the presence of ammonium sulphate, -.39**%.

Magnesium (A34)

The mean % Mg in the leaf and stem were .140 and .200 respectively. There was very little variation from one treatment to another.

Salt reduced the % Mg in the leaf by .008 and in the stem by .012. A significant decrease of .025*% was found in the leaf where salt and ammonium sulphate were applied together.

Ammonium sulphate had little overall effect on the magnesium content of the leaf, but there was a negative NS interaction of .017. It increased the % Mg in the stem by .015* and a larger increase of .026* was found when ammonium sulphate was applied in the absence of potassium chloride.

Superphosphate raised the mean % Mg by .012 in the leaf and by and by .004 in the stem. Again, in the leaf the increase was larger (.022*%) in the absence of potassium chloride.

Potassium chloride increased the % Mg in the leaf by .004, but reduced it by a similar quantity in the stem.

<u>Phosphorus</u> (A35)

The leaf had a mean content of .234% P and of the stem was .280. There was little variation from plot to plot.

Salt generally depressed the uptake of phosphorus. In the leaf the fall was .003% and in the stem, .022%. There was a significant negative NS interaction of -.025*% in the leaf.

Ammonium sulphate also reduced the phosphorus uptake, by .008 in the leaf and .011 in the stem. The NP interaction of -.022% was significant ($P = .05$).

Superphosphate itself had small incremental effects on both leaf and stem (.004 and .018% respectively). Larger increases of .037* and .048*% were found in the stem in the absence of salt and potassium chloride respectively.

Potassium chloride had no overall influence on the phosphorus uptake; there were reductions of .008% in the leaf and .006% in the stem.

KALE EXPERIMENT 6. 1956.

Site Cochno, Dumbartonshire.

Soil	Heavy loam, deep.	freely drained.	
	Exchangeable	Na 8.5 mgs. %	
	1% citric sol.	P 7.5 mgs. %	Low.
	1% citric sol.	K 18.5 mgs. %	Satisfactory.

Previous Cropping

1955	Oats	N.P.K. fertilizer.
1954	Grass	-

Variety Thousand head.

Fertilizer Treatments and Layout

The treatments were as for Experiment 5, i.e. a 32 plot layout in 4 blocks of 8 including all combinations of the presence and absence of ammonium sulphate (6 cwt.), superphosphate (3 cwt.), potassium chloride (2 cwt.) and salt (4 cwt.). The NPKS interaction was confounded between each of the two complete replicates.

The crop yielded 19.6 tons/acre. Ammonium sulphate and superphosphate both gave small increases in yield.

Appendix Tables A 36 - A42 detail the effects of fertilizers on crop yield and composition.

Fresh and Dry Matter Yields (A37)

The mean yields of fresh and dry kale were 19.60 and 2.443 tons respectively. Ammonium sulphate and superphosphate had small but significant effects on yield.

Salt generally depressed the yield, the reduction in fresh weight being 0.35 tons.

Ammonium sulphate significantly increased the yield of fresh (2.02** tons) and dry (.210* tons) kale. It increased the yield more in the absence of salt or potassium chloride. There was a significant positive NP interaction of 1.36** tons for the fresh kale.

Superphosphate also increased the yield of fresh kale significantly by 1.28** tons but the drop in D.M.% resulted in a correspondingly smaller and non-significant dry weight increase. Superphosphate was most effective in the absence of salt or potassium chloride and when given in association with ammonium sulphate.

Potassium chloride had small overall incremental effects on fresh (0.62) and dry (.019) matter. Larger increases were found in the presence of salt or in the absence of either ammonium sulphate or superphosphate.

<u>Composition of the Dry Matter</u>

<u>Sodium</u> (A38)

The mean sodium content of the leaf was .130 and of the stem, .106. Individual plots differed greatly from each other. The minimum values in the leaf and stem respectively were .040 and .025 for a PK plot and the maximum amounts were .405 and .285 for an NS plot.

Salt greatly increased the % Na in both leaf and stem, the respective increments being .048**% and .040**%.

Ammonium sulphate had even greater effects. The rise in leaf sodium was .082**% and in stem sodium .056**%.

Superphosphate did not influence the sodium uptake.

Potassium chloride markedly depressed the sodium levels; the reductions in leaf and stem were $.043^{**}$ and $.037^{**}$% respectively. In the leaf, the reduction was greater ($-.057^{**}$%) on plots without superphosphate and in the stem the decrease was greater ($-.056^{**}$%) in the absence of salt.

Potassium (A39)

The mean % K in the leaf was 3.17 and in the stem, 2.88. The plot to plot variation was from 2.50 to 3.90 in the leaf and from 1.95 to 3.35 in the stem.

Salt did not affect the % K in the leaf but significantly increased the level in the stem by 0.22%. In the stem, there was a marked negative KS interaction of -0.16^{*}% which led to a much greater increase (0.38^{**}% K) on plots to which no potassium chloride had been given.

Ammonium sulphate did not alter potassium uptake. There was a small increase of 0.01% in the stem and a small reduction of 0.05% in the leaf.

Superphosphate depressed the potassium content of both leaf and stem, particularly in the absence of nitrogen. In the leaf the reduction was -0.14% and in the stem it reached significance at -0.27^{**}%.

Potassium chloride itself had a marked influence on potassium uptake. The increase in the leaf was 0.25^{*}% and in the stem 0.16%. These rises were much greater (0.40^{*} and 0.32^{**} respectively) when no salt was applied.

Calcium (A40)

The mean % Ca of the leaf and stem were 2.76 and 0.84% respectively.

Fertilizers in general had only small effects on calcium uptake.

Salt increased the calcium content of the leaf by .06 and of the stem by .04%.

Ammonium sulphate tended to reduce the calcium level in the leaf but raised the content of the stem by .08**%. In the stem, the greatest increases were in the absence of salt (0.11**%) and in the absence of potassium chloride (0.14**%). The negative NK interaction was significant.

Superphosphate increased the % Ca in both the leaf and the stem by .07 and .04% respectively. In the leaf there was a large negative PK interaction of -.18*%. Superphosphate thus increased the calcium level of the leaf in the absence of potassium chloride, but when both were applied together there was a fall in the calcium status. In the stem however, the highest levels of calcium were found on the plots receiving superphosphate and potassium chloride together.

Potassium chloride reduced the % Ca in the leaf by a mean amount of -.07%. The effect was much more marked (-.25%) in the presence of superphosphate. Potassium chloride application did not alter the calcium level in the stem.

<u>Magnesium</u> (A41)

The mean % Mg was .113 in the leaf and .119 in the stem.

Salt had no effect on the magnesium content of either leaf or stem.

Ammonium sulphate increased the % Mg in the leaf by .009 and in the stem by .004.

Superphosphate did not alter the magnesium content of the stem but reduced that of the leaf by .007%.

Potassium chloride reduced both leaf and stem potassium, the former by .007 and the latter by .004%.

Phosphorus (A42)

The mean phosphorus content of the leaf was .288% and of the stems, .388%. Fertilizers had only small effects.

Salt increased the levels in the leaf and stem by .033 and .017*% respectively. In each case the increases were greater in the presence of superphosphate or potassium chloride. There was a significant negative NS interaction of -.036* in the stem.

Ammonium sulphate also increased the phosphorus level to a greater extent in the leaf(.030%) than in the stem (.011%). In addition to the negative NS interaction there was also a significant NP interaction in the stem of .016*%.

Superphosphate itself had only a very small influence on phosphorus uptake, increases of .014 and .011 being found in the leaf and stem respectively. In the leaf, larger increments were found in the presence of either salt or potassium chloride.

Potassium chloride increased the % P in the leaf by a mean value of .018% but reduced it by a similar amount in the stem.

K A L E   E X P E R I M E N T S   S U M M A R Y

Effects on Total Yield.

Table 14 details the main effects and interactions of all six experiments for the yields of fresh and dry matter.

Table 14.

Yields of Fresh and Dry Matter of Kale (tons).

Main Effects and Interactions.

Experiment		1	2	3	4	5	6
Mean Yield							
	Fresh	17.89	15.46	13.61	13.56	14.70	19.60
	Dry	1.989	1.882	1.870	1.693	1.793	2.443
Response to							
N	Fresh	4.29**	6.23**	7.75**	-	1.93**	2.02**
	Dry	.278*	.510*	.747**	-	.179**	.210*
P	Fresh	2.85**	1.27	0.34	4.71**	7.11**	1.28**
	Dry	.291*	.110	.096	.578**	.814**	.115
K	Fresh	0.48	0.50	0.42	0.83	3.40**	0.62
	Dry	.095	.063	.021	.020	.332**	.019
S	Fresh	0.87*	0.95*	0.97*	1.27	1.06	-0.35
	Dry	.099*	.099*	.107*	.085	.149	-.016
Interactions							
NP	Fresh	0.43	1.79	0.64	-	1.69*	1.36*
	Dry	.011	.140	.050	-	.144	.056
NK	Fresh	-0.24	-0.87	1.20	-	-1.04	-0.30
	Dry	-.064	-.055	.206	-	-.054	-.079
NS	Fresh	1.18	-0.29	0.20	-	-0.22	-0.56
	Dry	.160	.018	-.020	-	-.084	-.031
PK	Fresh	-0.07	-2.51	-0.77	-2.06	1.82*	-0.77
	Dry	.028	-.315	-.099	-.329	.173	-.061
PS	Fresh	-1.37	0.29	0.20	0.05	-0.15	-0.55
	Dry	-.093	.100	-.074	-.054	-.009	-.114
KS	Fresh	-1.43	-3.00**	-0.39	0.62	-0.32	0.28
	Dry	-.177	-.331*	-.076	-.208	-.088	.015

Salt.

Five of the six experiments gave increases in yield of approximately 1.0 tons of fresh kale. Three were significant and there were comparable increases in the dry matter. Only one of the sites (Expt. 5.) was on a soil markedly deficient in readily soluble potassium and only that one gave a large and significant response to potassium chloride. The remaining experiment (No. 6) showed a small loss in crop of 0.35 tons. This soil had the highest readily soluble potassium content.

It would therefore appear that dressings of salt in the order of 4 cwt. per acre can produce an extra ton of fresh kale except on soils which are very well supplied with potassium. In only one case (Expt. 5) did the extra yield from 2 cwt. of potassium chloride exceed that from 4 cwt. of salt, this being the single experiment where there was a large and significant response to added potassium. In general, the responses from potassium chloride were about half those from salt.

Salt and potassium chloride normally interacted negatively with each other as might be expected. The size of the interactions was not related to the separate responses to salt or potassium chloride. In experiment 2 the interaction was as large as -3.00^{**} tons.

Ammonium Sulphate.

In each experiment there were very significant returns from ammonium sulphate. They did, however, vary from an increase of 1.93^{**} tons from a 6 cwt. dressing (Expt. 5) to 7.75^{**} tons from an 8 cwt. one (Expt. 3). The fresh yield increments were all highly significant (P = 0.01) but as there was a consequent drop in dry matter %, the dry weight increases were frequently significant at the 5% level only.

Rather surprisingly, there were no marked NK interactions. Indeed, they were usually negative. In view of the high level of potassium in the dry matter of kale and the total to be removed per acre, it might have been expected that the NK interactions would have been as marked as, for example, is frequently the case with potatoes. Equally, in view of the returns from salt, there might have been some consistency in the NS interactions.

There were however, two significant NP interactions. These were in Experiments 5 and 6 where the responses to nitrogen were small and where both had significant increases due to superphosphate.

Superphosphate.

The four soils with the lowest and most deficient readily soluble phosphorus levels gave significant responses to superphosphate. The two with the highest, (but still quite low) contents gave smaller and non-significant increases. There was a reasonable correlation between soil analysis and the responses to 6 cwt. of superphosphate.

Experiment	1% Citric Sol P (mgs.%)		Extra Kale (tons)
5[X]	3.5	Deficient	7.11**
4	4.5	Deficient	4.71**
1	5.0	Deficient	2.85**
6[X]	7.5	Low	1.28**
2	10.0	Low	1.27
3	12.5	Satisfactory	0.34

[X] 3 cwt. superphosphate only.

There were no regular PS interactions.

Potassium Chloride.

Only in Experiment 5 on the most deficient soil was a large and significant response (3.4^{**} tons) obtained. The other increases ranged from 0.42 to 0.83 tons although none of the soils could be considered well supplied with readily soluble potassium.

There was no real correlation between citric soluble potassium and response in terms of extra kale to 3 cwt. of potassium chloride from this limited number of experiments.

Experiment	1% Citric Sol. K (mgs. %)		Extra Kale (tons)
5^X	5.5	Low	3.40^{**}
4	11.0	Low	0.83
6^X	18.5	Satisfactory	0.62
2	9.0	Low	0.50
1	8.5	Low	0.48
3	12.5	Satisfactory	0.42

^{X} 2 cwt. potassium chloride only.

Only in Experiment 5 where there were the largest responses to both potassium chloride and superphosphate was there a significant PK interaction ($+1.82^{*}$ tons). This was in fact the only positive one and all the others were negative.

Effects on Plant Composition.

Sodium

Table 15 summarises the effects of fertilizers on the sodium content of kale.

Table 15.

Dry Matter Composition of Kale. % Na. Main Effects and Interactions.

Experiment	1	2	3	4	5	6
Mean Content						
Leaf	.383	.329	.270	.477	.348	.130
Stem	.332	.324	.223	.582	.349	.106
Response to						
N Leaf	.154**	.297**	.309**	-	-.065*	.082**
Stem	.210**	.286**	.266**	-	-.060*	.056**
P Leaf	.059*	.037	-.026	.008	.124**	-.001
Stem	.070**	.015	-.041	-.017	.115**	-.008
K Leaf	-.260**	-.250**	-.304**	-.336**	-.292**	-.043**
Stem	-.216**	-.252**	-.292**	-.461**	-.266**	-.037**
S Leaf	.151**	.164**	.064**	.402**	.269**	.048**
Stem	.121**	.164**	.073**	.480**	.199**	.040**
Interactions						
NP Leaf	.007	.050	.044	-	-.027	.006
Stem	.005	.050	-.020	-	-.027	.018
NK Leaf	-.074	-.267**	-.256*	-	-.028	-.005
Stem	-.106*	-.223**	-.232**	-	-.020	.003
NS Leaf	-.002	-.065	-.039	-	.007	.007
Stem	-.065	-.064	-.057	-	.053	-.007
PK Leaf	-.004	-.019	.026	.035	-.052	.014
Stem	-.017	-.016	.018	-.025	-.016	.002
PS Leaf	-.003	-.045	-.036	.003	.080*	-.011
Stem	-.016	-.025	-.051	.079	.060	-.017
KS Leaf	-.218**	-.081	-.069	-.355**	-.139**	.007
Stem	-.169**	-.102	-.095*	-.222**	-.266**	.019

Salt has consistently increased the sodium level in the crop, both leaf and stem being equally affected. The increments varied from about .050% Na to about .450% Na from one experiment to another. The smallest increases were generally associated with the lowest mean sodium levels. In each case the increments were highly significant and at least 50% of the mean contents.

Ammonium sulphate increased the sodium level in four out of five experiments by large and significant amounts, usually in the same order as those produced by salt. The magnitude of the separate increases showed some correlation with the yield response resulting from the ammonium sulphate treatment.

Experiment	Yield Increase (tons) from Ammonium Sulphate.	Increase in % Na	
		Leaf	Stem.
5	1.93	-.065*	-.060*
6	2.02	+.082**	+.056**
1	4.29	+.154**	+.210**
2	6.23	+.297**	+.286**
3	7.75	+.309**	+.266**

The increase in the sodium level resulting from the use of ammonium sulphate can therefore be associated with its effects on promoting growth.

Superphosphate had variable effects on the sodium uptake. Two experiments (Nos. 1 and 5) resulted in significant increases, and both these were crops which responded well in yield to superphosphate. On the other hand, there was a good yield increment in Experiment 4 but no consequent increase in % Na. There was little effect from superphosphate on sodium uptake where there was no marked response in yield.

Potassium chloride consistently and very significantly reduced the level of sodium. The depressions were generally in the order of .275%. Only in Experiment 6 was it much less (.040%), this also being the site where the yield response to salt was negative. As potassium chloride invariably increases the amount of potassium in the plant, it can be concluded that this presents an obstacle to the entry of sodium.

The negative KS interactions were the most important. With the exception of Experiment 6 they were all large and highly significant. Salt has a greatly reduced effect in raising the sodium level when applied in the presence of potassium chloride.

There were also large and significant negative NK interactions in the first three experiments and smaller ones in the remaining two. The % Na in the plant was increased by nitrogen to a far greater degree when potassium chloride was not given.

The other interactions showed no consistent trends and were generally quite small.

Potassium

Table 16 summarises the main effects and interactions with regard to the potassium content of kale.

Salt has had no real effect on the potassium uptake of kale. There have been rises and falls of about 0.1% K or less. In Experiment 4 where there were the largest increases in % Na from salt, there were the greatest reductions in % K amounting to -0.3% in both leaf and stem. There was also one isolated increase of 0.22*% in the stem for Experiment 6.

Table 16.

Dry Matter Composition of Kale. % K.

Main Effects and Interactions.

Experiment		1	2	3	4	5	6
Mean Content							
	Leaf	2.44	1.64	2.63	2.62	2.19	3.17
	Stem	3.49	3.18	2.84	4.14	3.91	2.88
Response to							
N	Leaf	-.17*	-.07	-.21	-	.24*	-.05
	Stem	.07	.38	.15	-	.57**	-.01
P	Leaf	-.04	.17	.07	-.25	-.41**	-.14
	Stem	-.16	.08	.01	-.35	-.25**	-.27**
K	Leaf	.39**	.37*	1.02**	.85**	.88**	.25*
	Stem	.40**	.42	.92**	.71*	1.12**	.16
S	Leaf	-.12	.03	.10	-.30*	.06	.01
	Stem	-.03	-.07	.10	-.31	.12	.22*
Interactions							
NP	Leaf	-.07	-.05	.10	-	-.14	.20
	Stem	.15	-.15	-.05	-	-.22*	.12
NK	Leaf	-.13	-.15	.80	-	-.20	-.08
	Stem	-.02	-.03	.62	-	-.23*	-.01
NS	Leaf	-.06	-.03	-.21	-	-.03	.05
	Stem	-.08	-.07	-.26	-	-.07	-.02
PK	Leaf	.09	.37	.07	.38	.08	.13
	Stem	-.03	.16	.01	.51	-.20*	-.01
PS	Leaf	.05	-.14	-.14	.28	.01	.00
	Stem	.05	-.09	.09	.33	.02	.02
KS	Leaf	.03	.01	.19	.43	-.05	-.15
	Stem	.04	-.03	.32	-.43	-.02	-.16

Ammonium sulphate also has had no regular effect. In Experiment 5, the only one to give a significant yield increase from potassium chloride, it enhanced potassium uptake, but generally the influence was small. There was however a tendency for ammonium sulphate to depress the % K in the leaf yet to increase it in the stem.

Superphosphate had small and irregular effects. In four experiments (Nos. 1, 4, 5 and 6) where it increased yields, it reduced the % K, the greatest decreases being associated with the largest yield response to superphosphate. In the remaining two experiments the effect was reversed.

Potassium chloride itself significantly increased uptakes by amounts ranging from 0.2 to 1.0% K.

There were no marked or consistent trends in the various interactions.

Calcium

A summary of the effects of fertilizers on the calcium content of kale is given in Table 17.

Salt has had little influence on the calcium content of kale, the general tendency being to depress it by about .05%. In Experiment 5, the fall in % Ca reached $-.27^{**}$% in the leaf.

Ammonium sulphate had no regular effect; there were both rises and falls from the mean in the order of .05 to .10%.

Superphosphate also reacted irregularly. It had a marked influence (+ 0.26^{**} % Ca) on the leaf in Experiment 5 which responded the most in yield to superphosphate, but elsewhere the effects were much smaller.

Potassium chloride consistently reduced calcium uptake by amounts ranging up to about 0.15% throughout the plant. These reductions are no doubt associated with the rise in % K due to potassium chloride applications, but they do not seem to be proportionately related.

Table 17.

Dry Matter Composition of Kale. % Ca.

Main Effects and Interactions.

Experiment		1	2	3	4	5	6
Mean Content							
	Leaf	2.20	2.19	2.33	2.65	2.95	2.76
	Stem	.90	.78	.79	.91	1.07	.84
Response to							
N	Leaf	.02	-.15	-.02	-	.10	-.01
	Stem	.04	-.01	.09*	-	.07	.08**
P	Leaf	-.10*	-.04	.01	.07	.26**	.07
	Stem	-.05	-.05*	.01	-.14*	.02	.04
K	Leaf	-.05	-.07	-.01	-.25*	-.16*	-.07
	Stem	-.04	-.07**	.10*	-.02	-.01	.01
S	Leaf	-.05	-.03	-.02	-.16	-.27**	.06
	Stem	.02	.00	-.05*	.02	-.09	.04
Interactions							
NP	Leaf	.11	-.17	-.10	-	-.05	-.05*
	Stem	-.04	.06*	.02	-	.06	.00
NK	Leaf	.11	.06	.07	-	-.21**	.04
	Stem	-.01	-.05*	-.05	-	.04	-.06*
NS	Leaf	-.11	.10	.03	-	.11	.02
	Stem	.06	-.03	-.04	-	.02	-.02
PK	Leaf	-.01	-.18	-.03	.05	.09	-.18
	Stem	-.02	-.03	.01	.00	-.17	.03
PS	Leaf	-.02	-.19	.02	-.36	-.17*	.00
	Stem	-.01	.01	.08	-.03	.01	-.02
KS	Leaf	.11	-.18	-.14	.01	.21**	.03
	Stem	-.04	.00	-.03	.08	.03	-.01

There were no marked interaction effects.

Magnesium

The effects of fertilizers on the magnesium content of kale are shown in Table 18.

Table 18.

Dry Matter Composition of Kale. % Mg.

Main Effects and Interactions.

Experiment		1	2	3	4	5	6
Mean Content							
	Leaf	.123	.089	.152	.163	.140	.113
	Stem	.152	.133	.161	.163	.200	.119
Response to							
N	Leaf	-.004	.011	.021*	-	.002	.009
	Stem	.002	.015*	.001	-	.015*	.004
P	Leaf	-.003	.000	-.026*	.024	.012	-.007
	Stem	-.010	-.003	.000	-.011	.004	.001
K	Leaf	-.004	-.012	-.034**	-.016	-.004	-.007
	Stem	-.003	-.010*	.003	.011	.004	-.004
S	Leaf	-.005	.001	-.011	-.003	-.008	-.002
	Stem	-.012	.000	-.009	-.011	-.012	.002
Interactions							
NP	Leaf	.001	.001	-.007	-	-.004	-.003
	Stem	.008	.006	-.016	-	-.003	.006
NK	Leaf	.001	.003	-.018	-	-.001	-.003
	Stem	.014	.003	-.012	-	-.011	.002
NS	Leaf	.009	-.005	-.012	-	-.017	.003
	Stem	.001	-.014	-.001	-	.003	-.003
PK	Leaf	-.001	.009	.002	-.017	-.010	.004
	Stem	.007	.007	.002	-.007	-.001	-.002
PS	Leaf	.009	.014	.006	-.007	-.008	-.003
	Stem	-.012	-.002	-.026	.003	.002	.001
KS	Leaf	-.006	-.008	.012	-.019	.000	.004
	Stem	-.019	-.010	.027	-.028	.005	.006

Salt consistently depressed **the magnesium content of both leaf and stem,** but by small and non-significant amounts. Reductions over the combined leaf and stem ranged up to about .010% and were frequently much less.

Ammonium sulphate increased magnesium uptake, in three cases to a significant degree. Rises of up to .015% taken over the whole plant were found.

Superphosphate was without general effect. There were small irregular increases and decreases.

Potassium chloride depressed the % Mg in all six experiments. When leaf and stem were combined the decreases ranged up to about .017%. Only in two experiments were the reductions significant.

There were no large or consistent interactions.

Phosphorus.

The effects of fertilizers on the phosphorus content of kale are summarised in Table 19.

Salt had no regular effect on phosphorus uptake. Averaging leaf and stem, there were increases and decreases ranging up to ± .020% occurring with equal regularity.

Ammonium sulphate also had effects which differed from one experiment to another. In three experiments where it increased the % P, the rise was greater in the leaf than in the stem.

Superphosphate invariably increased the % P in both leaf and stem. Over the whole plant the increments ranged from about .010 to about .040% P and in four experiments were significant. The increases did not appear to be related to the responses in yield from superphosphate.

Potassium chloride had small and irregular effects. Increases and decreases over the whole plant ranging up to about ± .010% were found.

There were no consistent interactions involving phosphorus although there were isolated significant ones.

Table 19. Dry Matter Composition of Kale. % P.

Main Effects and Interactions.

Experiment		1	2	3	4	5	6
Mean Content							
	Leaf	.289	.310	.180	.212	.234	.288
	Stem	.320	.360	.210	.264	.280	.388
Response to							
N	Leaf	.018	.040*	-.003	-	-.008	.030
	Stem	.006	.000	-.003	-	-.011	.011
P	Leaf	.023*	.039*	.015*	.024*	.044	.014
	Stem	.031*	.035*	.008	.063*	.018	.011
K	Leaf	-.009	.002	.011*	.014	-.008	.018
	Stem	-.007	.003	.027	-.009	-.006	-.016*
S	Leaf	.010	.014**	-.008*	-.008	-.003	.033
	Stem	.019*	.010	-.021**	-.007	-.022	.017*
Interactions							
NP	Leaf	-.005	.007	.018*	-	-.022*	.000
	Stem	.007	.011	-.018	-	.003	.016
NK	Leaf	.010	-.018	.008	-	-.011	.014
	Stem	-.003	-.032	-.012	-	-.004	-.004
NS	Leaf	-.012	-.017	.007	-	-.025*	.002
	Stem	-.002	.004	.013	-	.003	-.036*
PK	Leaf	-.016	-.018	.006	.002	.009	.018
	Stem	.030	-.022	-.002	-.003	-.030*	.001
PS	Leaf	-.020	-.004	.021*	.025	-.003	.021
	Stem	-.043*	-.010	.002	.029	-.019	.006
KS	Leaf	-.003	-.027*	-.002	-.022	-.012	.034
	Stem	.012	.001	-.001	-.009	-.019	.012

EXPERIMENTS WITH TURNIPS.

There have been a number of previous investigations regarding the effect of sodium on the growth of turnips and swedes. As early as 1914 Bolin reported the results of 10 experiments in Sweden where, on average, 5.5 tons of extra swedes were produced from an application of 9cwt. of salt. Crowther & Benzian (1945) have summarised the results of a number of experiments where ammonium sulphate and sodium nitrate have been compared as a source of nitrogen and they concluded that the latter was 20 - 25% superior. Harmer & Benne (1941) working on a potassium deficient peat soil reported an increase in the yield of turnips of almost 3 tons from an application of 5 cwt. of salt. Holt & Volk (1945) found in pot experiments that sodium increased the yield of turnips and that 30% of a full crop could be obtained when potassium was entirely replaced by sodium. Lehr & Bussink (1954) have also reported improved yields of turnips when sodium nitrate and calcium nitrate were compared.

On the other hand, Jacob (1930), as a result of sand culture experiments, concluded that sodium had no effect on swedes. Dorph-Petersen & Steenbjerg (1950) have found increases in the yield of swedes of only 0.1 ton as an average of 9 experiments comparing sodium and calcium nitrates, but in one experiment on a potassium deficient soil an increment of almost 1.0 ton was obtained from sodium.

Four field experiments have been completed with turnips.

The first two were laid down in 1955. Each conformed to a 27 plot layout in 3 blocks of 9 plots to investigate all combinations of the following treatments.

Superphosphate	0, 3 and 6 cwt. (PO, P1, P2)
Potassium Chloride	0, 1 and 2 cwt. (KO, K1, K2)
Salt	0, 3 and 6 cwt. (SO, S1, S2)

Each plot in addition had a basal dressing of 2 cwt. of ammonium sulphate.

In 1956 two further experiments were carried out, but to a different design. The treatments were the presence and absence of

Ammonium Sulphate	2 cwt. (N.)
Superphosphate	3 cwt. (P.)
Potassium Chloride	2 cwt. (K.)
Salt	4 cwt. (S.)

The layout of each experiment was the usual one for a 2 x 2 x 2 x 2 factorial trial of 32 plots in 4 blocks of 8. The NPKS interaction was confounded between each of the two complete replicates.

The analyses of variance of these two designs were as for the similar kale experiments.

The turnips were grown on slightly raised ridges about 27 ins. apart. All the fertilizers were applied by hand before the final seed bed preparations and were well intermixed with the soil during subsequent cultivations. Singling, weeding etc., were carried out as necessary by the farmer in conjunction with the remainder of the field.

Plot Size.

The experiments have been carried out on 0.01 acre plots. Each was 6 rows wide, normally 27 ins. apart, and about 33 ft. in length. The central four rows were harvested for yield determinations and samples were taken from this area for analysis.

Sampling.

Harvesting was generally carried out in November before frost seriously damaged the tops. In each case the crop was topped by hand and the roots in each case had very little soil adhering to them. The entire produce (roots and tops) from each plot was weighed on a spring balance in the field.

The roots were sampled by means of a corer, a diagonal section being taken from each of about 40 roots. This is the generally accepted practice and it was not considered necessary to test the validity of the method. The cores from each plot were placed in polythene bags, tied and removed to the laboratory. They were then weighed, dried at 100°C, reweighed and finally ground.

The tops were sampled by taking 15 tops at random from each plot. These were chopped, subsampled by quartering and weighed fresh. After drying at 100°C they were reweighed and then ground.

TURNIPS. EXPERIMENT 1. 1955.

Site Cochno. Dumbartonshire.

Soil	Heavy loam. poorly drained.				
	Exchangeable	Na 6.5	mgs. %		
	1% citric sol.	P 13.0	mgs. %	Satisfactory.	
	1% citric sol.	K 13.5	mgs. %	Satisfactory.	
		pH 6.7			

This experiment was laid down in another portion of the same field as Experiment 3 with kale and the analyses are therefore similar.

Previous Cropping

1954	Potatoes	Manuring unknown.
1953	Oats	Manuring unknown.

Fertilizer Treatments and Layout

All 27 combinations of the following treatments were arranged in the usual 3 x 3 x 3 layout with no replication.

Superphosphate	0, 3 and 6 cwt. (P0, P1, P2)
Potassium Chloride	0, 1 and 2 cwt. (K0, K1, K2)
Salt	0, 3 and 6 cwt. (S0, S1, S2)

Each plot in addition, had a seedbed application of 2cwt. of ammonium sulphate.

The crop grew well throughout and the mean yield of roots was 18.4 tons. There were no substantial yield increments from fertilizers.

Tables A43 - A50 contain the information regarding the effects of fertilizers on crop yield and composition.

Yields of Fresh and Dry Matter (A44 & A45)

The mean yields of fresh and dry roots were 18.36 and 1.566 tons respectively. Individual plots varied in yield from 13.5 to 21.3 tons but the general effect of fertilizers was small. The fresh tops had a mean yield of 3.73 tons and the weight of dry matter was .474 tons.

Salt increased both fresh and dry yields of roots, the former by 2.88 and the latter by .280 tons when applied at the 6 cwt. rate. Neither effect was significant and salt had no influence on the yield of tops.

Superphosphate at 6 cwt. per acre reduced the weight of fresh roots by 0.67 tons, but did not affect the dry matter. It also reduced the fresh and dry yields of tops by 0.44 and .050 tons respectively.

Potassium chloride tended to reduce the fresh weight of roots but, by increasing the D.M.%, to increase the dry matter yield by .116 tons. It significantly reduced the fresh weight of tops by 0.76* tons and the dry yield by .078* tons.

Composition of the Dry Matter

Sodium (A46)

The mean % Na of the roots was .120. There was considerable variation according to the fertilizer treatment, i.e. .030 on the POK2SO plot to .200 on the POKOS2 plot. The mean content of the tops was .171% and the range was from .077 (P0K2S0) to .315 (P1K0S2).

Salt had large and very **significant** effects on sodium uptake. The mean % Na of the untreated plots was .084 in the roots rising to .139 with 6 cwt. of salt. In the tops the level was raised to .173 from .119 by 3cwt. of salt and to .221 with the 6 cwt. application.

Superphosphate reduced the sodium level in the roots from .138 to .114 which was almost significant and in the tops from .197 to .151 (Sig. at 5% level).

Potassium chloride had very significant effects in reducing the sodium content of both roots and tops. In the roots the level fell from .156 to .126 with the 1 cwt. application and to .077 with the 2 cwt. rate. Similar reductions from .202 to .168 to .142% were found in the tops.

Potassium (A47)

The mean % K in the roots was 3.06 and in the tops, 3.17. There was little variation from plot to plot in the roots, but the range of values in the tops was from 2.25% (P2K0S0) to 5.10% (P2K2S1).

Salt did not influence the potassium content of either roots or tops.

Superphosphate reduced the % K in the roots by 0.14% and increased it by 0.29% in the tops.

Potassium chloride itself had very little influence on the potassium content of the roots, the 2 cwt. dressing raising the level from 2.95 to 3.12%. It did however increase the % K in the tops significantly from 2.85 to 3.48%.

Calcium (A48)

The mean calcium content of the roots was .657 and of the tops 2.31%. There was little variation from plot to plot and none of the fertilizers affected the calcium levels by more than ± .007%.

Magnesium (A49)

The amount of magnesium in the roots was .103% and .204% in the tops. Fertilizers had little effect, but in general they tended to depress the magnesium levels by about .007% in each case.

Phosphorus (A50)

The roots had a mean % P of .291 whilst that in the tops was .163. In the roots the range was from .225 to .350% and in the tops from .095 to .260%.

Salt enhanced the % P in the roots from .274 to .298 and this was almost significant, but it had no influence on the level of the tops.

Superphosphate itself increased the % P in the roots from .278 to .299 (almost significant) and the increase from .138% to .194% in the tops from the 6 cwt. dressing did reach significance at the 5% level.

Potassium chloride at 2 cwt. per acre significantly reduced the phosphorus uptake in the roots from .309 to .276%. The negative PK interaction was also significant. On the other hand the phosphorus content of the tops was raised from .137 to .179%.

TURNIPS. EXPERIMENT 2. 1955.

Site	Balloch. Dumbartonshire.			
Soil	Red sandstone drift.			
	Medium loam, freely drained.			
	Exchangeable	Na	43.5 mgs. %	
	1% citric sol.	P	4.0 mgs. %	Deficient.
	1% citric sol.	K	11.0 mgs. %	Low.
		pH	6.1	

This experiment was sited immediately adjacent to Experiment 4 with kale and the soil analyses are virtually the same.

Prvious Cropping.

1954	Oats	2 cwt. Ammonium Sulphate
1953	Permanent Grass.	

Fertilizer Treatments and Layout.

The design of the experiment was the same as that for Experiment 1 namely, a 27 plot layout to test all combinations of 0,3 and 6 cwt. of Superphosphate, 0, 1 and 2 cwt. of Potassium Chloride and 0, 3 and 6 cwt. of Salt. Each plot in addition had a basal dressing of 2 cwt. of Ammonium Sulphate.

There were substantial yield increments from superphosphate.

The yields and plant analyses are given in Tables A51 - A58.

Yields of Fresh and Dry Matter (A52 & A53)

The mean yields of roots and tops were 17.76 and 2.96 tons respectively. The root yield varied from 10.3 (P0K2S0) to 24.1 tons (P2K1S1) and that of the tops from 1.20 (P0K1S2) to 4.32 tons (P2K0S1).

The mean yields of dry matter were 1.556 and .325 tons.

Salt increased the yield of fresh roots by 2.22 tons and the dry matter by .162 tons. Its effect on the tops was quite small, fresh and dry weight increments being .06 and .01 tons respectively.

Superphosphate had large and very significant effects on the yield of roots. 6 cwt. raised the fresh yield from 13.50 to 20.67 tons and the dry matter from 1.211 to 1.802 tons. The increase in the yield of tops was quite small and non-significant.

Potassium chloride at 2 cwt. per acre raised the yield of fresh roots by only 0.47 tons and the dry matter by .037 tons. It reduced the weight of fresh and dry tops by 0.34 and .015 tons respectively.

<u>Composition of Dry Matter</u>

<u>Sodium</u> (A54)

In the tops the range was from .055 (P1K1S0) to .265(P2K0S2) % Na, with a mean of .146%. The mean content of the tops was .332% and the range .100 (P1K1S0) to .900 (P2K0S2).

Salt produced large and highly significant increases in the sodium content of both roots and tops. 3 cwt. of salt raised the mean % Na of the roots from .093 to .154 and 6 cwt. increased it further to .192%. The corresponding increments for the tops were from .201 to .296 to .499%. Each progressive increase was significant at the 1% level.

Superphosphate had only small effects. The increases in % Na from 6 cwt. were .015 and .028 respectively for roots and tops.

Potassium chloride reduced the sodium uptake. 2 cwt. per acre reduced the level from .165 to .133% in the roots and from .367 to .282% (sig. at 5% level) in the tops.

Potassium (A55)

The mean potassium contents of the roots and tops were 2.60 and 3.36% respectively.

Salt at 6 cwt. per acre increased the % K from 2.52 to 2.79 in the roots and from 3.26 to 3.39% in the tops, but neither was significant.

Superphosphate also increased the potassium uptake slightly, by 0.10% in the roots and by 0.25% in the tops.

Potassium chloride itself increased the % K in the tops from 3.18 to 3.55 (which was not significant) but the effect on the roots was negligible.

Calcium (A56)

The mean calcium content of the roots was .397 and the extreme values were .315 and .480%. In the tops the range was from 1.68 to 2.50% with a mean of 2.02% Ca.

Salt increased the % Ca in the roots by .054 which was almost significant. It had the reverse effect on the tops when the decrease from 2.09 to 1.97% was just significant at the 5% level.

Superphosphate raised the % Ca in the roots by .065*% and in the tops by 0.13*%.

Potassium chloride had no effect on root calcium but depressed the amount in the tops significantly from 2.11 to 1.97%.

Magnesium (A57)

The roots had a mean % Mg of .082 and the tops contained .208%.

Salt had very little influence. It reduced the level in the roots by .004% but increased it in the tops by .007%.

Superphosphate had no effect on magnesium uptake.

Potassium chloride reduced the magnesium in the tops by about .020% but had no influence on the roots.

Phosphorus

Superphosphate (A58)

The mean % P in roots and tops were .157 and .135 respectively.

Salt significantly increased the uptake in both roots and tops. With the 6 cwt. application the increments were $.038^{*}$ and $.030^{*}$% respectively.

Superphosphate itself greatly increased the phosphorus content. Root phosphorus was raised by $.067^{**}$ and that of the tops by $.049^{**}$%.

Potassium chloride reduced the % P in the roots from .179 to .140% (sig. at P = .05) and from .139 to .126% in the tops.

TURNIPS. EXPERIMENT 3. 1956

Site Cochno. Dumbartonshire.

Soil Heavy loam. Deep, freely drained.

Exchangeable	Na	9.5	mgs.	%	
1% Citric Sol.	P	9.5	mgs.	%	Low
1% Citric Sol.	K	12.5	mgs.	%	Satisfactory.
	pH	6.7			

This experiment was sited in the same field as Experiment 6 with kale. It was however some 150 yards away and the soil analyses differ in that this area for the turnips was rather higher in readily soluble phosphorus and lower in potassium.

Previous Cropping.

1955	Oats	NPK fertilizer
1954	Grass	Unknown manuring.

Fertilizer Treatments and Layout

The experiment tested all combinations of the following treatments;

0 and 2 cwt. Ammonium Sulphate	N
0 and 3 cwt. Superphosphate	P
0 and 2 cwt. Potassium Chloride	K
0 and 4 cwt. Salt	S

Two complete replicates were laid out by arranging the plots in 4 groups of 8 with the NPKS interaction confounded between the replicates.

The mean yield was 16.06 tons of roots per acre. There were small but significant responses from both superphosphate and potassium chloride. The site was badly infested with the weed, redshank. This was kept under control by hand weeding and thus did not seriously impair the yield.

Appendix Tables A59 - A65 detail the effects of the fertilizers on crop yield and composition.

Yields of Fresh and Dry Matter (A60)

The mean fresh yields of roots and tops were 16.06 and 3.39 tons. The respective dry matter weights were 1.30 and .419 tons.

Salt slightly increased the yield of roots (0.73 tons) and of tops (0.11 tons). Salt had a larger and more significant effect in the absence of superphosphate, the increment being 2.12** tons.

Ammonium sulphate increased the mean yield of fresh tops by 0.22* tons but the effect was non-significant for the dry weight. It depressed the yield of fresh roots by 0.28 tons.

Superphosphate also increased the fresh yield of tops by 0.22* tons, the dry matter increment being non-significant at .024 tons. The fresh weight of roots was increased by 1.37** tons and by greater amounts in the absence of salt (1.95**) and ammonium sulphate (1.84**). As the D.M.% was reduced, only the mean dry weight increase and that in the absence of salt were significant.

Potassium chloride increased the fresh yields of roots and tops by 1.17* and 0.42** tons respectively. There were comparable and significant increments in the dry weights.

Composition of the Dry Matter

Sodium (A61)

The mean % Na was .226 in the tops and .175 in the roots. Very large variations occurred from plot to plot e.g. In the tops the range was from .095% in and NK plot to .462 in an NPS plot. The corresponding figures for the roots were .045 and .255%.

Salt caused large and significant increases in the sodium level of both roots ($.044^{**}$%) and tops ($.098^{**}$%). Salt given in association with either ammonium sulphate or superphosphate had even greater effects.

Ammonium sulphate had little influence. It raised the sodium content of the roots by .018 and of the tops by .025%.

Superphosphate raised the % Na in the tops by $.050^{*}$. Greater increments were found in the presence of salt ($.082^{*}$%) and of potassium ($.080^{*}$). A mean increase of .025 % was found in the roots. The joint presence of salt increased this to $.042^{*}$%.

Potassium chloride had large and significant depressive effects on sodium uptake. The mean content of the tops fell by $.074^{**}$% and of the roots by $.035^{**}$%. In the tops the decrease was particularly large in the absence of superphosphate and ammonium sulphate.

Potassium (A62)

The mean potassium contents of the roots and tops were 2.05 and 2.41 respectively. Fertilizers did not cause appreciable variations.

Salt depressed the % K in the roots by .08 and in the tops by .03. In each case there were negative KS interactions and this reached significance at -0.23*% in the case of the tops. Salt thus increased the potassium level in the tops by .20% when given in the absence of potassium chloride, but depressed it by .26% when both were applied together.

Ammonium sulphate did not influence the potassium status.

Superphosphate significantly reduced the % K in the tops. The mean decrease was .23*% but this was increased to -0.40*% in the presence of salt and to -.37* and -.34*% in the absence of ammonium sulphate and potassium chloride respectively.

Potassium chloride itself increased the % K in the tops by 0.18% and in the roots by 0.24*%. Much greater increases were found in the absence of salt (0.41** and 0.35**% respectively).

<u>Calcium</u> (A63)

The mean calcium content of the tops was 1.80% and that of the roots 0.384%.

Salt increased the % Ca in the tops by .029% and reduced it by .017% in the roots.

Ammonium sulphate did not influence the calcium content of the roots but depressed it significantly by .145**% in the tops. Much larger depressions from ammonium sulphate were found in the presence of other fertilizers.

Superphosphate was also without effect on the roots and decreased the % Ca in the tops by .055%.

Potassium chloride reduced the calcium ~~reduced the calcium~~ level in both tops (-.045) and roots (-.026*%). Larger depressions were found in the absence of superphosphate for both parts and in the roots when salt was omitted.

<u>Magnesium</u> (A64)

The tops had a mean magnesium content of .132% and the level in the roots was .081%.

All the fertilizers supplied had very small depressive effects on the magnesium contents of both roots and tops. Only in the cases of salt and potassium chloride did they reach significance. Even then they were in the order of -.006*% and in the roots only.

<u>Phosphorus</u> (A65)

The mean % P of the roots was .210 and that of the tops .189. Fertilizers had only small effects on phosphorus uptake.

Salt tended to increase the % P in both roots and tops but by mean amounts of only .015 and .008 respectively.

Ammonium sulphate had little effect on the tops but depressed the phosphorus content of the roots by .019%.

Superphosphate increased the levels in each case by about .016%. In the tops the increments were in the order of .028*% in the presence of either salt or potassium chloride.

Potassium chloride raised the % P in the tops by .020*%. It increased the level by smaller amounts when given in association with other fertilizers. It also increased the mean phosphorus content of the roots by .016%.

TURNIPS EXPERIMENT 4. 1956.

Site Balloch. Dumbartonshire

Soil Sandy loam, deep, freely drained.

High in organic matter.

Exchangeable	Na	5.0 mgs %	
1% Citric Sol	P	3.5 mgs %	Deficient
1% Citric Sol	K	8.5 mgs %	Low
	pH	5.4	

Previous Cropping

Permanent grass. Very poor, no manuring.

Fertilizer Treatments and Layout

The treatments and design of the experiment were as for Experiment3. All combinations of the following applications were tested in a 2 x 2 x 2 x 2 layout of 32 plots in 4 blocks of 8.

O and 2 cwt. Ammonium Sulphate	N
O and 3 cwt. Superphosphate	P
O and 2 cwt. Potassium Chloride	K
O and 4 cwt. Salt	S

In spite of the marked acidity and the large response to superphosphate, the mean yield was as high at 21.5 tons of roots per acre. There was a small significant increase from salt.

Data concerning the effects of the fertilizers on plant yield and composition are given in Tables A66 - A72.

Yields of Fresh and Dry Matter (A67)

The mean fresh yields of roots and tops were 21.47 and 5.08 tons respectively. The comparable dry matter weights were 1.94 and .664 tons. The fresh yield of roots ranged from 14.44 tons on a nil plot to 27.78 tons with a PK treatment.

Salt significantly increased the fresh yield of roots by 1.87* tons and the dry matter by .14* tons. There were large and very significant PS interactions in each case. These resulted in salt increasing the fresh and dry weights by 4.46** and 0.33** tons respectively when given without superphosphate. In the roots there were also significant negative KS interactions, salt being of little benefit if applied together with potassium chloride. Salt tended to reduce the yield of tops. Again there was a significant negative PS interaction and a small KS one.

Ammonium sulphate had only minor effects. The fresh yields of roots and tops were increased by .56 and .14 tons respectively.

Superphosphate had a marked influence on yield. The fresh weight increments were 5.02** tons of roots and .97** tons of tops. The very significant negative PS interactions in each case resulted in the increases being 7.56** and 2.60** tons respectively in the absence of salt.

Potassium chloride had only small effects. The mean fresh weight of roots was increased by .90 tons (2.52* in the absence of salt) and the fresh yield of tops fell by .10 ton.

Composition of Dry Matter.

Sodium (A68)

The mean sodium content of the tops was .402% and that of the roots .134%. Large variations were found from plot to plot. The lowest level in the tops was .200% in a nil plot and the highest .700% on an N plot. In the roots the range was from .280% (NPS) down to .050% with the NK treatment.

Salt had large and significant effects, the mean increase in % Na being .237** for the tops and .064* for the roots. There were no marked interactions involving salt.

Ammonium sulphate did not influence sodium uptake.

Superphosphate slightly raised the sodium level by mean amounts of .042% in the tops and .020% in the roots. A larger increase of .103*% was found in the tops on those plots which in addition had potassium chloride.

Potassium chloride had significant effects in reducing the sodium uptake by .078*% in the tops and by .033**% in the roots. In the roots the depression reached .072**% on plots which did not receive salt and there was a large fall of .138** for the tops on plots without superphosphate.

Potassium (A69)

The tops contained 1.98% K and the roots 1.68%. Variation from plot to plot was mainly due to the presence and absence of potassium chloride.

Salt had a small depressive effect of -.03% on the tops and a larger incremental one of .13*% for the roots. Salt increased the potassium content of the roots most when potassium chloride was also applied.

Ammonium sulphate had no overall influence on the root potassium but depressed the amount in the tops by .12% and by double that on plots which also had potassium chloride.

Superphosphate depressed the % K in both roots and tops by .19 and .07 respectively. There were significant decreases in the tops in the absence of potassium chloride (-.50**%) and salt (-.30*%).

Potassium chloride itself enhanced the potassium uptake by large and significant (P = 0.01) amounts, .49**% in the tops and .31**% in the roots. There was a significant PK interaction of 0.31*% in the tops and an NK one of -.14**% in the roots.

<u>Calcium</u> (A70)

The mean % Ca in the tops was 1.713 and .355 in the roots. Fertilizers generally reduced the uptake.

Salt reduced the calcium level in the tops by .056% and in the roots by .015%. Larger depressions were found in the absence of ammonium sulphate.

Ammonium sulphate had rather greater effects. The reduction in the calcium content of the tops was .083% and in the roots, .028*%. In the tops the effect was more pronounced in the absence of salt and superphosphate.

Superphosphate reduced the % Ca in the tops by .114% but was without influence on the roots.

Potassium chloride caused only small reductions in the calcium uptake.

Magnesium (A71)

The mean contents of magnesium were .135% in the tops and .075% in the roots.

Salt and ammonium sulphate had very little effect.

Superphosphate enhanced the mean % Mg in the tops by .013 and by .024* on plots which received no salt.

Potassium chloride reduced the magnesium level by .021*% in the tops and by .006% in the roots. Potassium chloride given in the absence of either ammonium sulphate or superphosphate caused decreases in the order of .030*%.

Phosphorus (A72)

Phosphorus uptake was enhanced by all fertilizers. The mean % P was .194 in the tops and .161 in the roots.

Salt increased the amount in the tops by .024*% and in the roots by .005%. Larger and more significant increments were found in the absence of other fertilizers, especially superphosphate. The negative PS interactions in each case were significant and resulted in increases of .048** and .019**% in tops and roots from salt when no superphosphate was applied. When both salt and superphosphate were given together there was no stimulation of phosphorus uptake from salt.

Ammonium sulphate also raised the % P by .025*% in the tops, but had no influence on the roots.

Superphosphate itself increased the phosphorus content of the tops by .051**% and of the roots by .030*%. In each case the increments were markedly greater in the absence of salt and ammonium sulphate.

Potassium chloride had only small effects on phosphorus uptake.

TURNIPS EXPERIMENTS. SUMMARY.

Effects on Yield

Table 20 gives the main effects and interactions for the four experiments with regard to fresh and dry yields of roots and tops.

Table 20. Yields of Fresh and Dry Matter of Turnips (tons).

Main Effects and Interactions.

		FRESH YIELD				DRY MATTER			
EXPERIMENT		1	2	3	4	1	2	3	4
Mean yield									
	Tops	3.73	2.96	3.39	5.08	.474	.325	.419	.664
	Roots	18.36	17.76	16.06	21.47	1.566	1.556	1.30	1.94
Response to									
S	Tops	.14	.06	.11	-.34	.001	.010	.009	-.056
	Roots	2.88	2.22	.73	1.87*	.280	.162	.03	.14*
N	Tops	-	-	.22*	.14	-	-	.025	.039
	Roots	-	-	-.28	.58	-	-	-.06	.04
P	Tops	-.44	.67	.22*	.97**	-.050	.095	.024	.119**
	Roots	-.67	7.17**	1.37**	5.02**	.028	.591**	.08*	.46**
K	Tops	-.76*	-.32	.42**	-.10	-.078*	-.025	.053**	-.032
	Roots	.23	.47	1.17*	.90	.116	.037	.11**	.07
Interactions									
NP	Tops	-	-	.01	-.25	-	-	-.004	-.032
	Roots	-	-	.20	-1.21	-	-	.01	-.011
NK	Tops	-	-	.14	.32	-	-	.018	.039
	Roots	-	-	.13	-.19	-	-	.01	-.03
NS	Tops	-	-	.06	.05	-	-	.009	-.013
	Roots	-	-	.44	-.78	-	-	-.01	-.08
PK	Tops	-.39	-.39	-.29*	.59*	-.042	-.057	-.041**	.059
	Roots	-2.10	.48	.09	1.12	.006	-.005	.03	.10
PS	Tops	-.50	.66	.09	-1.62**	-.058	.052	.009	-.205**
	Roots	-.69	1.65	-.57	-2.61**	.021	.063	-.05	-.19**
KS	Tops	.18	.00	.03	-.53*	.037	-.002	.007	-.050
	Roots	-.99	-1.92	-.01	-1.63*	-.015	-.028	-.04	-.21**

Salt increased the fresh and dry yield of roots in each experiment. The only significant increase of 1.87* tons of fresh and 0.14* tons of dry matter was in Experiment 4 which was the site lowest in readily soluble potassium. On the other hand the smallest increase of 0.73 tons was on the only soil where a significant response to potassium chloride occurred. (Expt. 3.) Rather larger increases of about 2.5 tons of fresh roots were found in the first two experiments. There is therefore little correlation between response to potassium chloride and response to salt. Salt had nagligible effects on the yield of tops.

Ammonium sulphate did not alter the yield of roots in the two experiments in which it was used. It did however increase the yield of tops to a significant extent in Experiment 3 (+.22* tons).

Superphosphate had significant incremental effects in all experiments except the first. The increases were broadly related to the readily soluble phosphorus level in the soil.

Experiment	cwt.	Response to Superphosphate Roots	Tops	1% Citric Sol P mgs %.	
2	6	7.17**	0.67	4.0	Deficient
4	3	5.02**	0.97**	3.5	Deficient
3	3	1.37**	0.22*	9.5	Low
1	6	-0.67	-0.44	13.0	Satisfactory

There were negative PS interactions in the fresh weight yields for three experiments in the case of the roots and in two for the yield of tops. They were particularly large and highly significant in Experiment 4. There is thus a tendency for salt to give higher yields in the absence of superphosphate and vice-versa .

Potassium chloride raised the yields of roots and tops to a significant degree in Experiment 3 only. Otherwise it tended to reduce the weight of tops. The increases in yield from 2 cwt. of potassium chloride were not related to the readily soluble potassium content of the soil.

Experiment	Response to Potassium Chloride Roots	Tops	1% Citric Sol. K mgs. %	
3	1.17*	0.42**	12.5	Satisfactory
4	0.90	-0.10	8.5	Low
2	0.47	-0.32	11.0	Low
1	0.23	-0.76*	13.5	Satisfactory

In all four experiments there were negative KS interactions for the yields of fresh and dry roots. In only Experiment 4 was it significant and on this site there was also a negative interaction for the yield of tops.

Effects on Dry Matter Composition

Sodium

The effects of fertilizers on the sodium uptake of turnips are summarised in Table 21.

Salt had very marked and highly significant effects on the sodium level in all four experiments. The increases have ranged from .044** to .099**% in the roots and from .098** to .298** in the tops. These increments were generally at least 50% of the mean sodium levels in each case. These results are directly comparable with the effects of salt on kale.

Table 21. Dry Matter Composition of Turnips. % Na.

Main Effects and Interactions.

	Expt. 1.		Expt. 2.		Expt. 3.		Expt. 4.	
	Tops	Roots	Tops	Roots	Tops	Roots	Tops	Roots
Mean	.171	.120	.332	.146	.226	.175	.402	.134
Response to								
S	.102**	.055**	.298**	.099**	.098**	.044**	.237**	.064*
N	-	-	-	-	.025	.018	.011	-.015
P	-.046*	-.024	.028	.015	.050*	.023	.042	.020
K	-.060**	-.079**	-.084*	-.032	-.074*	-.035**	-.078*	-.033**
Interactions								
NP	-	-	-	-	-.012	-.013	-.018	.011
NK	-	-	-	-	-.040	-.011	-.005	-.006
NS	-	-	-	-	.013	.010	.003	.003
PK	-.016	-.030	-.107	-.008	.030	-.002	.062*	-.001
PS	-.033	-.032	.074	.029	.032	.020	-.032	.004
KS	-.008	-.015	-.017	.015	.005	-.005	-.002	.039*

Ammonium sulphate had little effect on the sodium levels in the two experiments in which it was used. This was in contrast to the results with kale, but the effects on yield were quite different for the two crops.

Superphosphate increased the % Na in both roots and tops in the last three experiments by amounts ranging from .015 to .050%. Only in one case was the increment significant, and that in the tops only. The uptake of sodium was reduced throughout the plant in Experiment 1, which was also the only one where superphosphate did not increase the yield. Broadly similar results were found with kale.

Potassium chloride, as with kale, consistently and very significantly reduced the sodium uptake in both roots and tops. In the tops the depression varied between $.060^{**}$ and $.084^{**}$% and in the roots between .032 and $.079^{**}$%.

There were no marked or consistent interactions.

<u>Potassium</u>

Table 22 summarises the effect of fertilizers on the potassium content of turnips.

Table 22. Dry Matter Composition of Turnips. % K.

Main Effects and Interactions.

	Expt. 1.		Expt. 2.		Expt. 3.		Expt. 4.	
	Tops	Roots	Tops	Roots	Tops	Roots	Tops	Roots
Mean	3.17	3.06	3.36	2.60	2.41	2.05	1.98	1.68
Response to								
S	-.02	.08	.13	.27	-.03	-.08	-.03	$.13^{*}$
N	-	-	-	-	-.01	-.01	-.12	.00
P	.29	-.14	.25	.11	$-.23^{*}$	-.05	-.19	-.07
K	$.63^{*}$	.17	.37	.08	.18	$.24^{*}$	$.49^{**}$	$.31^{**}$
Interactions								
NP	-	-	-	-	.14	.09	-.09	-.01
NK	-	-	-	-	.09	.07	-.12	$-.14^{**}$
NS	-	-	-	-	.06	.08	-.11	.03
PK	.45	-.20	.45	-.27	-.11	-.16	$.31^{*}$	-.05
PS	.28	.13	.70	.50	-.17	-.02	.11	.00
KS	-.18	-.02	-.47	-.07	$-.23^{*}$	-.11	.00	.06

Salt had variable effects on potassium uptake. It generally reduced it slightly (.03%) in the tops but increased it rather more in the roots.

Ammonium sulphate had negligible effects in Experiment 3 and depressed the % K in the tops by .12% in Experiment 4.

Superphosphate also had no consistent influence. There were increases and decreases in the order of .25% K in the tops and .10% K in the roots.

Potassium chloride always increased potassium uptake. The increments were generally greater in the tops than in the roots and ranged up to 0.63** and 0.31**% respectively. They did not seem to be related to the yield response to potassium chloride.

The KS interactions were generally negative.

Calcium

The effects of fertilizers on the calcium content of turnips for the four experiments are shown in Table 23.

Table 23. Dry Matter Composition of Turnips. % Ca.

Main Effects and Interactions.

	Expt. 1.		Expt. 2.		Expt. 3.		Expt. 4.	
	Tops	Roots	Tops	Roots	Tops	Roots	Tops	Roots
Mean	2.31	.657	2.02	.397	1.80	.384	1.71	.355
Main Effects								
S	-.07	-.007	-.12	.054	.03	-.017	-.06	-.015
N	-	-	-	-	-.14	-.006	-.08	-.028*
P	.000	-.006	.13*	.065*	-.06	.008	-.11	.001
K	-.09	.015	-.13*	-.004	-.05	-.026*	-.02	-.012
Interactions								
NP	-	-	-	-	-.07	-.013	.07	-.007
NK	-	-	-	-	-.06	-.006	.01	-.015
NS	-	-	-	-	-.10	.011	.07	.017
PK	.19	-.005	-.04	.003	-.12*	.018	-.10	.016
PS	-.13	-.011	-.20	.015	-.01	-.018	-.04	-.018
KS	-.22	-.028	.15	-.005	-.06	.024	.01	.015

Salt had irregular effects on calcium uptake. They were all small and non-significant.

Ammonium sulphate depressed calcium levels in the two experiments in which it was used. In Experiment 4 the decrease of .028*% was significant.

Superphosphate stimulated calcium uptake in the tops and roots in only one experiment. It was generally without effect in the others but tended to depress the calcium content of the tops in Experiment 3 and 4.

Potassium chloride normally reduced the % Ca in both roots and tops. In the roots the falls ranged up to .026 and in the tops to .13%.

Magnesium

None of the fertilizers appreciably altered the magnesium level. Table 24 summarises the results.

Salt generally reduced the magnesium contents by amounts ranging up to .007%.

Ammonium sulphate and superphosphate had very small and irregular effects.

Potassium chloride consistently reduced the % Mg. Root magnesium fell by amounts of up to .007%. The level in the tops was decreased by between .007 and .021%.

The KS interactions were generally positive indicating that salt and potassium chloride reinforce each other in reducing magnesium uptake.

Table 24. Dry Matter Composition of Turnips. % Mg.

Main Effects and Interactions.

	Expt. 1.		Expt. 2.		Expt. 3.		Expt. 4.	
	Tops	Roots	Tops	Roots	Tops	Roots	Tops	Roots
Mean	.204	.103	.208	.082	.132	.081	.135	.075
Response to								
S	-.007	-.006	.007	-.004	.000	-.006*	-.004	.003
N	-	-	-	-	-.002	-.003	.004	.004
P	.002	-.009*	.002	-.003	.002	-.003	.013	.001
K	-.007	-.005	-.015	-.002	-.008	-.007*	-.021*	-.006
Interactions								
NP	-	-	-	-	-.002	-.001	.001	.002
NK	-	-	-	-	-.001	.002	.010	.000
NS	-	-	-	-	-.001	-.003	.008	.004
PK	.007	-.003	-.008	.004	.005	.001	.009	.005
PS	.004	-.007	-.008	.002	.004	.001	-.011	-.003
KS	.008	.004	-.008	.003	.006	.008**	-.002	.001

Phosphorus

Table 25 presents the data regarding the effects of fertilizers on the phosphorus content of turnips.

Salt has increased the % P in each experiment. The increases ranged up to .038*% in the roots and to .030% in the tops.

Ammonium sulphate had irregular effects in the two experiments in which it was used.

Superphosphate consistently increased the % P in both roots and tops. The increments were large and significant, ranging up to .067**% in the roots and .056**% in the tops.

Table 25. Dry Matter Composition of Turnips. % P.

Main Effects and Interactions.

	Expt. 1.		Expt. 2.		Expt. 3.		Expt. 4.	
	Tops	Roots	Tops	Roots	Tops	Roots	Tops	Roots
Mean	.163	.291	.135	.157	.189	.210	.194	.161
Response to								
S	-.004	.024	.030	.038*	.008	.015	.024*	.005
N	-	-	-	-	.004	-.019	.025*	.000
P	.056**	.011	.049**	.067**	.016	.017	.051**	.030**
K	.042*	-.033*	-.013	-.039*	.020*	.014	.013	.006
Interactions								
NP	-	-	-	-	-.006	-.006	-.014	-.013**
NK	-	-	-	-	-.006	-.002	-.005	-.001
NS	-	-	-	-	-.011	-.002	-.009	-.003
PK	.027	-.053*	-.018	.000	-.013	.005	.011	-.005
PS	.018	-.003	.004	.013	.011	-.008	-.024**	-.016**
KS	.001	.009	-.004	.023	-.021*	-.009	-.009	.002

Potassium chloride had variable effects. There were both significant increases and decreases.

In Experiment 4 there were large and significant negative PS interactions in both roots and tops, but the remaining interactions were generally small and irregular.

EXPERIMENTS WITH GRASS

Salt has been used for many years on grass by some farmers in those areas adjacent to the sources of production in Cheshire and Staffordshire. In addition to the possible effects on yield it is reported to preserve the freshness of the vegetation in dry weather and to increase the palatability of older and coarser material. There have been no recorded experiments in this country.

Reports from New Zealand however have indicated that salt may be of benefit to grass (which presumably includes clover). Lynch (1954) has shown from the results of 15 trials with salt on potassium deficient soils that it may be of considerable benefit. On sandy soils grass responded to salt only if no potassium chloride was given. On "ash" soils small returns were found even if given in combination with added potassium. Salt did not improve yields on basalt soils. The clover (wild white) grew better and there was more uniform and closer grazing. There was an improved potassium uptake resulting from the salt applications.

Bell(1955) and During (1957) also in New Zealand have reported that salt may be of benefit to grass under potassium deficient conditions.

Gammon (1953) found in pot experiments that pangola grass (which has a very high potassium requirement) could have two-thirds of this need replaced by sodium without loss of crop. There was no direct benefit with other grasses with lower potassium requirements.

Clover made poorer growth as sodium was substituted for potassium.

Reference has already been made (p.5) to the effect that a number of workers have reported that lucerne particularly and various clovers are responsive to salt, more especially under potassium deficient conditions.

Four experiments to investigate the effect of salt in association with other fertilizers on the growth and composition of grass have been completed. In each case the fertilizers were applied to established swards. There were two experiments in 1956 and two in 1957 and in each year one was sited on a sward high in clover and the other on almost exclusively grass species.

In 1956, the treatments investigated were

0 and 3 cwt. Ammonium Sulphate	N
0 and 3 cwt. Superphosphate	P
0 and 2 cwt. Potassium Chloride	K
0 and 4 cwt. Salt	S

The layouts were in standard 2 x 2 x 2 x 2 factorial designs of 4 blocks of 8 plots, the NPKS interaction being confounded between the two complete replicates in each experiment.

At one site, (Experiment 1) eight additional plots were laid down to investigate the effect of higher levels of fertilizer application, namely

6 cwt Ammonium Sulphate	in all combinations.
4 cwt Potassium chloride	
8 cwt Salt	

All the fertilizers were applied in the spring in a single application, and in each case two cuts of herbage were taken for yield determinations, but sampling for analysis was done more frequently.

In 1957 two further experiments were commenced. The treatments were as follows.

0 and 3 cwt. Ammonium Sulphate	N
In addition, dressings of 3 cwt of ammonium sulphate were given after each of the several cuts taken.	
0 and 3 cwt. Superphosphate	P
0 and 2 cwt. Potassium Chloride	K
0 and 4 cwt. Salt	S
0 and 2 cwt. Magnesium Sulphate (Hydrated)	M.

The plots were laid out in standard 2^5 layouts in 4 blocks of 8. The SMP, SNK, and MNPK interactions were confounded between blocks. The analysis of variance was as follows.

		Degrees of freedom
Main Effects		5
Interactions	2 factor	10
	3 factor (excl. SMP & SNK)	8
	4 factor (excl. MNPK)	4
	5 factor	1
Blocks	(SMP. SNK. MNPK)	3
	TOTAL	31

It was hoped that the repeated nitrogen top-dressings would establish serious potassium deficiency and these experiments will be continued at least into 1958 with this object in mind.

Plot Size

In each experiment, plots of .005 acre have been used as is the usual practice. These were laid down in narrow plots each 4 ft. wide and 54½ ft. long. After marking the boundaries with string the mixed fertilizers were applied by hand.

Harvesting and Sampling

The herbage was cut at appropriate times by means of an Allen Autoscythe. This was employed to take a 3 ft. cut from the centre and running the entire length of each plot.

Samples were taken by bulking 25 handfuls of the cut herbage obtained at random from the whole length. The autoscythe leaves a tidy swath and the samples represent the entire cut material without loss of leaf. The samples were transported to the laboratory in polythene bags.

Sample Treatment

In view of the large difference in mineral composition between grasses and clovers and the effects of fertilizers on the botanical composition of the sward, it was decided to separate the grasses and clovers and to analyse them separately.

Each sample, weighing generally over 1 Kg. was spread on a table and separated into grasses and clovers. They were then weighed fresh, dried at 100°C, reweighed and ground. Inevitably some small loss of water occurs during the division and this was kept to the minimum by working in a cool room. Some respiration also takes place in the samples which of necessity have to wait a few hours before separation. This has been kept to the minimum by storing the samples in a refrigerator. In any event the water loss was small and all samples were dealt with on the day of cutting.

GRASS EXPERIMENT 1. 1956

Site Cochno. Dumbartonshire.

Soil Heavy loam, well drained.

Exchangeable	Na	7.5 mgs. %	
1 % Citric Sol.	P	12.5 mgs. %	Satisfactory
1 % Citric Sol.	K	12.5 mgs. %	Satisfactory
	pH	6.5	

Sward Composition

The sward consisted predominately of perennial ryegrass with red and wild white clovers. It had been sown under oats in the previous year.

Fertilizer Treatments and Layout

All combinations of the following treatments were investigated in a 2^4 factorial design of 32 plots in 4 blocks of 8, the NPKS interaction being confounded between replicates.

O and 3 cwt Ammonium Sulphate	N
O and 3 cwt Superphosphate	P
P and 2 cwt Potassium Chloride	K
O and 4 cwt Salt	S

To eight further plots immediately adjacent to the above were applied all combinations of the following higher rates of N, K and S.

O and 6 cwt Ammonium Sulphate	N2
O and 4 cwt Potassium Chloride	K2
O and 8 cwt Salt	S2

In each case the whole of the fertilizers were applied as one single treatment on April 5th. Although that day was overcast, no rain fell for almost three weeks and there were severe scorching effects on the clover from salt at both the 4 and 8 cwt rates. To some extent the effects were more pronounced with the combined salt and potassium chloride dressings. This was entirely due to retention on the clover leaves. The scorching tended to be rather irregular and the rather high standard errors in this experiment for yields of clover can be attributed to this.

As a result of the reduced clover, supplementary nitrogen was not applied later in the year in order not to eliminate it entirely from the sward.

The herbage was sampled four times during the year, namely;

A. May 5th, at the grazing stage.

B. May 30th, at the early hay stage, when the first cut was taken.

C. July 21st, when the grass had re-grown to the silage stage and the second cut was taken.

D. August 21st, at the subsequent aftermath grazing stage.

Salt adversely affected clover yields and ammonium sulphate greatly increased the growth of herbage up to the first cut. Thereafter it had little net effect as it further depressed the clover but at the same time increased the grass.

Tables A73 - A87 give the effects of the various treatments on the yield and composition of the grass and clover.

Yields of Dry Matter (A76 & A77)

The mean yield of total dry matter at the first cut was 21.64 cwt of which 16.41 was grass and 5.23 clover. At the second cut the total yield was 23.04 cwt, 15.00 being grass and 8.04 being clover.

Salt generally depressed the yields of total dry matter by reason of its adverse effect on the clover. At each cut the clover was decreased by a mean value of about 2.3 cwt and this was significant at the 5% level. Greater damage occured to the clover on plots receiving phosphorus and/or potassium in addition to the salt. Salt slightly increased the yield of grass. This may not be entirely attributable to a direct nutritional effect but perhaps to the reduced competition from clover.

Ammonium sulphate greatly increased the total dry matter at the first cut by 11.93** cwt. The main effect was to increase the grass by 14.50** cwt and to depress the clover by 2.58** cwt. The residual effect of the single dressing of ammonium sulphate was very small and at the second cut the increase in total dry matter was only 1.35 cwt. There were however marked differences between grass and clover. The grass increased by 7.84** cwt and the clover yield fell by 6.51** cwt. Again, the clover depression was greater in the absence of potassium.

Superphosphate had only a small influence on the yield of total dry matter, increases of 1.21 cwt being recorded at each cut. Grass and clover contributed equally to this.

Potassium chloride depressed the yield of total dry matter by about 1.5 cwt at each cut, the majority of the fall being due to the reduction in clover. One particularly large decrease of 4.42* cwt was found in the second cut for the total dry matter on plots which also received no nitrogen.

These effects were all accentuated in the additional plots where higher rates of ammonium sulphate, potassium chloride and salt were applied.

Salt at 8 cwt/acre greatly reduced yields at both cuts by its almost catastrophic effect on the clover. Clover was almost entirely eliminated by the initial scorching particularly when ammonium sulphate and/or potassium chloride were also applied.

Ammonium sulphate at 6 cwt increased yields to a markedly greater extent than the 3 cwt application. Again, its effect was to increase the grass at the expense of the clover.

The 4 cwt application of potassium chloride reduced the yield relative to the control plot at the first cut, but when given in association with ammonium sulphate produced the largest yield of total dry matter at both cuts, but the clover was still adversely affected and the dry matter was almost entirely grass.

Composition of the Dry Matter

Sodium (A78 & A79)

The mean % Na in the grass was .266 at the first sampling and fell steadily to .062% at the fourth. In the clover a more or less steady value of about .100% was maintained throughout. Very large variations were recorded from one treatment to another. In the grass the range was from .022% on a K plot at the fourth sampling to .800% on an NS plot at the first. In clover the highest sodium content was .332 on a PS plot in the first sample and the lowest was .025% on a PK plot at the fourth.

Salt consistently increased the % Na in grass and clover at all times by large and significant amounts. In grass, the increases were much the greatest at the first two samplings (.167** and .134**% respectively) than in the third and fourth (.053** and .022*%). For the A and B samples salt increased the % Na most in the presence of ammonium sulphate. This was however reversed in the C and D samples. The effect of salt on the clover was rather more uniform, increases falling from .102**% at the first to .033**% at the fourth sampling. Salt at the 8 cwt rate on the additional plots increased the sodium level to an even greater degree. Amounts as high as .900 and .480% were found in the grass and clover respectively.

Ammonium sulphate increased the sodium level of grass in the A and B samples as much as did salt, the mean increments being .148** and .179** respectively. When nitrogen was no longer increasing yields at the C and D samplings its influence on raising the % Na was much reduced and was only .006% in the last sample. In the first two samples the effect of nitrogen was greater in the presence of salt. There were also very large and significant negative NK interactions and thus ammonium sulphate had a much reduced influence on sodium uptake when applied in association with potassium chloride. For example, in the first sample ammonium sulphate alone increased the % Na by .254** but by only .042 when given with potassium chloride. The influence on clover was very much smaller and non-significant. There was either no effect or an increase or decrease of .030%. The small reductions at the A and B samplings may be associated with the decrease in clover yield. At the higher rate of 6 cwt/acre on the additional plots, the sodium level of grass was increased more and the effect was more prolonged. Even this high rate of nitrogen however was not able to increase the % Na in the presence of potassium chloride and a low level of as little as .010% Na was found at the fourth sampling on the plot receiving 4 cwt of potassium chloride. As in the main experiment there was no increase in the sodium level of the clover.

Superphosphate had the general effect of depressing sodium uptake in both grass and clover. In grass, the largest reductions were in the early part of the season, but in the clover the C and D samples were showing the greater falls. In each case the decreases were significantly greater where nitrogen was also given.

Potassium chloride had outstanding effects in reducing sodium uptake. In the grass the mean reduction fell from -.105** in the A sample to -.047**% in the last. In clover the effect was reversed in that the first sample showed a depression of .017% and the fourth a reduction of .056**%. In neither case were the KS interactions of importance, but there were large and significant negative NK interactions throughout. Potassium thus depressed the % Na most when given together with ammonium sulphate. Potassium chloride at 4 cwt per acre on the additional plots had correspondingly greater effects. e.g. In the B sample the % Na in the grass was .275 in the N plot, .055 in the NK, .900 in the NS and .395 for the NKS treatment. Similar trends were found in the clover.

Potassium (A80 & A81)

The potassium contents of the grass and clover were highest in the first sample being 3.36 and 3.12% respectively. In clover the amount fell steadily to 1.86% and the trend in the grass was similar but more irregular. There was considerable variation in the % K in different plots. Thus in the grass the range was from 4.80% in the A sample of an NPK plot to 1.30% in an NP plot at the third sampling. In clover, 4.0% was reached in the NPK plot in the first sample and 0.95% in the C sample of the NP plot.

Salt had little effect on the mean % K of the grass. There were small increases, especially in the presence of nitrogen for the A and B samples followed by small depressions in subsequent samples. For the first two samples there were large and significant negative KS interactions which led to salt increasing the % K when no potassium chloride was given but reducing it when the two were applied together. Similar trends, including the significant negative KS interactions were found in the clover, but the overall effect was rather more irregular than with grass. The additional plots receiving 8 cwt of salt also showed much the same effects on potassium uptake.

Ammonium sulphate increased the potassium uptake of grass markedly at the first two samplings but the increase in weight of crop removed was reflected in lower subsequent uptakes. In the A sample the mean effect was as high as +0.74**% and the depressions in the C and D samples were -0.46** and -0.28**% respectively. There were large and significant positive NK interactions resulting in much increased potassium uptakes when ammonium sulphate and potassium chloride were given together, being as high as 1.21**% in the A sample. Similar trends in the overall effect of ammonium sulphate were found in the clover and again there were large and significant positive NK interactions. In the absence of potassium chloride, ammonium sulphate consistently reduced the % K of clover. On the plots which had 4 cwt of potassium chloride higher potassium values were obtained and salt at the 8 cwt rate tended to reduce the increases in both grass and clover.

Superphosphate increased the mean content of potassium in both grass and clover by amounts ranging up to 0.3%. In the grass, the effect was much reduced after the first sample but was much more prolonged in clover. Tha absence of salt and the presence of ammonium sulphate also resulted in large increments in the % K of clover from superphosphate.

Potassium chloride itself caused large and significant increments in the potassium contents of both grass and clover at all stages. The increases ranged from .2 to .5% and were all significant at the 1% level. In the grass there were large and significant (P = .01) negative KS interactions which resulted in potassium chloride increasing the % K by very large amounts but only in the absence of salt. When salt was applied the increases were smaller and non-significant. In grass also there were large and highly significant positive NK interactions and this resulted in potassium chloride having no effect on potassium uptake in the absence of ammonium sulphate. There were also large negative KS and positive NK interactions for the clover. Potassium chloride applied at 4 cwt per acre on the additional plots only increased the % K when given in association with ammonium sulphate.

Calcium (A82 & A83)

The mean calcium content of the clover remained fairly steady at about 2.0% throughout, but in the grass the level fluctuated between .48 and .63%.

Salt depressed the % Ca in the A sample of grass by .049** but thereafter had no influence. In clover there were small reductions of about .05% in the first two samples and corresponding increments in the last two. The additional plots which had 8 cwt of salt showed similar trends, calcium being reduced in the early grass samples and clover reacting in an irregular manner.

Ammonium sulphate tended to decrease the mean % Ca of the grass by amounts in the order of .017% in all except the B sample. The first sample showed significant reductions of .057** and .036*% in the presence of superphosphate and potassium chloride respectively. There was also a large negative NP interaction at the fourth sampling. Ammonium sulphate markedly reduced the calcium content of the clover by $.22^{**}$ and $.32^{**}$% at the first two samplings, but increased the uptake slightly thereafter. On the additional plots at 6 cwt per acre it generally reduced the calcium in the A sample but increased it in the last one.

Superphosphate stimulated the calcium uptake of the grass at all but the third sampling, that of .023% at the first being almost significant. There were large negative NP and PS interactions also in the A sample. It had almost no effect on the clover.

Potassium chloride consistently depressed the % Ca in the grass by amounts ranging from .010 to $.026^{*}$%. There was little influence on the clover and when given at 4 cwt per acre on the additional plots there was no appreciable further influence.

<u>Magnesium</u> (A84 & A85)

The mean % Mg in the grass was .115 in the A sample falling to about .095 at the B and C, and rising to .129 in the final sample. In the clover the level dropped steadily from .260 to .218%.

Salt had little effect on the grass at the first two samplings but depressed the uptake by $.008^{*}$ and $.017^{*}$% at the third and fourth. The decrease was much the largest on these later samples on plots which had nitrogen ($-.029^{**}$) or in the absence of phosphorus ($-.020^{**}$) or potassium ($-.030^{**}$). In clover the largest reduction was in the A sample and again the fall was greatest in the presence of nitrogen and the absence of phosphorus or potassium. On the additional plots with 8 cwt of salt the magnesium level in the grass fell even more, e.g. at the first cut salt reduced the

% Mg from .114 to .074, but there was no further influence on the clover.

Ammonium sulphate significantly increased the % Mg of grass at the first (.030**) and second (.015**) samplings, but thereafter was without effect. Increases were also found in the clover at all except the second sampling. Where 6 cwt of ammonium sulphate was applied the magnesium was increased most in the clover, e.g. the % Mg on the nil plot was .216, .230, .176 and .198 as the season progressed and .284, .216, .234 and .250 on the N plot.

Superphosphate depressed the % Mg in grass throughout by amounts ranging up to .010*% in the first sample. Greater reductions were found when superphosphate and ammonium sulphate were applied together. It also reduced the uptake in clover by amounts ranging up to .020**% and again the decreases were much greater in the presence of ammonium sulphate.

Potassium chloride reduced the % Mg in both grass and clover by up to .010% but the effects were not significant. When given at 4 cwt per acre on the additional plots it tended to reduce the uptake particularly when applied alone or in association with salt.

Phosphorus (A86 & A87)

The mean % P of the grass remained fairly steady at about .27% except in the C sample when it fell to about .22%. In the clover the level was much the highest in the first sample (.320) falling to .222 in the second, .137 at the third and .163 at the fourth.

Salt had little influence on the % P in grass except in the D sample when it increased the level by .021%. It tended to reduce the content of the clover by amounts ranging up to .016%. The dressing of 8 cwt per acre on the additional plots also had no influence on the grass but markedly reduced the level in the clover, e.g. in the A sample there was .245% P in the nil plot and .120% in the S plot and in the D sample, .200 and .085 respectively. This no doubt reflects the severe injury by scorching to the clover in the early stages.

Ammonium sulphate did not alter the phosphorus uptake of the early grass samples but markedly reduced it in the later two by about .040**%. These were much reduced in the presence of salt and greatly increased where superphosphate was also given, e.g. to -.074**% in the D sample. Ammonium sulphate significantly increased the % P in clover at the first and second samplings by .027* and .032* respectively but there were subsequent reductions of .025* and .027**%. In each case there were large and significant negative NP interactions and in the A sample the phosphorus level was markedly increased in the absence of salt. When given at 6 cwt per acre, ammonium sulphate further depressed the uptake of phosphorus by both grass and clover.

Superphosphate itself increased the % P in the grass by about .022% at the first two samplings and reduced it by a similar amount at the fourth. Very comparable results were found in the clover.

Potassium chloride generally decreased phosphorus levels in both grass and clover by amounts ranging up to .015%. It very markedly reduced the amount in clover when given at 4 cwt per acre.

GRASS EXPERIMENT 2. 1956.

Site	Balloch. Dumbartonshire.				
Soil	Red sandstone drift.				
	Light loam, freely drained.				
	Exchangeable	Na	3.5	mgs. %	
	1% Citric Sol.	P	7.5	mgs. %	Low
	1% Citric Sol.	K	8.0	mgs. %	Low
Sward	Predominately perennial ryegrass, no clover.				
	Reseeded under oats in 1954.				

Fertilizer Treatments and Layout

The experiment investigated the presence and absence of

3 cwt Ammonium Sulphate	N
3 cwt Superphosphate	P
2 cwt Potassium Chloride	K
4 cwt Salt	S

The treatments were arranged in 4 blocks of 8 plots, with the NPKS interaction confounded between the two complete replicates.

The fertilizers were applied on April 4th and there was an outstanding response to ammonium sulphate at the first cut, but not thereafter.

The crop was sampled three times.

A May 15th at the silage stage.

B June 20th at the hay stage when the first cut was taken. Mean D.M. yield 16.9 cwt.

C August 24th when the subsequent regrowth had reached the silage stage and the second cut was taken. Mean D.M. yield 8.0 cwt.

Tables A88 - A94 present the effects of the fertilizers on the yield and composition.

Yields of Dry Matter (A89)

The mean yields at the first (B) and second (C) cuts were 16.91 and 7.98 cwt respectively. There were substantial yield increments from ammonium sulphate, but at the first cut only.

Salt increased the mean yield at the first cut by 1.39 cwt and by 2.33* cwt in the absence of potassium chloride. The mean yield increment was smaller, but significant at 0.46* cwt at the second cut and it was again greater in the absence of potassium chloride.

Ammonium sulphate increased the mean yield at the first cut by 7.84** cwt. There was an appreciable NK interaction of 0.88 cwt. The mean yield of the second cut was unaffected by ammonium sulphate.

Superphosphate had only small effects on yield. There was an increase of 0.49 cwt at the first cut and a decrease of -0.26 cwt at the second.

Potassium chloride significantly increased yields at the first (2.18* cwt) and the second (0.37* cwt) cuts. There was a large negative KS interaction of -0.94 cwt which resulted in there being an increase of 3.12* cwt of dry matter in the absence of salt and only 1.24 cwt in its presence.

Composition of Dry Matter

Sodium (A90)

There were very large variations in the sodium content. The mean value fell from .290% at the first sampling to .217% at the second and .073% at the third. Considerable differences occured from plot to plot at each stage, i.e. .750% on an NS plot and .075% on a K plot at the first sampling and much lower values (.215% on an NP plot and .015% on an NPK plot) at the third.

Salt had a very significant influence on sodium uptake, the mean increases being $.132^{**}$ and $.116^{**}$% in the A and B samples. The effect was however much reduced in the third sample being only .015%. In the first two samples there were large positive NS and negative PS interactions.

Ammonium sulphate exerted an even greater influence. The increases were $.268^{**}$% in the A, $.239^{**}$% in the B and only $.035^{*}$% in the C samples. There were large and significant negative NK interactions and ammonium sulphate had much greater incremental effects in the absence of potassium chloride.

Superphosphate had little influence on sodium uptake apart from the negative PS interaction.

Potassium chloride very markedly reduced the mean % Na by $.143^{**}$, $.091^{**}$ and $.054^{**}$% in the first, second and third samples. There were much reduced and non-significant depressions on those plots which did not receive ammonium sulphate.

<u>Potassium</u> (A91)

The mean % K fell from 2.23% in the first sample to 1.55% in the second and rose to 1.76% in the third. There were considerable variations according to the fertilizer treatment e.g. 1.40% for an

NP plot and 3.15% for an NPK plot in the A samples. These differences were primarily associated with the potassium chloride application.

Salt did not have much overall influence on potassium uptake. There was a mean increase of .12% in the A sample and a decrease of .08% in the C sample. There were appreciable negative KS interactions throughout which resulted in salt increasing the % K in the absence of potassium chloride but depressing it in its presence.

Ammonium sulphate increased the % K in the A and B samples but reduced it in the last cut. The NK interactions were positive and in the A sample there was an increase of .71**% K when ammonium sulphate and potassium chloride were given together.

Superphosphate did not influence the potassium content.

Potassium chloride itself greatly increased the % K by .56** at the first sampling, .33* at the second and .21* at the third. The increases were much greater in the absence of salt (.79**, .57** and .33**% respectively) and in the presence of ammonium sulphate (.94**, .42* and .36**%).

<u>Calcium</u> (A92)

The mean calcium contents were .416, .325 and .405 respectively and fertilizers in general had small effects.

Salt reduced the % Ca throughout, by about .016% in the A and B samples and by .043*% in the third. There were negative PS interactions throughout.

Ammonium sulphate increased the uptake at the first two samplings by .027 and .048*% but reduced it in the third by .044*%.

Superphosphate itself increased the mean % P by amounts ranging up to .026%. The presence of ammonium sulphate caused larger increases, indeed superphosphate in the absence of nitrogen had little effect.

Potassium chloride had only minor and irregular effects.

GRASS EXPERIMENT 3. 1956.

Site Cochno. Dumbartonshire.

Soil Heavy loam. Well drained

Exchangeable	Na	9.0	mgs %	
1% Citric Sol.	P	13.0	mgs %	Satisfactory
1% Citric Sol.	K	12.5	mgs %	Satisfactory.

Sward Perennial ryegrass, wild white clover. Smaller amounts of cocksfoot, timothy and red clover. Reseeded in 1955.

Fertilizer Treatments and Layout

The experiment was a 32 plot layout to investigate all combinations of the following treatments

O and 3 cwt Ammonium Sulphate (N)

(Further 3 cwt dressings were given after each cut making a total of 12 cwt for the year.)

O and 3 cwt Superphosphate (P)

O and 2 cwt Potassium chloride (K)

O and 4 cwt Salt (S)

O and 2 cwt Magnesium Sulphate (Hydrated) (M)

The plots were arranged in 4 blocks of 8 with the SMP, SNK and MNPK interactions confounded.

The fertilizers were applied by hand in damp weather on March 15th. Rain followed almost at once and there were no initial adverse effects on the clover due to scorching. Top dressings of ammonium sulphate were applied immediately after each cut, the dates of which were;

A 3rd June. Early hay stage.

B 16th July. Silage stage. White clover in full flower.

C 18th August. Silage stage.

D 24th September. Aftermath grazing.

The respective mean yields were 32.2, 12.5, 14.0 and 6.1 cwt D.M. respectively. Ammonium sulphate consistently increased yields and markedly depressed the contribution of clover to the sward.

It is intended to continue this experiment with the same treatments in 1958.

Tables A95 - A110 present the effects of the various fertilizers on yield and composition.

Dry Matter Yields (A98, A99 & A100)

The initial growth was good and the first cut yielded 32.2 cwt of dry matter. This was followed by a long spell of dry weather and the mean yield of the second cut was 12.5 cwt. At the third and fourth cuts the yields were 14.0 and 6.1 cwt respectively under rather wetter than average conditions.

Salt generally depressed the yields at each cut reaching a total of 1.86 cwt at the first cut but only 0.1 to 0.2 cwt thereafter. Both grass and clover were reduced equally. The SK interactions were generally negative and salt reduced the yields most in the presence of potassium chloride. In the third and fourth cuts salt actually increased the yield of grass in the absence of potassium.

Magnesium sulphate had no regular or real effect on yield; there were small and irregular increments and reductions in dry matter yields. There was an isolated significant negative MP interaction of -0.78^{*} cwt for the second cut of clover.

Ammonium sulphate produced large and significant increases in total dry matter yields and consistently reduced the % D.M. The large stimulation of grass yields resulted in the normal reductions in clover. In each case the total and grass yield increments were significant (P = 0.01) as were the clover reductions. Rather surprisingly, there were no marked NK interactions.

Superphosphate was ineffective in increasing the yields of either grass or clover. There was an initial increase of 1.56 cwt in the first sample - principally from the grass.

Potassium chloride had no overall effect on yield for the first two cuts but caused small increases of 0.90 and 0.71* cwts at the third and fourth. Grass and clover both contributed to the increase. There were however important negative KS interactions. In all cuts except the second, potassium chloride increased the grass and total yields most when no salt was applied. Clover behaved rather differently in that for the later cuts better yields were obtained from salt and potassium chloride together.

Composition of the Dry Matter

Sodium (A101 & A102)

In the grass, the mean % Na increased steadily throughout the year from .144 at the first cut to .446 at the fourth. The level in the clover was about .250% throughout. Very substantial variations were found in both grass and clover according to the fertilizer treatment. The lowest content in the grass was .045% on the K plot at the first cut and the highest .990% on the N and SNP plots in the last cut. The amount in the clover varied from .125% (K plot, 1st cut) to .455% (N plot, 4th cut)

Salt increased the % Na by large and highly significant amounts in the order of .100% (P = .01) in all except the last cut of grass when it was much smaller at .035%. In the first sample of clover the increase was as much as .196**%. In general, greater increments were found when salt was applied with other fertilizers and the NS interactions were positive and significant for both grass and clover for the second and third cuts. The notable exception was with potassium chloride. Greater increases in sodium uptake were found in the presence of potassium chloride for grass, but in its absence in the case of clover.

Magnesium **sulphate** depressed the % Na in both grass and clover throughout. In the grass the reduction became greater as the season progressed and reached -.068*% at the fourth cut. In the clover the reduction in the magnesium content was more irregular and varied between -.012 and -.027%.

Ammonium sulphate increased the sodium uptake in both grass and clover by significant amounts at each cut. In the grass the increments became progressively greater with each cut and reached about .400% at the fourth. There were large positive NS interactions in the second and third samples, and very significant negative NK interactions at all except the first cut. Thus ammonium sulphate increased the % Na most in the presence of salt or in the absence of potassium chloride. There were also progressive increases in the sodium level of the clover and there were marked positive NS interactions.

Superphosphate had no real effect on the sodium content of either grass or clover. It reduced the sodium level of the grass by about .020% and tended to increase that in the clover very slightly.

Potassium chloride substantially reduced the % Na in both grass and clover. The depressions became greater as the season progressed and reached -.160**% in the grass and -.114**% in the clover and were highly significant at all stages. For the grass, the reduction was greater in the absence of salt and magnesium and in the presence of ammonium sulphate. In clover, the SK interactions were negative and thus the depressive effect of potassium chloride was more marked in the presence of salt.

<u>Potassium</u> (A103 & A104)

The potassium content of the clover remained fairly steady at a level between 1.6 and 1.9% throughout. The amount in grass rose from 1.63% at the first to 2.43% at the third cut and then fell to 2.09%.

Salt had no real effect on either grass or clover, in each case the % K was altered by less than .06%.

Magnesium sulphate was also without influence. There were irregular increases and decreases of under 0.1% in both grass and clover.

Ammonium sulphate after the first cut markedly reduced the potassium uptake by .15*% at the second rising to .75**% at the third and .71**% at the fourth. In each case greater reductions were found on plots to which no potassium chloride has been given. Similar results were found for the clover but the depressions were smaller at about .20**%. It tended to be a little greater where salt was also applied.

Superphosphate had no effect on the % K in either grass or clover.

Potassium chloride itself substantially increased the potassium contents. The increase rose steadily in the grass from $.24^{**}$ to $.53^{**}$%. Salt given in association with potassium had no further effect but the increases were substantially greater on plots which which had ammonium sulphate. The increase in the % K of the clover was more consistent at between $.44^{**}$ and $.55^{**}$% throughout the season and was not affected by the presence of other fertilizers.

<u>Calcium</u> (A105 & A106)

The calcium content of the grass increased from .450% at the first cut to .738% at the fourth. The level in the clover was more constant at about 1.7 to 2.0% Ca.

Salt had no real or consistent effect on calcium uptake by either grass or clover. There were large positive SP interactions for the grass at the second and fourth cuts.

Magnesium sulphate was almost without effect on the clover, the tendency being to reduce the level. It generally depressed the uptake by the grass by amounts which reached significance at $.066^{**}$% at the second cut.

Ammonium sulphate increased the % Ca in grass in all except the third cut. These were significant for the first (+$.035^{*}$%) and fourth (+$.082^{**}$%) cuts and were greater in the absence of salt or magnesium sulphate. Ammonium sulphate did not affect the calcium content of the clover.

Superphosphate had no general influence on the uptakes by either grass or clover.

Potassium chloride also had little overall effect but there were significant reductions for the first cut of grass of .049* and .047* when salt and ammonium sulphate were also given.

Magnesium (A107 & A108)

The mean amount of magnesium in the clover remained at about .225% throughout the year but that in the clover increased steadily from .090 to .180%.

Salt generally depressed the % Mg in both grass and clover. Significant (P = .05) reductions of about .012% were found in the second cut of clover and the fourth cut of grass but otherwise the effects were small. There were several significant positive KS interactions and salt reduced the magnesium level most in the absence of potassium chloride.

Magnesium sulphate itself had remarkably little influence, indeed it generally reduced the % Mg in grass by about .005%. It did increase the levels significantly in the first and last cuts of clover (.017** and .005*% respectively). In clover too, the increases tended to be greater if potassium chloride was also applied and if ammonium sulphate was omitted.

Ammonium sulphate increased the magnesium uptake of both grass and clover significantly. In the grass it reached .043**% at the last cut and there was one exceptional reduction of .021**% for the first cut of clover.

Superphosphate had negligible effects. It tended to reduce the % Mg in both grass and clover by about .002 to .005%.

Potassium chloride significantly reduced the levels in both grass and clover at all stages by amounts ranging up to .024**%. It had an even greater influence in the absence of salt.

Phosphorus (A109 & A110)

The % P in both grass and clover rose steadily as the season progressed from about .170 to .230 in each case.

Salt generally increased the concentration in the grass by about .010% but it reduced the uptake significantly in the first (-.020**%) and third (-.025*%) cuts of clover.

Magnesium sulphate tended to depress the % P in grass but by less than .010% and had similar effects in clover apart from a reduction of .021*% in the third cut.

Ammonium sulphate had very significant effects in lowering the % P in grass at the third (-.071**) and fourth (-.051**) cuts. Its influence on clover was quite small after a decrease of .018**% for the first cut.

Superphosphate itself had quite small effects. It consistently increased the levels in grass and clover by about .010% but only reached significance in the first clover sample. The largest increases in grass were on plots receiving both superphosphate and salt.

Potassium chloride was without effect on the phosphorus content of the grass but generally enhanced that of the clover particularly in the last cut when the increase reached .035**%.

GRASS EXPERIMENT 4. 1957.

Site Eaglesham. Renfrewshire.

Soil Poor, heavy loam, badly drained.
Ashgrove Series.

Exchangeable	Na	10.0 mgs %	
1% Citric Sol.	P	7.5 mgs %	Low
1% Citric Sol.	K	9.0 mgs %	Low
	pH	5.7	

Sward Perennial ryegrass. no clover.

Sown in 1954.

Fertilizer Treatments and Layout

The treatments were as for Experiment 3, namely

O and 3 cwt Ammonium Sulphate (N)
(Repeated after each cut)

O and 3 cwt Superphosphate (P)

O and 2 cwt Potassium Chloride (K)

O and 4 cwt Salt (S)

O and 2 cwt Magnesium Sulphate (Hydrated) (M)

The plots were laid out in a 2^5 factorial design of 4 blocks of 8 plots with the SMP, SNK and MNPK interactions confounded.

The fertilizers were applied on March 18th and cuts were taken as follows:

A May 30th. Early hay stage.
B July 20th. Silage stage.
C August 25th. Aftermath grazing.

The mean dry matter yields were 12.1, 10.2 and 8.7 cwts respectively. Growth was very slow throughout the year and there were substantial increments from ammonium sulphate. Those plots without nitrogen gave exceptionally low yields.

Tables A111-A118 summarise the effects of the fertilizers on yield and composition.

Yields of Dry Matter (A113)

The mean dry matter yields were 12.11, 10.23 and 8.68 cwts for the three cuts. There were very substantial increments from ammonium sulphate at all stages and smaller ones from potassium chloride.

Salt did not influence the yield of the first cut, but increased it significantly by 1.24* cwts at the second and by 0.38 cwts at the third. There were clear negative KS interactions throughout and these reached significance at the 1% level for the second (2.66** cwts) and third (1.10** cwts) when the soil was becoming progressively more deficient in readily soluble potassium. Salt did not increase yields when potassium chloride was given.

Magnesium sulphate had very little effect on the first two cuts, but raised the yield by 0.52* cwts at the third.

Ammonium sulphate produced large and significant dry matter increments. Yields with nitrogen were generally three times greater than those without. After the first cut, ammonium sulphate did not exert its full influence unless potassium chloride was also given and the NK interactions were significantly positive.

Superphosphate had very small effects considering the low level of readily soluble phosphorus in the soil.

Potassium chloride consistently enhanced yields by amounts increasing from 1.0 cwts at the first cut to 3.28** cwts at the third. Much greater increments were recorded on plots which did not have salt and both the negative KS and positive NK interactions were significant.

Composition of the Dry Matter

Sodium (A114)

The mean % Na rose from .181 at the first to .182 at the second and to .252 at the third cut. There were large and very marked variations between treatments. e.g. In the first cut the range was from .040% (K plot) to .387% (NS plot). At the third cut the corresponding amounts were .035 and .725%.

Salt increased the % Na more at the first cut (.083**%) than subsequently. The increases were generally greater in the presence of magnesium sulphate and ammonium sulphate and in the absence of potassium chloride.

Magnesium sulphate did not affect sodium uptake at any stage.

Ammonium sulphate produced large and significant increments, .146**% at the first, .257**% at the second and .352**% at the third. There were large and significant negative NK interactions and thus ammonium sulphate increased the % Na much more in the absence of potassium chloride,- by as much as .531**% at the third cut, but by only .173**% in the presence of potassium chloride.

Superphosphate had little influence on sodium uptake, increases of between .015 and .035% being found. It had rather larger effects in the absence of salt or in the presence of ammonium sulphate.

Potassium chloride depressed the % Na by large and significant amounts at all stages. The reductions were in the same order as the increases due to ammonium sulphate and much greater than those due to salt itself. It generally reduced the levels most when salt was also given and by greatly increased amounts in the presence of ammonium sulphate.

<u>Potassium</u> (A115)

The soil was not well supplied with readily soluble potassium and the amount in the grass was about 1.05% at each of the three cuts. The range was from 0.60 to 1.40% K depending on whether or not potassium chloride was given.

Salt did not affect the first cut but increased the mean % K by .03 and .06 at the second and third. These amounts were well below the level for significance, but an increase of 0.20^{**}% was found at the third cut for plots without potassium chloride, the SK interaction being -0.14^{**}%.

Magnesium sulphate had little effect.

Ammonium sulphate depressed the % K by $.09^{**}$% in the first cut but thereafter had no overall effect. There were however substantial and significant [redacted] NK interactions which resulted in ammonium sulphate having large depressive effects in the absence of potassium chloride, but in increasing the % K when given together.

Superphosphate tended to reduce the uptake of potassium.

Potassium chloride itself increased the % K at all three cuts by about .40**%. There were greater increases in the absence of salt and in the presence of ammonium sulphate.

Calcium (A116)

The mean % Ca rose from .361 at the first to .458 at the second and to .620 at the third cut. Fertilizer effects were quite small.

Salt depressed the uptake by .037**% at the first cut and by .052*% at the second.

Magnesium sulphate had no influence.

Ammonium sulphate markedly increased the uptake of calcium by .088**% at the second cut but otherwise had no marked effect.

Superphosphate increased the % Ca by .01 to .02% at each cut.

Potassium chloride also had no real or consistent effect.

Magnesium (A117)

The amounts of magnesium in each of the three cuts were rather low being .091, .119 and .135% respectively. There was considerable variation from plot to plot e.g, .062% in the SK plot at the first cut and .236% on the MN plot at the third.

Salt consistently depressed the magnesium levels. By the third cut it had reached -.026*% and was much greater on plots to which potassium chloride was applied. The largest reduction (-.042**%) was in the third cut for ammonium sulphate treated plots.

Magnesium sulphate itself enhanced the uptake significantly by steadily increasing amounts with each cut, .013*% at the first, .014*%

at the second and .025*% at the third. There were larger increases on potassium chloride treated plots.

Ammonium sulphate significantly increased the magnesium uptakes at the second and third cuts by .038** and .048**% respectively. The increases were considerably greater in the absence of salt, potassium chloride and superphosphate.

Superphosphate tended to depress the % Mg by amounts ranging up to .007%.

Potassium chloride consistently reduced the magnesium uptake by amounts which increased to .030*% at the third cut. The reduction was much greater in the presence of salt, ammonium sulphate and superphosphate.

Phosphorus (A118)

The phosphorus content of grass varied very little from one cut to another around a level of about .165%.

Salt slightly increased the % P but by less than .010.

Magnesium sulphate was without effect.

Ammonium sulphate also had little influence.

Superphosphate itself enhanced the phosphorus levels consistently by .013*% at the first cut, by .026**% at the second and by .019**% at the third.

Potassium chloride had no general overall effect.

GRASS EXPERIMENTS SUMMARY

Dry Matter Yields (Table 26.)

Salt has increased the yield of grass in Experiments 2 and 4. These swards contained no clover and both gave significant increases in yield from potassium chloride. In Experiment 1 the clover was severely scorched by the salt and the yield suffered in consequence. There were only small increments in the weight of grass. In Experiment 3 where there was no response to potassium chloride until the third and fourth cuts, salt tended to reduce the yields of both grass and clover slightly. The KS interactions were generally negative indicating that salt is of greater benefit in the absence of potassium chloride.

Ammonium sulphate consistently increased yields by large amounts. The effect was a net one as clover was consistently depressed and the grass increased. In the first two experiments where there was only one application of ammonium sulphate there was little residual effect on total yield after the first cut. There were frequent positive NK interactions, ammonium sulphate thus being of greater value when given in association with potassium chloride.

Superphosphate had little influence on yield although the soils were generally low in readily soluble phosphorus.

Potassium chloride had significant incremental effects in Experiments 2 and 4 which were the soils least well supplied with readily soluble potassium. It markedly depressed the clover in Experiment 1 due to leaf scorch at the time of application.

Table 26. Grass Experiments Yields of Dry Matter (cwts)

EXPERIMENT		Mean Yield		Differential Responses										Consistent Interactions			
				Sodium		Magnesium		Nitrogen		Phosphorus		Potassium		K S		N K	
		Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover
1.	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	16.41	5.23	0.54	-2.26*	-	-	14.50**	-2.58**	0.76	0.44	-0.15	-1.22	0.98	-0.92	-0.67	1.31
	C	15.00	8.04	0.19	-2.36*	-	-	7.84**	-6.51**	0.54	0.68	-0.12	-1.04	-0.18	-1.21	0.84	2.01
	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	16.91	-	1.39	-	-	-	7.84**	-	0.49	-	2.18*	-	-0.94	-	0.88	-
	C	7.98	-	0.46*	-	-	-	0.09	-	-0.26	-	0.37*	-	-0.24	-	0.02	-
3.	A	27.84	4.31	-1.16	-0.70	-0.76	-0.06	15.08**	-2.14**	1.36	0.24	-0.14	0.16	-0.66	-0.24	-1.19	0.33
	B	8.53	3.97	-0.01	-0.15	-0.19	0.38	9.17**	-4.48**	-0.09	-0.06	-0.04	-0.24	0.14	-0.03	0.04	0.50
	C	10.58	3.46	-0.16	-0.11	0.46	0.21	11.86**	-4.89**	0.66	-0.06	0.73	0.18	-0.98	0.26	0.09	0.09
	D	5.29	0.80	-0.09	-0.04	0.08	-0.01	4.08**	-1.08**	0.07	0.02	0.51*	0.20*	-0.72*	0.06	0.12	-0.10
4.	A	12.11	-	-0.08	-	0.70	-	15.39**	-	0.05	-	1.00	-	-0.25	-	-0.29	-
	B	10.23	-	1.24*	-	0.06	-	9.95**	-	0.81	-	2.08**	-	-1.42**	-	1.17*	-
	C	8.68	-	0.38	-	0.52*	-	6.00**	-	0.34	-	3.28**	-	-0.72*	-	1.08*	-

In Experiment 3 only after repeated cuts following stimulation with ammonium sulphate did potassium chloride significantly increase yield.

Magnesium sulphate had little effect in the two experiments in which it was used. It did seem to be of some small benefit in Experiment 4.

Composition of the Dry Matter

Sodium

Table 27 summarises the main effects and principal interactions of the fertilizers on the sodium uptakes.

Salt had large and very significant incremental effects on the % Na of both grass and clover in each experiment. Frequently the increases were more than 50% of the mean sodium level. In the first two experiments with only a single ammonium sulphate application, the mean % Na and the increases from salt fell off rapidly after the first sampling. In the remaining two with repeated nitrogen dressings, the sodium level steadily increased and the increments from salt were more irregular.

Ammonium sulphate consistently increased the % Na. In the first experiment the increase was found in grass only and at the first two samplings, i.e. whilst its yield promoting effect lasted. There was no increase in the clover which was reduced in yield. Experiment 2 on a sward devoid of clover showed a similar trend. In Experiment 3 the % Na in grass increased due to ammonium sulphate at each sampling. There was also an increase in sodium in the clover although there was a reduction in clover yield. This could perhaps be explained on the basis that although the clover yield was reduced,

Table 27. Grass Experiments Dry Matter Composition. % Na

EXPERIMENT		Mean %		Differential Responses										Consistent Interactions			
				Sodium		Magnesium		Nitrogen		Phosphorus		Potassium		N S		N K	
		Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover
1.	A	.266	.101	.167**	.102**	-	-	.148**	-.030	-.055*	-.005	-.105**	-.017	.044	-.006	-.106**	-.013
	B	.177	.064	.134**	.069**	-	-	.179**	-.007	-.046	-.009	-.075**	-.019**	.063*	-.011	-.048*	-.015*
	C	.076	.093	.053**	.083**	-	-	.039**	.030	-.017	-.029	-.040**	-.059*	-.008	.019	-.025*	-.037
	D	.062	.092	.022*	.033**	-	-	.006	.000	.003	-.022*	-.047**	-.056**	-.011	-.020*	-.007	-.033**
2.	A	.290	-	.132**	-	-	-	.268**	-	.023	-	-.143**	-	.030	-	-.101**	-
	B	.217	-	.116**	-	-	-	.239**	-	-.009	-	-.091**	-	.063**	-	-.045**	-
	C	.073	-	.020	-	-	-	.035*	-	-.001	-	-.054**	-	.007	-	-.028	-
3.	A	.144	.273	.070**	.196**	-.006	-.012	.087**	.065*	-.005	.004	-.062**	-.029	.001	.020	.000	.026
	B	.224	.265	.105**	.108**	-.042*	-.027	.248**	.066**	-.021	.002	-.097**	-.082**	.059**	.032*	-.058**	.018
	C	.371	.231	.136**	.112**	-.050	-.013	.432**	.111**	-.016	.024	-.163**	-.094**	.047	.048*	-.077**	-.009
	D	.446	.248	.035	.088**	-.068*	-.027	.392**	.088**	-.039	-.010	-.158**	-.114**	-.001	.028	-.118**	-.003
4.	A	.181	-	.083**	-	.007	-	.146**	-	.015	-	-.159**	-	.023	-	-.089**	-
	B	.182	-	.027	-	.009	-	.257**	-	.028	-	-.090**	-	.008	-	-.069**	-
	C	.252	-	.041*	-	-.001	-	.352**	-	.034	-	-.217**	-	.001	-	-.179**	-

individual surviving plants grew to a greater size.

Superphosphate had little effect on sodium uptake, there being a small tendency to reduce the level in three of the experiments.

Potassium chloride consistently and very significantly depressed the % Na in both grass and clover. Reductions in the order of .100 to .200% were quite frequent.

Magnesium sulphate also reduced sodium uptake in one of the two experiments in which it was used.

Potassium

The effects of fertilizers on the potassium uptake of grass and clover are shown in Table 28. Salt had no consistent effect on potassium uptake. Within each experiment there were both small rises and falls in % K. With the exception of the clover in Experiment 1, no effect was greater than ± 0.13%.

Ammonium sulphate had variable effects, primarily concerned with the time of sampling. It generally increased the % K in the early stages and subsequently reduced it - primarily because of the extra drain on soil potassium caused by the increase in yield.

Superphosphate stimulated potassium uptake in Experiment 1, but had either no influence or a slight depressive one in the other three.

Potassium chloride itself increased the % K in both grass and clover at each cut in all experiments by between 0.25^{**} and 0.55^{**}%. Most of the increments were quite consistent at about 0.45^{**} to 0.55^{**}%. There were regular interactions involving potassium.

Table 28. Grass Experiments Dry Matter Composition % K.

EXPERIMENT		Mean %		Differential Responses										Consistent Interactions					
				Sodium		Magnesium		Nitrogen		Phosphorus		Potassium		K S		N K		P K	
		Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover
1.	A	3.36	3.12	.13	.10	-	-	.74**	.19**	.30**	.27**	.48**	.37**	-.42**	-.30**	.51**	.25**	.08	.05
	B	2.25	2.85	.11	-.38*	-	-	.22*	-.13	.19*	.24	.40**	.51**	-.25**	-.30**	.52**	.30**	.11	.08
	C	1.87	1.90	-.11*	-.16	-	-	-.46**	-.22*	.06	.32**	.20**	.33**	-.09	-.07	.21**	.03	.01	.04
	D	2.40	1.86	-.02	.17	-	-	-.28**	-.25**	.05	.14	.29**	.42**	-.09	.17*	.26**	.20*	.04	.18*
2.	A	2.23	-	.12	-	-	-	.33	-	-.01	-	.58**	-	-.23	-	.38*	-	.07	-
	B	1.55	-	.00	-	-	-	.17	-	.02	-	.33*	-	-.24	-	.09	-	-.09	-
	C	1.76	-	-.08	-	-	-	-.15	-	.05	-	.21*	-	-.12	-	.15	-	.02	-
3.	A	1.63	1.85	.01	.06	-.01	-.07	.06	.08	-.13	-.05	.24**	.53**	-.07	.00	.06	-.14	.03	.07
	B	1.96	1.65	.02	.02	.05	.11	-.15*	-.05	-.03	-.05	.24**	.44**	-.13*	-.10	.21**	-.03	.02	.04
	C	2.43	1.86	-.04	.05	-.04	.08	-.75**	-.22**	.04	.01	.59**	.55**	-.01	.11	.13	.00	.11	.06
	D	2.09	1.55	-.04	.01	.09	.11	-.71**	-.20*	-.11	.00	.53**	.47**	.10	-.03	.09	-.09	-.02	.04
4.	A	1.09	-	-.01	-	.03	-	-.09**	-	-.06*	-	.44**	-	-.03	-	.22**	-	.00	-
	B	1.05	-	.03	-	.06	-	.04	-	-.02	-	.38**	-	-.03	-	.18**	-	.05	-
	C	1.03	-	.06	-	-.01	-	.00	-	-.03	-	.41**	-	-.14**	-	.11**	-	.02	-

The KS interactions were negative and frequently significant. Potassium chloride thus has a greater effect in the absence of salt and vice versa. The NK interactions were quite large and positive and there were smaller PK interactions.

Magnesium sulphate did not influence potassium uptake.

Calcium

Table 29 summarises the data on the calcium contents of grass and clover.

Table 29. Grass Experiments. Dry Matter Composition % Ca.

	Mean %		Differential Responses									
			Salt		Magnesium		Nitrogen		Phosphorus		Potassium	
Expt.	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover
1. A	.634	2.03	-.049**	-.06	-	-	-.018	-.22**	.023	-.02	-.026*	-.06
B	.510	1.82	-.007	-.04	-	-	.008	-.34**	.003	-.01	-.018	.00
C	.487	1.85	.000	.06	-	-	-.018	.07	-.013	.01	-.027	.06
D	.567	2.19	.007	.08*	-	-	-.016	.13**	.004	.06	-.010	-.03
2. A	.416	-	-.016	-	-	-	.027	-	.026	-	-.002	-
B	.325	-	-.017	-	-	-	.048*	-	.022	-	.005	-
C	.405	-	-.043**	-	-	-	-.044*	-	.017	-	-.026	-
3. A	.450	2.03	-.005	-.12	-.018	.00	.035*	-.14	-.006	-.02	-.022	.01
B	.628	1.70	.041	-.06	-.066**	.00	.031	-.03	-.020	.00	.033	.01
C	.687	1.85	-.001	-.01	-.036	.05	-.003	-.02	.016	.04	-.038	-.06
D	.738	1.83	-.038	.03	-.012	-.01	.082**	.04	.006	-.05	.003	-.07
4. A	.361	-	-.037**	-	-.003	-	.018	-	.013	-	-.010	-
B	.458	-	-.052*	-	.012	-	.088**	-	.011	-	.007	-
C	.620	-	.009	-	.000	-	-.017	-	.023	-	-.012	-

There were no consistent interactions.

Salt generally reduced the % Ca in both grass and clover by amounts ranging up to about .040%.

Ammonium sulphate had no regular influence. There were both increases and decreases within each experiment.

Superphosphate also had little effect.

Potassium chloride reduced calcium uptake, but by amounts which did not reach significance.

Magnesium sulphate appeared to depress the % Ca in Experiment 3 but to have little effect on the clover.

<u>Magnesium</u>

A summary of the results for magnesium is given in Table 30. The % Mg in the grass increased as the season progressed but fell slightly in the clover.

Salt consistently depressed magnesium uptake. In the grass it reached significance in all experiments at the third or fourth sampling by amounts in the order of -.015 to -.020%.

Ammonium sulphate invariably increased the % Mg in both grass and clover. There were significant increases in the order of .020 to .040% in all experiments. In Experiments 1 and 2 there were increases only in the early samples where ammonium sulphate increased the yield of grass.

Superphosphate normally reduced the magnesium uptake by about .005%.

Potassium chloride also reduced the % Mg in a similar manner to salt, the amounts being about .020% lower. Generally the effect was

Table 30. Grass Experiments. Dry Matter Composition % Mg.

EXPERIMENT		Mean %		Differential Responses.										Consistent Interactions.					
				Sodium		Magnesium		Nitrogen		Phosphorus		Potassium		K S		N K		P K	
		Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover
1.	A	.115	.260	-.003	-.028	-	-	.030**	.025	-.010*	-.003	-.005	-.009	.006	.010	-.016*	.004	.005	-.007
	B	.092	.227	.001	-.006	-	-	.015**	-.002	-.008*	-.020**	-.001	-.001	-.002	.006	.004	-.004	.002	-.006
	C	.097	.229	-.008*	.003	-	-	-.003	.020	-.007*	-.014	-.009**	-.006	.004	.012	.000	-.007	-.001	-.019
	D	.129	.218	-.017*	-.005	-	-	-.002	.017	-.003	-.019	-.001	-.001	.013*	.017	-.002	.013	-.010	-.007
2.	A	.095	-	-.006	-	-	-	.028**	-	.007	-	.000	-	-.002	-	-.011*	-	-.005	-
	B	.078	-	-.009	-	-	-	.015*	-	.002	-	-.004	-	-.009	-	-.002	-	.002	-
	C	.105	-	-.013**	-	-	-	-.004	-	.003	-	-.008*	-	.002	-	-.008*	-	-.001	-
3.	A	.090	.221	-.006	-.007	.001	.017**	.002	-.021**	-.002	-.002	-.004	-.014*	.008	.001	.004	.006	.004	-.007
	B	.154	.229	-.005	-.012*	-.008	.000	.016*	.014**	-.007	-.005	-.023**	-.019**	.009	.012*	.007	-.007	-.001	-.010
	C	.180	.259	-.005	.003	-.003	.006	.015*	.019**	-.002	-.006	-.023**	-.024**	.022**	.025**	-.006	.004	-.016*	-.003
	D	.177	.207	-.013*	-.001	-.001	.005*	.043**	.006	.007	-.002	-.019**	-.010**	.011*	-.004	.000	.006*	-.007	-.003
4.	A	.091	-	-.003	-	.013*	-	.001	-	-.007	-	-.003	-	-.005	-	-.001	-	-.005	-
	B	.119	-	-.013*	-	.014*	-	.038**	-	-.002	-	-.009	-	-.023**	-	-.012*	-	-.006	-
	C	.135	-	-.026*	-	.025*	-	.048**	-	-.006	-	-.030*	-	-.004	-	-.024**	-	-.010	-

most pronounced in the later cuts. There were marked and regular KS interactions which were usually positive, indicating that the depressive influences of salt and potassium chloride are additive. There were also frequent significant negative NK interactions and smaller PK ones.

Magnesium sulphate itself markedly increased the % Mg in Experiment 4 but only increased the level in the clover of Experiment 3.

Phosphorus

The results for phosphorus are summarised in Table 31.

Salt had little effect on phosphorus uptake. It tended to increase the % P in the grass by under .010% and to reduce it in the clover.

Ammonium sulphate had irregular effects. There were significant increments and reductions from one experiment to another. Phosphorus levels fell very significantly in Experiments 1 and 3 at the third and fourth samplings.

Superphosphate normally increased phosphorus uptake in both grass and clover by amounts in the order of .020% P.

Potassium chloride showed no consistent trend.

Magnesium sulphate reduced phosphorus uptake slightly in the two experiments in which it was used.

Table 31. Grass Experiments Dry Matter Composition % P.

EXPERIMENT		Mean %		Differential Responses.									
				Sodium		Magnesium		Nitrogen		Phosphorus		Potassium	
		Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover	Grass	Clover
1.	A	.280	.320	.002	-.016	-	-	.000	.027*	.022*	.038**	-.010	-.016
	B	.256	.222	.007	-.010	-	-	.005	.032*	.023	.017	-.016	-.015
	C	.219	.137	.005	-.006	-	-	-.049**	-.025*	.004	.000	-.005	.000
	D	.264	.163	.021	-.014*	-	-	-.039**	-.027**	-.019	-.016*	-.012	.007
2.	A	.272	-	.008	-	-	-	.046**	-	.026	-	-.008	-
	B	.171	-	-.001	-	-	-	.037**	-	.025*	-	-.004	-
	C	.183	-	.000	-	-	-	.001	-	.011	-	.011	-
3.	A	.175	.162	.000	-.020**	-.007	-.005	.000	-.018**	.013	.013*	.002	.009
	B	.193	.188	.008	.000	.003	.000	-.012	-.001	.010	.009	-.005	-.003
	C	.246	.194	.012	-.025*	-.001	-.021*	-.071**	-.006	.014	.003	-.003	.010
	D	.238	.223	.009	.006	-.006	-.009	-.051**	-.004	.009	.005	.004	.035**
4.	A	.160	-	.007	-	-.007	-	.005	-	.013*	-	.006	-
	B	.177	-	.008	-	-.003	-	.005	-	.026**	-	.011	-
	C	.163	-	.004	-	.004	-	.001	-	.019**	-	-.004	-

There were no marked or consistent interactions.

DISCUSSION

CROP YIELDS

(a) Comparative Effects of Sodium and Potassium Chlorides.

It has not been possible to find soils which were markedly deficient in readily soluble potassium in the vicinity of Glasgow for these experiments. Kale is normally grown close to the farmstead to facilitate winter feeding and such fields are normally more fertile than the remainder of the farm. Nevertheless, in spite of this limitation, responses to salt have been found in kale, turnips and grass under normal soil conditions. Table 32 summarises the responses obtained from sodium and potassium chlorides in each case.

Five of the six kale experiments and three of the four with turnips have given positive responses to salt even although only one in each group responded significantly to potassium chloride. In four of the kale experiments the responses to salt were some 100% greater than those from potassium chloride and in two of the turnip trials salt was outstandingly better than potassium chloride.

In the grass experiments, salt did not increase yields as much as did potassium chloride and there was severe scorch damage to the clover in one case. Nevertheless, in the two experiments which responded well to potassium there were signs of smaller returns from salt. It will be of interest to follow the yields of herbage in Experiments 3 and 4 during their continuation under the same treatments as potassium deficiency progressively affects growth.

Table 32. Responses to Sodium and Potassium Chlorides.

EXPERIMENT		Response to		K S	Potassium
		Sodium	Potassium	Interaction	Status
KALE (tons)	1	0.87*	0.48	-1.43	Low
	2	0.95*	0.50	-3.00**	Low
	3	0.97*	0.42	-0.39	Satisfactory
	4	1.27	0.83	0.62	Low
	5	1.06	3.40**	-0.32	Low
	6	-0.35	0.62	0.28	Satisfactory
TURNIPS (tons) Roots	1	2.88	0.23	-0.99	Satisfactory
	2	2.22	0.47	-1.92	Low
	3	0.73	1.17*	-0.01	Satisfactory
	4	-0.35	0.90	-1.63*	Low
HERBAGE (cwt) Total D.M.	1B	-1.73	-1.37	0.06	Satisfactory
	1C	-2.16	-1.56	-1.40	Satisfactory
	2B	1.39	2.18*	-0.94	Low
	2C	0.46*	0.37*	-0.24	Low
	3A	-1.86	0.02	-0.89	Satisfactory
	3B	-0.16	-0.28	0.11	
	3C	-0.27	0.90	-0.72	
	3D	-0.13	0.71*	-0.66*	
	4A	-0.08	1.00	-0.25	Low
	4B	1.24*	2.08**	-1.42**	
	4C	0.38	3.28**	-0.72**	

The general similarity between sodium and potassium for these three crops is further shown by the consistent negative KS interactions. These were found in four of the six kale experiments, all four of those with turnips and in thirteen of the fifteen grass cuts. In each case they were quite large in relation to the salt and potassium chloride responses. In the first two kale experiments they were of such size that salt reduced yields in the presence of potassium chloride.

These experiments therefore show that salt has some value as a fertilizer for the three crops investigated even although the soils were not acutely deficient in readily soluble potassium. In almost every case the salt was much more effective in the absence of potassium chloride and there is thus reason for supposing that considerably greater responses may be obtained when the soil is very deficient in potassium.

(b) Salt and Superphosphate

Table 33 summarises the responses from salt and superphosphate on kale and turnips. There were no responses to superphosphate in the grass experiments.

Although the experiments were generally sited on soils where there were significant responses to superphosphate, there was no pronounced trend to show negative PS interactions such as would be expected if salt enabled the plant to make better use of soil phosphorus.

The PS interactions for kale were quite small and only in Experiment 1 where it reached -1.37 tons does it seem important. Negative interactions were found in three of the four turnip experiments, the remaining one being +1.65 tons. Experiment 4 with a negative PS interaction of -2.61^{**} tons and a large response to superphosphate did enable the effects of salt in the absence of superphosphate to be seen clearly in the field. Equally, the response here to superphosphate was increased greatly in the absence of salt ($+7.63^{**}$ tons compared with its effect in association with salt of $+2.41^{**}$ tons).

Table 33. Responses to Salt and Superphosphate (tons).

EXPERIMENT		Response to Salt	Response to Superphosphate	P S Interaction	Phosphorus Status
KALE	1	0.87^{*}	2.85^{*}	-1.37	Deficient
	2	0.95^{*}	1.27	0.29	Low
	3	0.97^{*}	0.34	0.20	Satisfactory
	4	1.27	4.71^{**}	0.05	Deficient
	5	1.06	7.11^{**}	-0.15	Deficient
	6	-0.35	1.28^{**}	-0.55	Low
TURNIPS	1	2.88	-0.67	-0.69	Satisfactory
	2	2.22	7.17^{**}	1.65	Deficient
	3	0.73	1.37^{**}	-0.65	Low
	4	-0.35	5.02^{**}	-2.61^{**}	Deficient

Examinations were made of the soils from the individual plots of this experiment at the end of the season. Extraction of phosphorus by both citric and acetic acids did not reveal any greater content of available phosphorus on the plots with salt.

There is thus no consistent trend to show that salt enables the plant to make better use of phosphate, although two individual experiments did show large negative PS interactions.

EFFECTS ON PLANT COMPOSITION

(a) SODIUM

The sodium content of the three crops investigated has been the most variable of the mineral consituents. Salt, ammonium sulphate and frequently superphosphate have enhanced the uptake whilst potassium chloride has seriously depressed it. All parts of the plant are affected in the same manner and very wide differences in the sodium level may be found in the one experiment resulting from the different treatments.

Table 34. Extreme Sodium Contents of Individual Plots.

Na. %

EXPERIMENT			1	2	3	4	5	6
KALE	Leaf	Min.	.110	.090	.030	.095	.065	.040
		Max.	.885	.950	.825	1.270	1.070	.405
	Stem	Min.	.115	.110	.025	.110	.105	.025
		Max.	.820	.875	.800	1.520	.850	.205
TURNIPS	Tops	Min.	.077	.055	.095	.200	-	-
		Max.	.315	.265	.462	.700	-	-
	Roots	Min.	.030	.332	.045	.050	-	-
		Max.	.200	.900	.255	.280	-	-
HERBAGE	Grass	Min.	.022	.015	.045	.035		
		Max.	.800	.750	.990	.725	as extremes	
	Clover	Min.	.025	-	.125	-	of all cuts.	
		Max.	.332	-	.455	-		

These variations (Table 34) are very large when considered in relation to the changes in composition such as may occur with other elements. Even under exceptional conditions of deficiency and adequacy it is rare to find the % K, Ca, Mg, P and other elements in plants varying by more than a fctor of 3 or 4 and usually by very much less. The sodium minima and maxima vary between a factor of 8 and 30 for kale, between 20 and 60 for grass, 3 and 16 for clover and 3 and 17 for turnips. The higher values for the first two are associated with the effects which nitrogen have on sodium uptake for responsive crops compared with its small influence on turnips and clover.

Salt and potassium chloride have directly opposite effects on sodium uptake for all three crops. Reference to Tables 15, 21 and 27 show that in every experiment the positive influence of salt and the negative effect of potassium chloride on the % Na have been very large and significant ($P = 0.01$). In each case amounts in the order of 0.1 or 0.2% Na or more have been involved which are generally in the order of at least 50% of the mean. In the kale experiments, 3 cwt of potassium chloride normally reduced sodium uptake by a greater amount than the increase from 4 cwt of salt. In the turnip and grass experiments, 2 cwt of potassium chloride and 4 cwt of salt had broadly equal effects. There were frequent and large negative KS interactions for the kale experiments but not for the other crops.

It is thus apparent that sodium from sodium chloride can enter the plant readily in greatly increased quantity provided that it is not in competition with potassium chloride. When given together, the net effect on sodium uptake is small as potassium is the preferred element.

There would not appear to be a great deal of practical significance in the depressive effect on % Na brought about by potassium chloride for these crops. Potassium chloride itself invariably increases the % K and this is no doubt partly at the expense of sodium. Crowther (1945) has however reported that small reductions of between 0.1 and 0.2 cwt. of sugar per acre were found as a mean of 28 experiments with potassium chloride on sugar beet where the soil potassium status was already good ($>$ 16 mgs.% K_2O soluble in 1% citric acid). This should be compared with a gain of 1.2 cwt. of sugar as a mean for 23 soils with analyses between 12 and 16 mgms.% K_2O. (Superphosphate applied to soils high in readily soluble phosphate increased yields by almost 1 cwt of sugar which was substantially the same as those with medium phosphate contents.) Pizer (1952) has also reported reductions in the yield of sugar beet from applications of potassium chloride to soils of high potassium status. It is not unreasonable to suppose that under such circumstances that the supply of sodium (which is an important nutrient for sugar beet) is severely restricted by competition from potassium.

Magnesium sulphate in the two grass experiments in which it was used has also reduced sodium levels to a small extent.

The sodium content of the three crops has also been controlled by the supply of ammonium sulphate, and to a less extent by superphosphate. So long as these fertilizers increase growth, there is an accompanying increase in the sodium uptake. Table 35 shows the main effects of ammonium sulphate and superphosphate on the yield and sodium contents.

Table 35. Effects of Ammonium Sulphate and Superphosphate on Yield and Sodium Uptake.

			Nitrogen		Phosphorus	
			tons	%Na	tons	%Na
KALE	1	Leaf	4.29**	.154**	2.85**	.059**
		Stem		.210**		.070**
	2	Leaf	6.25**	.297**	1.27	.037
		Stem		.286**		.013
	3	Leaf	7.75**	.309**	0.34	-.026
		Stem		.266**		-.041
	4	Leaf	-	-	4.71**	.008
		Stem		-		-.041
	5	Leaf	1.93**	-.065**	7.11**	.124**
		Stem		-.060*		.115**
	6	Leaf	2.02**	.082**	1.28**	-.001
		Stem		.056**		-.008
TURNIPS	1	Tops	-	-	-0.44	-.046*
		Roots	-	-	-0.67	-.024
	2	Tops	-	-	0.67	.028
		Roots	-	-	7.17**	.015
	3	Tops	0.22	.025	0.22*	.050*
		Roots	-0.28	.018	1.37**	.023
	4	Tops	0.14	.011	0.97**	.042
		Roots	0.58	-.015	5.02**	.020

		Nitrogen		Phosphorus	
		cwt D.M.	%Na	cwt D.M.	%Na
GRASS	1A	14.50**	.179**	0.76	-.046
	B	7.84**	.039**	0.54	-.017
	C	nil.	.006	-	-
CLOVER	1B	-2.58**	-.007	0.44	-.009
	C	-6.51**	.030	0.68	-.029
GRASS	2B	7.84**	.239**	0.49	-.009
	C	0.69	.035*	-0.26	-.001
GRASS	3A	15.08**	.087**	1.36	-.005
	B	9.17**	.248**	-0.09	-.021
	C	11.86**	.432**	0.66	-.016
	D	4.08**	.392**	0.07	-.039
CLOVER	3A	-2.14**	.065*	0.24	.004
	B	-4.48**	.066**	-0.06	.002
	C	-4.89**	.111**	-0.06	.024
	D	-1.08	.088**	0.02	-.010
GRASS	4A	15.39**	.146**	0.05	.015
	B	9.95**	.257**	0.81	.028
	C	6.00**	.352**	0.34	.034

Ammonium sulphate markedly increased the % Na in all the kale experiments except No. 5, and the increases were greater where the yield increment was most. It had no effect on yield in the turnip experiments and it consequently had little influence on the sodium uptake. It increased the % Na in all the grass experiments in every case where it increased yields. The anomolous results for clover may perhaps be explained on the basis that whereas nitrogen depressed the clover yield, individual surviving plants made better growth. The increases in sodium uptake resulting from ammonium sulphate were comparable in size to those from salt.

In the grass, the NK interactions were generally negative and the NS ones positive for the % Na. Four of the five NK interactions with kale were also negative.

The effect of superphosphate on sodium uptake has been less pronounced and more irregular. It increased the % Na most in the two kale experiments where it had the greatest effect on yield. There were only small increments in the turnip experiments and no effect on the grass which did not respond in yield.

There is thus evidence to suggest that the sodium level is enhanced when some other factor, especially nitrogen, and with less certainty phosphate, increases yield. This may be due to a definite need of the plant, or perhaps, in a sense, be accidental. Increased growth is normally associated with reduced dry matter contents and greater water uptake and theremay be secondary influences on root size and permeability.

Scharrer and Jung (1957) have recently published the results of pot experiments with maize to investigate the effects on mineral composition of sodium, potassium and calcium supplied as different anions, - the nitrates, sulphates, bicarbonates, phosphates and chlorides. They found that anions important in plant nutrition such as nitrate and phosphate promote the penetration into plants of cations (e.g. Na) for which there is normally a small requirement, but the uptake of potassium, due to its essential nature, was unaffected by the anion.

These experiments therefore indicate that data regarding the uptake of sodium supplied as sodium nitrate should be interpreted with caution as some large portion may be due to the nitrate.

It is difficult to follow the arguments of Frens (1955) who blames the scouring of cattle consuming young luscious grass on inadequate amounts of sodium (and perhaps copper) in the diet which leads to water resorptive difficulties. t'Hart (1956) has also suggested that heavy nitrogen fertilization of grass may induce grass tetany by (amongst other things) depressing the sodium uptake of the herbage.

The present experiments and those of Stewart and Holmes (1953) conclusively show that intensively manured grass has a much higher sodium content than similar herbage grown without nitrogen.

(B) POTASSIUM

Reference to Tables 16, 22 and 28 shows that potassium chloride has been universally effective in increasing the % K in kale, turnips, grass and clover by large and significant (P = 0.01) amounts. The increments in grass and clover have normally been in the order of 0.25 to 0.60% K at all stages. There have been increments ranging between 0.25 and 1.0% K in the kale and from about 0.1 to 0.5% in turnips. Potassium clearly enters the plant easily and in increased amounts with additional supplies.

Salt has had very little influence on potassium uptake. In kale and turnips there has been an almost equal division between small increases and reductions in the order of 0.1% K or less. Only rarely was this amount exceeded. Similar, but perhaps smaller, effects were observed in grass.

In view of the great depressive effects of potassium chloride on sodium uptake, it is not at all unexpected to find that salt has such a small influence on potassium uptake. On the other hand, it might have been the case that salt should reduce the % K as it so greatly increases the sodium content of the dry matter. In the grass and clover and turnips, but not with kale, there were generally negative KS interactions indicating that salt has a tendency to increase the % K when no potassium chloride is given, but to depress it when both are applied together.

The influence of salt on potassium uptake is therefore exceedingly small compared with the influence of potassium on the sodium content of crops.

Ammonium sulphate has had little consistent effect on the potassium contents of either kale or turnips. It might perhaps have been expected to reduce it in view of the large increase in sodium uptake. The effect is also hard to follow in grass as the yield stimulus in the early cuts increases the % K but is followed by a reduction in potassium consequent upon the removal of large amounts from the soil compared with the untreated plots.

There were frequent positive and significant NK interactions for the grass experiments, but these tended to be negative and much smaller in kale.

(C) CALCIUM

Throughout all the experiments, the calcium contents have been remarkable for the small variations caused by fertilizer applications.

Reference to Tables 17, 23 and 29 shows that salt and potassium chloride have normally reduced calcium uptakes. Only rarely however have the decreases been significant and they have generally been considerably less than -0.05% Ca. Ammonium sulphate had irregular effects in the order of ±0.05% or less.

There is thus little expectation that application of sodium and NP fertilizers have a serious adverse effect on the calcium content of these three crops which provide the bulk of the food of animals on many farms, but naturally the calcium content of herbage falls considerably as the clover content is reduced.

(D) MAGNESIUM

Fertilizers have not greatly affected the magnesium content of the three crops (Tables 18, 24 and 30).

Salt has normally reduced magnesium uptakes by amounts in the order of -.005% Mg. Only rarely has this level been exceeded and then to the greatest extent in the later grass cuts when the reductions reached significance at about -.013*% to -.025*%.

Potassium chloride behaved in a similar manner. It reduced magnesium levels in turnips and kale by about .005 to .010% and in the grass experiments by amounts of up to .030%. Significant reductions were found in each of the grass experiments, but only infrequently in the other crops.

The fall in magnesium uptake resulting from potassium chloride is well known and these experiments show that salt has similar antagonistic effects.

Ammonium sulphate and superphosphate have had very small and irregular effects in turnips and kale, with the exception that nitrogen generally increased the uptake of magnesium by kale. Ammonium sulphate invariably increased the % Mg in grass, frequently by significant amounts in the order of .015 to .045%.

(E) PHOSPHORUS

Tables 19, 25 and 31 summarise the effects of fertilizers on the uptake of phosphorus.

Superphosphate has normally increased the % P in all crops. In the case of grass and clover only small effects in the order of .010 to .025% P were observed and in only one experiment were the increases significant at each cut. In kale there have been significant increments of about .030% in four of the six experiments and in turnips the uptakes have been enhanced by amounts ranging up to .050% in the tops and .067% in the roots.

Salt has had little effect on the phosphorus content of grass, rises of up to about .010% being generally found and it normally reduced the level in clover by up to -.025%, perhaps because of its adverse influence on yield. Salt had irregular effects on kale; there were increments and reductions in the order of ±.020% which frequently reached significance.

Salt did however increase the % P in all four turnip experiments and in Experiment 4 there were particularly large and significant negative PS interactions for both roots and tops as there were for yield. This led to the following increases in phosphorus content.

% P. Increments.

	Mean	Superphosphate No Salt	Superphosphate Salt	Salt No Superphosphate	Salt Superphosphate
Tops	.194	.075**	.027	.048**	.000
Roots	.161	.041**	.018**	.019**	-.008

There is thus a clear effect of salt on increasing the phosphorus uptake as well as the yield in the absence of superphosphate in this experiment; but other sites which were equally phosphorus deficient did not show similar trends, the PS interactions being very small.

There is thus little support for the view that salt generally enhances phosphorus uptake.

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THE EFFECTS OF FERTILIZERS ON THE YIELD AND COMPOSITION OF FORAGE CROPS WITH SPECIAL REFERENCE TO SODIUM

by

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Appendix

KALE. EXPERIMENT 1.

	FRESH YIELD. tons			DRY MATTER tons			% D.M.		LEAF. % D.M.					STEM. % D.M.				
	Total	Leaf	Stem	Total	Leaf	Stem	Leaf	Stem	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
1 N1P0K0S0	15.08	9.40	5.68	1.876	1.194	.682	12.7	12.0	.240	2.20	2.00	.110	.300	.235	3.40	0.82	.166	.300
S1	17.20	9.90	7.30	1.966	1.148	.818	11.6	11.2	.750	2.20	2.42	.146	.275	.550	3.55	0.82	.174	.360
2 N1P1K2S0	19.74	13.19	6.55	2.323	1.517	.806	11.5	12.3	.355	2.65	2.26	.110	.325	.260	3.30	0.71	.160	.335
S1	20.30	12.90	7.40	2.228	1.458	.770	11.3	10.4	.450	2.15	2.32	.136	.300	.360	3.50	0.76	.166	.365
3 N0P0K1S0	14.30	9.55	4.75	1.616	1.070	.546	11.2	11.5	.190	2.90	2.36	.150	.245	.135	3.50	0.79	.182	.280
S1	15.40	9.36	6.04	1.762	1.082	.676	11.6	11.2	.200	3.00	2.00	.090	.300	.150	3.70	0.96	.140	.290
4 N2P2K0S0	22.20	13.40	8.80	2.260	1.367	.893	10.2	10.2	.555	2.60	2.42	.126	.285	.530	3.30	0.76	.166	.300
S1	22.48	12.62	9.86	2.425	1.439	.986	11.4	10.0	.805	2.40	2.00	.110	.315	.820	3.50	0.92	.132	.285
5 N2P0K2S0	15.50	9.33	6.17	1.755	1.064	.691	11.4	11.2	.245	2.75	2.12	.130	.260	.240	3.90	0.88	.182	.215
S1	18.80	11.20	7.60	1.933	1.120	.813	10.0	10.7	.265	2.65	2.24	.140	.300	.290	3.85	1.01	.164	.300
6 N1P2K1S0	16.62	8.61	8.01	1.796	0.947	.849	11.0	10.6	.375	2.35	2.20	.150	.300	.340	3.70	0.96	.196	.255
S1	19.04	11.88	7.16	2.107	1.319	.788	11.1	11.0	.420	2.25	2.12	.120	.290	.340	3.50	0.86	.132	.285
7 N0P2K2S0	18.26	9.88	8.38	2.170	1.156	1.014	11.7	12.1	.125	2.95	2.00	.130	.275	.150	3.50	0.86	.156	.300
S1	16.56	9.91	6.65	1.970	1.159	.811	11.7	12.2	.285	3.15	1.76	.118	.270	.145	3.40	0.76	.130	.340
8 N0P1K0S0	16.12	9.52	6.60	1.899	1.114	.785	11.7	11.9	.285	2.45	2.30	.102	.295	.220	3.05	0.86	.140	.300
S1	16.72	11.32	5.40	1.929	1.324	.605	11.7	11.2	.625	2.25	2.06	.140	.320	.370	3.10	0.94	.150	.275
9 N2P1K1S0	20.48	12.57	7.91	2.152	1.345	.807	10.7	10.2	.355	2.60	2.42	.126	.300	.250	3.75	1.01	.156	.340
S1	21.70	12.36	9.34	2.247	1.248	.999	10.1	10.7	.395	2.40	2.14	.116	.330	.310	3.70	1.01	.140	.380
10 N2P0K0S0	16.06	8.48	7.58	1.721	0.933	.788	11.0	10.4	.440	2.75	2.52	.116	.270	.440	3.20	1.13	.140	.300
S1	18.82	11.34	7.48	2.063	1.225	.838	10.8	11.2	.775	2.25	2.00	.124	.305	.800	3.10	0.92	.150	.360
11 N0P2K0S0	17.20	9.65	7.55	2.000	1.109	.891	11.5	11.8	.365	2.25	2.22	.142	.325	.245	3.00	0.96	.160	.350
S1	20.56	12.87	7.69	2.413	1.506	.907	11.7	11.8	.560	2.45	2.24	.136	.345	.385	3.20	0.86	.138	.355
12 N1P2K2S0	23.64	13.74	9.90	2.628	1.539	1.089	11.2	11.0	.330	3.00	2.38	.146	.325	.225	3.60	1.01	.166	.395
S2	21.78	12.68	9.10	2.419	1.382	1.037	10.9	11.4	.455	2.65	1.90	.138	.290	.340	3.50	0.88	.150	.380
13 N2P1K2S0	19.14	11.34	7.80	1.990	1.179	.811	10.4	10.4	.250	2.60	2.02	.120	.320	.260	3.45	0.86	.156	.300
S1	19.68	10.13	9.55	2.017	1.033	.984	10.2	10.3	.350	2.60	2.44	.126	.345	.280	3.60	0.86	.140	.355
14 N0P1K1S0	15.06	9.47	5.59	1.667	1.013	.654	10.7	11.7	.345	2.60	2.16	.146	.290	.270	3.80	0.76	.174	.285
S1	15.74	8.91	6.83	1.756	0.971	.785	10.9	11.5	.395	2.95	1.92	.110	.300	.305	3.70	0.82	.138	.320
15 N1P0K1S0	15.08	8.96	6.12	1.617	0.986	.631	11.0	10.3	.290	2.65	2.20	.130	.220	.205	4.05	0.96	.192	.280
S2	17.48	10.95	6.53	1.929	1.237	.692	11.3	10.6	.440	2.35	2.40	.150	.260	.445	3.90	1.16	.158	.335
16 N1P1K0S0	17.18	9.34	7.84	1.874	1.027	.874	11.0	10.8	.455	2.55	2.20	.130	.350	.330	3.85	1.06	.166	.400
S1	17.28	11.36	5.92	1.917	1.272	.645	11.2	10.9	.725	2.35	2.36	.140	.315	.525	3.55	0.96	.170	.335
17 N0P0K2S0	16.06	9.05	7.01	1.959	1.104	.855	12.2	12.2	.110	2.95	2.40	.160	.250	.105	3.85	1.10	.164	.305
S1	16.50	9.08	7.42	1.980	1.090	.890	12.0	12.0	.185	2.45	2.36	.126	.305	.135	4.20	0.80	.208	.320
18 N2P2K1S0	19.20	11.42	7.78	2.050	1.256	.794	11.0	10.2	.265	2.15	2.12	.114	.345	.235	3.25	0.76	.140	.340
S1	21.94	11.64	10.30	2.340	1.269	1.071	10.9	10.4	.400	2.05	2.36	.130	.310	.470	3.45	1.13	.174	.340
19 N1P1K1S0	17.92	10.74	7.18	1.949	1.181	.768	11.0	10.7	.345	2.25	2.22	.090	.230	.325	3.50	0.86	.130	.240
S1	18.44	8.59	9.85	2.036	0.962	1.074	11.2	10.9	.450	1.85	2.32	.120	.290	.325	3.15	0.84	.150	.305
20 N0P1K2S0	14.40	7.48	6.92	1.736	0.913	.833	12.2	11.9	.125	2.55	1.82	.112	.275	.120	3.40	0.80	.134	.320
S1	14.44	7.22	7.22	1.719	0.874	.845	12.1	11.7	.245	2.55	2.42	.090	.260	.215	3.80	0.94	.134	.375
21 N1P2K0S0	17.74	9.79	7.95	1.963	1.096	.867	11.2	10.9	.450	2.05	2.32	.110	.255	.425	2.95	0.86	.130	.370
S1	18.84	10.92	7.92	2.096	1.256	.840	11.5	10.6	.655	1.80	1.92	.142	.305	.650	3.20	0.91	.144	.375
22 N0P0K0S0	12.66	6.60	6.06	1.538	0.805	.733	12.2	12.1	.225	2.20	2.40	.146	.235	.220	3.20	0.82	.154	.280
S1	13.88	9.28	4.60	1.675	1.123	.552	12.1	12.0	.395	1.85	2.60	.122	.240	.245	2.90	0.96	.198	.375
23 N0P2K1S0	15.84	8.72	7.12	1.904	1.064	.840	12.2	11.8	.120	2.55	2.02	.110	.260	.125	3.45	0.96	.152	.320
S1	12.54	5.64	6.90	1.477	0.677	.800	12.0	11.6	.265	2.20	2.42	.100	.275	.350	3.30	0.91	.118	.280
24 N1P0K2S0	14.36	7.18	7.18	1.572	0.804	.768	11.2	10.7	.220	2.35	2.36	.090	.275	.230	3.45	0.88	.170	.280
S1	16.84	9.42	7.42	1.855	1.046	.809	11.1	10.9	.235	2.60	1.86	.114	.300	.295	3.30	0.88	.142	.275
25 N2P2K2S0	20.58	11.73	8.85	2.137	1.243	.894	10.6	10.1	.340	2.55	2.16	.106	.275	.390	4.00	0.82	.162	.360
S1	21.68	12.88	8.80	2.276	1.378	.898	10.7	10.2	.345	2.50	2.22	.112	.265	.395	3.90	0.80	.134	.335
26 N2P0K1S0	21.10	11.49	9.61	2.273	1.264	1.009	11.0	10.5	.375	2.20	2.40	.132	.285	.310	3.65	0.96	.156	.305
S1	20.44	11.60	8.84	2.213	1.223	.990	11.2	10.6	.370	2.25	2.12	.102	.260	.295	3.50	1.00	.116	.290
27 N2P1K0S0	18.30	9.50	8.80	1.979	1.064	.915	11.2	10.4	.500	2.05	2.08	.140	.305	.525	3.20	0.80	.162	.325
S1	21.30	11.98	9.32	2.342	1.354	.988	11.3	10.6	.885	2.10	1.86	.090	.280	.820	3.00	0.90	.130	.325

TOTAL FRESH YIELD. (tons)

KALE. EXPERIMENT 1.

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 0.86)						± 0.50
Ammonium Sulphate	0	14.80	15.41	16.83	16.19	14.81	16.04	15.68
	4	16.01	18.48	19.62	17.23	17.43	19.44	18.03
	8	18.45	20.10	21.35	19.86	20.81	19.23	19.97
Superphosphate	0				15.62	17.30	16.34	16.42
	3				17.82	18.22	17.95	18.00
	6				19.84	17.53	20.42	19.27
Mean		16.42	18.00	19.27	17.76	17.68	18.24	17.89

S.E. per plot. 1.49 Sig. Diff. of means. Central. 5% 2.97 1% 4.50; Marginal. 5% 1.73 1% 2.62

Interactions NP + 0.43 NK - 0.24 PK - 0.07

Responses to Salt.

		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 1.13)						± 0.65
Ammonium Sulphate	0	+ 0.63	+ 0.41	+ 0.55	+ 1.73	- 0.51	- 0.73	+ 0.16
	4	+ 2.33	+ 0.39	+ 0.57	+ 1.12	+ 1.78	+ 0.39	+ 1.10
	8	+ 1.80	+ 1.59	+ 0.64	+ 2.01	+ 1.10	+ 0.91	+ 1.34
Superphosphate	0				+ 2.03	+ 0.95	+ 1.78	+ 1.59
	3				+ 1.23	+ 0.81	+ 0.35	+ 0.80
	6				+ 1.59	+ 0.62	- 1.55	+ 0.22
Mean		+ 1.59	+ 0.80	+ 0.22	+ 1.62	+ 0.79	+ 0.19	+ 0.87*

S.E. per plot. 1.96 Sig. Diff. of means. Central. 5% 3.68 1% 5.36; Marginal. 5% 2.12 1% 3.08

Interactions NPS + 0.01 NKS + 0.68 PKS - 1.44; NS + 1.18 KS - 1.43 PS - 1.37

TOTAL DRY MATTER YIELD. (tons)

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 0.108)						±0.062
Ammonium Sulphate	0	1.755	1.785	1.989	1.909	1.697	1.922	1.843
	4	1.786	2.055	2.170	1.949	1.907	2.154	2.003
	8	1.993	2.121	2.248	2.132	2.213	2.018	2.121
Superphosphate	0				1.807	1.902	1.825	1.845
	3				1.990	1.968	2 .002	1.987
	6				2.193	1.947	2.267	2.136
Mean		1.845	1.987	2.136	1.997	1.939	2.092	1.989

S.E. per plot. 0.186 Sig. Diff. of means. Central. 5% .374 1% .566; Marginal. 5% .215 1% .325

Interactions NP + 0.011 NK - 0.064 PK + 0.028

Responses to Salt.

		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .125)						± .072
Ammonium Sulphate	0	+ .101	+ .034	- .071	+ .193	- .064	- .065	+ .022
	4	+ .228	+ .012	+ .078	+ .089	+ .237	- .007	+ .106
	8	+ .153	+ .162	+ .198	+ .290	+ .108	+ .115	+ .182
Superphosphate	0				+ .189	+ .133	+ .161	+ .161
	3				+ .145	+ .090	- .028	+ .069
	6				+ .237	+ .058	- .090	+ .068
Mean		+ .161	+ .069	+ .068	+ .191	+ .094	+ .014	+ .099*

S.E. per plot. .217 Sig. Diff. of means. Central. 5% .391 1% .568; Marginal. 5% .225 1% .327

Interactions NPS + .108 NKS + .041 PKS - .150; NS + .160 KS - .177 PS - .093

KALE. EXPERIMENT 1.

% Na. LEAF.

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .028)						± .016
Ammonium Sulphate	0	.234	.337	.287	.409	.253	.196	.286
	4	.363	.464	.448	.547	.387	.341	.425
	8	.412	.456	.451	.660	.360	.299	.440
Superphosphate	0				.471	.311	.227	.336
	3				.580	.381	.296	.419
	6				.565	.308	.313	.395
Mean		.336	.419	.395	.539	.333	.279	.383

S.E. per plot. .049 Sig. Diff. of means. Central. 5% .097 1% .147; Marginal. 5% .055 1% .084

Interactions NP + .007 NK – .074 PK – .004

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .040)						± .023
Ammonium Sulphate	0	+ .085	+ .170	+ .167	+ .235	+ .068	+ .118	+ .141
	4	+ .225	+ .157	+ .125	+ .328	+ .100	+ .078	+ .169
	8	+ .123	+ .175	+ .130	+ .330	+ .057	+ .042	+ .143
Superphosphate	0				+ .345	+ .052	+ .037	+ .144
	3				+ .332	+ .065	+ .105	+ .167
	6				+ .217	+ .108	+ .097	+ .141
Mean		+ .144	+ .167	+ .141	+ .298	+ .075	+ .079	+ .151**

S.E. per plot. .069 Sig. Diff. of means. Central. 5% .130 1% .190; Marginal. 5% .075 1% .109

Interactions NPS – .037 NKS – .085 PKS + .094; NS – .002 KS – .218** PS – .003

% Na. STEM.

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .023)						± .013
Ammonium Sulphate	0	.165	.250	.232	.279	.222	.145	.216
	4	.327	.354	.387	.453	.330	.285	.356
	8	.396	.407	.473	.656	.312	.309	.426
Superphosphate	0				.415	.257	.216	.296
	3				.464	.298	.249	.337
	6				.508	.310	.274	.363
Mean		.296	.337	.363	.463	.288	.247	.332

S.E. per plot. .039 Sig. Diff. of means. Central. 5% .080 1% .121; Marginal. 5% .045 1% .068

Interactions NP + .005 NK – .106* PK – .017

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .052)						± .030
Ammonium Sulphate	0	+ .023	+ .093	+ .120	+ .105	+ .092	+ .040	+ .079
	4	+ .207	+ .098	+ .113	+ .245	+ .080	+ .093	+ .139
	8	+ .132	+ .125	+ .177	+ .315	+ .093	+ .025	+ .144
Superphosphate	0				+ .233	+ .080	+ .048	+ .121
	3				+ .213	+ .032	+ .072	+ .106
	6				+ .218	+ .153	+ .038	+ .137
Mean		+ .121	+ .106	+ .137	+ .222	+ .088	+ .053	+ .121**

S.E. per plot. .090 Sig. Diff. of means. Central. 5% .169 1% .246; Marginal. 5% .098 1% .142

Interactions NPS – .026 NKS – .113 PKS + .002; NS – .065 KS – .169** PS – .016

% K. LEAF.

KALE. EXPERIMENT 1. Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN ± 0.05
		(± 0.08)						
Ammonium Sulphate	0	2.56	2.56	2.59	2.24	2.70	2.77	2.57
	4	2.39	2.30	2.35	2.19	2.28	2.57	2.35
	8	2.48	2.36	2.37	2.34	2.24	2.62	2.40
Superphosphate	0				2.24	2.56	2.63	2.48
	3				2.29	2.41	2.52	2.41
	6				2.24	2.26	2.81	2.44
Mean		2.48	2.41	2.44	2.26	2.41	2.65	2.44

S.E. per plot. 0.14 Sig. Diff. of means. Central. 5% 0.28 1% 0.42; Marginal. 5% 0.16 1% 0.25

Interactions NP - 0.07 NK - 0.13 PK + 0.09

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN ± 0.06
		(± 0.10)						
Ammonium Sulphate	0	- .25	+ .05	+ .02	- .12	+ .03	- .10	- .06
	4	- .02	- .37	- .20	- .12	- .23	- .20	- .19
	8	- .18	- .15	- .12	- .22	- .08	- .05	- .12
Superphosphate	0				- .28	- .05	- .12	- .15
	3				- .12	- .08	- .17	- .17
	6				- .15	- .18	- .07	- .10
Mean		- .15	- .12	- .10	- .15	- .11	- .12	- .12

S.E. per plot. 0.18 Sig. Diff. of means. Central. 5% .32 1% .47; Marginal. 5% .19 1% .28

Interactions NPS - .10 NKS + .07 PKS - .04; NS - .06 KS + .03 PS + .05

% K. STEM.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN ± 0.09
		(± 0.15)						
Ammonium Sulphate	0	3.59	3.44	3.31	3.08	3.57	3.69	3.45
	4	3.61	3.48	3.41	3.42	3.64	3.44	3.50
	8	3.55	3.45	3.57	3.22	3.57	3.78	3.52
Superphosphate	0				3.23	3.77	3.76	3.59
	3				3.29	3.57	3.51	3.46
	6				3.19	3.44	3.65	3.43
Mean		3.59	3.46	3.43	3.24	3.59	3.64	3.49

S.E. per plot. 0.26 Sig. Diff. of means. Central. 5% 0.52 1% 0.79; Marginal. 5% 0.31 1% 0.47

Interactions NP + 0.15 NK - 0.02 PK - 0.03

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN ± 0.10
		(± 0.17)						
Ammonium Sulphate	0	+ .08	+ .12	- .02	- .02	- .02	+ .22	+ .06
	4	- .05	- .32	- .02	.00	- .23	- .15	- .13
	8	- .13	- .03	+ .10	- .03	- .03	.00	- .02
Superphosphate	0				- .08	- .07	+ .05	- .03
	3				- .18	- .17	+ .12	- .08
	6				+ .22	- .05	- .10	+ .02
Mean		- .03	- .08	+ .02	- .02	- .09	+ .02	- .03

S.E. per plot. 0.30 Sig. Diff. of means. Central. 5% 0.55 1% 0.81; Marginal. 5% 0.32 1% 0.47

Interactions NPS + .16 NKS - .10 PKS - .22; NS - .08 KS + .04 PS + .05

KALE. EXPERIMENT 1. Main N P K Effects. % Ca. LEAF. Responses to Salt.

% Ca. LEAF.

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 0.05)						± 0.03
Ammonium Sulphate	0	2.35	2.11	2.12	2.30	2.15	2.13	2.19
	4	2.21	2.28	2.14	2.20	2.14	2.18	2.21
	8	2.23	2.16	2.23	2.15	2.27	2.20	2.21
Superphosphate	0				2.32	2.25	2.22	2.26
	3				2.14	2.20	2.21	2.19
	6				2.19	2.22	2.07	2.16
Mean		2.26	2.19	2.16	2.22	2.22	2.17	2.20

S.E. per plot. 0.09 Sig. Diff. of means. Central. 5% 0.17 1% 0.26 Marginal. 5% 0.10 1% 0.16

Interactions NP + 0.11 NK + 0.11 PK − 0.01

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 0.14)						± 0.08
Ammonium Sulphate	0	− .07	+ .04	+ .06	− .01	− .07	+ .11	+ .01
	4	+ .04	+ .11	− .32	+ .06	+ .07	− .31	− .06
	8	− .23	− .03	− .04	− .39	− .11	+ .20	− .10
Superphosphate	0				+ .03	− .15	− .14	− .08
	3				− .10	− .14	+ .36	+ .04
	6				− .27	+ .19	− .22	− .10
Mean		−. 08	+ .04	− .10	− .11	− .10	.00	− .05

S.E. per plot. 0.24 Sig. Diff. of means. Central. 5% .46 1% .66 Marginal. 5% .26 1% .38

Interactions NPS + .03 NS − .11 NKS + .22 KS + .11 PKS + .11 PS − .02

% Ca. STEM.

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .05)						± .03
Ammonium Sulphate	0	.91	.85	.88	.90	.87	.88	.88
	4	.92	.86	.91	.90	.94	.85	.90
	8	.98	.91	.87	.91	.98	.87	.92
Superphosphate	0				.91	.97	.92	.94
	3				.92	.88	.82	.89
	6				.88	.93	.85	.89
Mean		.94	.87	.89	.90	.93	.86	.90

S.E. per plot. .08 Sig. Diff. of means. Central. 5% .17 1% .26 Marginal. 5% .10 1% .15

Interactions NP − .04 NK − .01 PK − .02

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .10)						± .06
Ammonium Sulphate	0	.00	+ .09	− .08	+ .04	+ .06	− .09	.00
	4	+ .07	− .02	+ .06	− .02	+ .03	− .03	− .01
	8	− .01	+ .03	+ .17	+ .02	+ .14	+ .04	+ .06
Superphosphate	0				− .02	+ .14	− .06	+ .02
	3				+ .03	+ .01	+ .06	+ .03
	6				+ .04	+ .07	− .08	+ .01
Mean		+ .02	+ .03	+ .01	+ .01	+ .07	− .03	+ .02

S.E. per plot. .18 Sig. Diff. of means. Central. 5% .32 1% .47 Marginal. 5% .19 1% .28

Interactions NPS + .13 NS + .06 NKS + .07 KS − .04 PKS − .04 PS − .01

KALE. EXPERIMENT 1. Main N P K Effects. **% Mg. LEAF.** Responses to Salt.

% Mg. LEAF. Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .006)						± .003
Ammonium Sulphate	0	.132	.117	.123	.131	.118	.123	.124
	4	.123	.121	.133	.130	.125	.122	.126
	8	.124	.120	.116	.128	.120	.122	.120
Superphosphate	0				.127	.129	.127	.127
	3				.124	.118	.116	.119
	6				.128	.119	.125	.124
Mean		.127	.119	.124	.126	.121	.122	.123

S.E. per plot. .010 Sig. Diff. of means. Central. 5% .020 1% .032 Marginal. 5% .010 1% .016

Interactions NP + .001 NK + .001 PK – .001

% Mg. LEAF. Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .014)						± .008
Ammonium Sulphate	0	– .039	– .007	–.009	+ .003	– .039	– .023	– .018
	4	+ .013	+ .022	– .002	+ .026	– .007	+ .014	+ .011
	8	– .011	– .018	+ .002	– .019	– .008	+ .001	– .009
Superphosphate	0				+ .007	– .037	– .007	– .012
	3				– .001	– .005	+ .003	– .001
	6				+ .003	– .008	– .005	– .003
Mean		– .012	– .001	– .003	+ .003	– .017	– .003	– .005

S.E. per plot. .024 Sig. Diff. of means. Central. 5% .046 1% .066 Marginal. 5% .026 1% .038

Interactions NPS – .008 NKS + .023 PKS + .003
NS + .009 KS – .006 PS + .009

% Mg. STEM. Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .009)						± .005
Ammonium Sulphate	0	.158	.145	.142	.157	.151	.138	.148
	4	.167	.157	.153	.158	.160	,159	.159
	8	.151	.147	.151	.147	.147	.156	.150
Superphosphate	0				.164	.157	.155	.159
	3				.153	.148	.148	.150
	6				.145	.152	.150	.149
Mean		.159	.150	.149	.154	.152	.151	.152

S.E. per plot. .015 Sig. Diff. of means. Central. 5% .031 1% .047 Marginal. 5% .017 1% .026

Interactions NP + .008 NK + .014 PK + .007

% Mg. STEM. Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .017)						± .010
Ammonium Sulphate	0	– .014	– .009	– .027	+ .011	– .037	– .023	– .017
	4	+ .005	+ .010	– .022	+ .009	– .003	– .013	– .007
	8	– .016	– .021	– .009	– .019	– .007	– .021	– .016
Superphosphate	0				+ .021	– .016	– .030	– .008
	3				– .006	– .011	– .003	– .007
	6				– .014	– .021	– .023	– .020
Mean		– .008	– .007	– .020	.000	– .016	– .019	– .012

S.E. per plot. .029 Sig. Diff. of means. Central. 5% .055 1% .081 Marginal. 5% .033 1% .047

Interactions NPS + .010 NKS + .016 PKS + .021
NS + .001 KS – .019 PS – .012

KALE. EXPERIMENT 1. Main N P K Effects. **% P. LEAF.** Responses to Salt.

Main N P K Effects (% P. Leaf)

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .012)						± .007
Ammonium Sulphate	0	.263	.290	.292	.294	.279	.273	.282
	4	.272	.294	.294	.300	.265	.295	.287
	8	.280	.304	.299	.294	.305	.294	.298
Superphosphate	0				.271	.262	.282	.272
	3				.311	.290	.296	.299
	6				.305	.297	.284	.295
Mean		.272	.299	.295	.296	.283	.287	.289

S.E. per plot. .020 Sig. Diff. of means. Central. 5% .040 1% .060 Marginal. 5% .023 1% .035

Interactions NP – .005 NK + .010 PK – .016

Responses to Salt (% P. Leaf)

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .017)						± .010
Ammonium Sulphate	0	+ .038	+ .007	+ .012	+ .018	+ .023	+ .012	+ .019
	4	+ .013	.000	+ .002	– .003	+ .030	– .012	+ .005
	8	+ .017	+ .010	– .005	+ .013	– .010	+ .018	+ .007
Superphosphate	0				+ .005	+ .023	+ .040	+ .023
	3				– .012	+ .033	– .005	+ .006
	6				+ .035	– .010	– .017	+ .003
Mean		+ .023	+ .006	+ .003	+ .009	+ .016	+ .006	+ .010

S.E. per plot. .029 Sig. Diff. of means. Central. 5% .055 1% .081 Marginal. 5% .033 1% .047

Interactions NPS + .002 NKS + .006 PKS – .043
NS – .012 KS – .003 PS – .020

% P. STEM.

Main N P K Effects (% P. Stem)

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .015)						± .009
Ammonium Sulphate	0	.305	.313	.324	.323	.296	.324	.314
	4	.305	.330	.344	.357	.284	.339	.326
	8	.295	.338	.327	.316	.333	.311	.320
Superphosphate	0				.329	.297	.280	.301
	3				.327	.312	.342	.327
	6				.340	.303	.352	.332
Mean		.301	.327	.332	.332	.304	.325	.320

S.E. per plot. .026 Sig. Diff. of means. Central. 5% .052 1% .079 Marginal. 5% .030 1% .045

Interactions NP + .007 NK – .003 PK + .030

Responses to Salt (% P. Stem)

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .017)						± .010
Ammonium Sulphate	0	+ .040	+ .022	+ .002	+ .025	+ .002	+ .037	+ .021
	4	+ .037	+ .010	+ .007	.000	+ .050	+ .003	+ .018
	8	+ .043	+ .032	– .017	+ .015	+ .008	+ .035	+ .019
Superphosphate	0				+ .072	+ .017	+ .032	+ .040
	3				– .030	+ .047	+ .047	+ .021
	6				– .002	– .003	– .003	– .003
Mean		+ .040	+ .021	– .003	+ .013	+ .020	+ .025	+ .019*

S.E. per plot. .031 Sig. Diff. of means. Central. 5% .055 1% .081 Marginal. 5% .033 1% .047

Interactions NPS – .011 NKS + .004 PKS + .018
NS – .002 KS + .012 PS – .043*

		FRESH YIELD. tons			DRY MATTER. tons			% D.M.		LEAF. % D.M.					STEM. % D.M.				
		Total	Leaf	Stem	Total	Leaf	Stem	Leaf	Stem	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
1	N1P1K2S0	15.50	7.00	8.50	1.783	.882	.901	12.6	10.6	.170	1.55	1.86	.096	.300	.125	3.30	0.68	.130	.390
	S1	15.50	6.35	9.15	1.911	.813	1.098	12.8	12.0	.300	2.00	2.02	.096	.295	.240	3.40	0.76	.152	.365
2	N0P2K2S0	10.30	4.90	5.40	1.265	.617	.648	12.8	12.0	.105	2.20	2.40	.102	.300	.110	3.60	0.82	.140	.390
	S1	10.10	4.97	5.13	1.241	.611	.630	12.3	12.3	.250	2.35	2.12	.104	.305	.195	3.25	0.72	.128	.350
3	N0P1K0S0	9.18	4.87	4.31	1.217	.657	.560	13.5	13.0	.100	1.45	2.26	.122	.240	.140	2.70	0.76	.140	.350
	S1	11.30	4.52	6.78	1.487	.619	.868	13.7	12.8	.195	1.70	2.60	.120	.270	.240	3.30	0.70	.146	.315
4	N1P0K0S0	16.16	7.36	8.80	1.912	.980	.932	12.4	10.6	.375	1.50	2.62	.124	.300	.380	3.20	0.76	.140	.340
	S1	17.20	8.79	8.41	2.004	1.028	.976	11.7	11.6	.500	1.65	2.26	.120	.285	.475	2.90	0.88	.170	.370
5	N2P0K2S0	20.58	8.76	11.82	2.439	1.127	1.312	12.0	11.1	.200	1.65	2.20	.096	.345	.260	3.50	0.76	.162	.300
	S1	18.92	8.52	10.40	2.099	.997	1.102	11.7	10.6	.300	1.65	2.28	.078	.335	.330	3.30	0.68	.144	.350
6	N1P2K1S0	18.20	8.30	9.90	2.181	1.013	1.168	12.2	11.8	.285	1.75	2.22	.070	.365	.270	3.25	0.63	.128	.350
	S1	21.56	10.41	11.15	2.488	1.239	1.249	11.9	11.2	.400	1.55	2.42	.120	.350	.625	2.80	0.96	.134	.335
7	N0P0K1S0	14.08	5.62	8.46	1.791	.776	1.015	13.8	12.0	.150	1.35	2.36	.090	.280	.105	2.50	0.80	.120	.330
	S1	17.76	7.31	10.45	2.035	.885	1.150	12.1	11.0	.200	1.60	2.00	.100	.335	.250	3.05	0.92	.140	.350
8	N2P1K1S0	18.20	8.29	9.91	2.065	.995	1.070	12.0	10.8	.220	1.45	2.10	.110	.335	.270	3.00	0.94	.156	.345
	S1	19.08	7.63	11.45	2.011	.855	1.156	11.2	10.1	.400	1.30	2.40	.100	.365	.435	3.30	0.76	.150	.345
9	N2P2K0S0	19.64	8.94	10.70	2.037	1.010	1.027	11.3	9.6	.775	1.20	2.02	.110	.350	.670	3.10	0.89	.140	.390
	S1	21.56	9.06	12.50	2.375	1.087	1.288	12.0	10.3	.950	1.35	1.90	.100	.395	.875	2.90	0.82	.148	.410
10	N2P2K1S0	21.10	11.50	9.60	2.397	1.380	1.017	12.0	10.6	.300	1.55	2.10	.096	.380	.310	3.20	0.86	.150	.400
	S1	19.70	11.00	8.70	2.514	1.494	1.018	13.6	11.7	.535	1.50	1.96	.086	.375	.520	3.55	0.75	.158	.400
11	N2P0K0S0	11.94	6.76	5.18	1.503	.892	.611	13.2	11.8	.455	1.30	1.96	.076	.295	.455	3.30	0.76	.142	.310
	S1	15.68	8.52	7.16	1.849	.997	.852	11.7	11.9	.875	1.30	2.30	.106	.315	.895	3.20	0.88	.126	.300
12	N1P2K2S0	15.08	7.67	7.41	1.765	.920	.845	12.0	11.4	.220	2.65	2.00	.060	.285	.140	4.10	0.64	.126	.400
	S1	14.22	7.97	6.25	1.870	1.076	.794	13.5	12.7	.195	2.05	1.90	.080	.265	.190	3.70	0.64	.118	.415
13	N2P1K2S0	16.44	8.39	8.05	1.906	.982	.926	11.7	11.5	.135	1.85	1.96	.092	.305	.140	4.55	0.76	.126	.360
	S1	17.76	10.12	7.64	2.040	1.123	.917	11.1	12.0	.270	2.30	2.00	.076	.280	.240	4.15	0.66	.126	.350
14	N0P1K1S0	10.44	6.15	4.29	1.426	.843	.583	13.7	13.6	.085	1.50	2.42	.076	.220	.095	2.50	0.68	.112	.370
	S1	12.72	6.12	6.60	1.635	.777	.858	12.7	13.0	.200	1.80	2.50	.100	.300	.210	2.90	0.82	.128	.400
15	N1P0K1S0	15.42	7.10	8.32	1.981	.916	1.065	12.9	12.8	.200	1.20	2.56	.120	.300	.240	2.80	0.82	.134	.380
	S1	15.48	7.43	8.05	1.999	.966	1.033	13.0	12.0	.510	1.60	2.00	.070	.300	.470	2.80	0.84	.116	.370
16	N0P0K2S0	15.90	7.81	8.09	2.051	1.015	1.036	13.0	12.8	.110	1.30	2.50	.116	.275	.125	2.65	0.80	.116	.380
	S1	13.26	6.76	6.50	1.666	.879	.787	13.0	12.1	.275	1.35	2.30	.076	.325	.325	3.05	0.88	.118	.410
17	N1P1K0S0	16.68	8.02	8.66	2.093	1.106	.987	12.8	11.4	.470	1.20	2.32	.130	.300	.440	2.85	0.68	.152	.350
	S1	18.48	8.88	9.60	2.232	1.128	1.104	12.7	11.5	.670	1.10	2.24	.116	.365	.820	2.25	0.72	.144	.405
18	N0P2K0S0	13.10	6.67	6.43	1.755	.900	.855	13.5	13.3	.095	1.25	2.56	.082	.305	.100	2.80	0.82	.110	.365
	S1	17.60	8.17	9.43	2.353	1.127	1.226	13.8	13.0	.310	1.15	2.74	.120	.335	.305	2.70	0.80	.144	.410
19	N1P0K2S0	13.60	7.38	6.22	1.720	.974	.746	13.2	12.0	.120	1.85	2.50	.078	.255	.125	3.55	0.88	.130	.295
	S1	14.00	7.60	6.40	1.910	1.010	.800	13.3	12.5	.260	1.35	2.22	.060	.255	.195	3.30	0.74	.114	.345
20	N0P0K0S0	6.48	3.95	2.53	0.988	.593	.385	15.0	15.2	.090	1.75	1.80	.060	.240	.110	3.10	0.95	.136	.290
	S1	7.00	4.10	2.90	1.038	.603	.435	14.7	15.0	.210	1.75	1.86	.066	.245	.225	3.00	0.82	.138	.285
21	N1P2K0S0	10.90	6.14	4.76	1.398	.798	.600	13.0	12.6	.250	1.50	1.98	.060	.255	.260	3.15	0.88	.132	.375
	S1	14.18	7.46	6.72	1.728	.895	.833	12.0	12.4	.550	1.60	2.42	.050	.295	.400	3.35	0.76	.094	.390
22	N2P0K1S0	14.76	7.68	7.08	1.685	.899	.786	11.7	11.1	.225	1.45	2.08	.078	.275	.215	3.30	0.64	.132	.350
	S1	17.64	9.53	8.11	2.186	1.245	.941	11.8	11.6	.515	1.30	2.02	.100	.295	.475	3.00	0.88	.108	.380
23	N0P2K1S0	11.12	6.56	4.56	1.516	.900	.616	13.7	13.5	.080	1.85	2.08	.070	.345	.110	2.85	0.82	.118	.350
	S1	11.72	5.47	6.25	1.628	.766	.862	14.0	13.9	.155	12.0	2.22	.050	.340	.155	2.50	0.64	.100	.360
24	N0P1K2S0	14.82	8.00	6.82	2.065	1.133	.832	13.3	12.2	.125	2.20	2.30	.060	.330	.100	3.70	0.68	.108	.330
	S1	12.84	6.81	6.03	1.641	.900	.741	13.2	12.3	.265	2.40	1.88	.076	.300	.220	3.50	0.76	.128	.345
25	N1P1K1S0	15.00	8.15	6.85	1.970	1.141	.829	14.0	12.1	.220	1.40	2.10	.066	.330	.270	3.20	0.76	.128	.390
	S1	15.40	7.39	8.01	1.850	.961	.889	13.0	11.1	.525	1.85	2.00	.090	.355	.425	3.40	0.76	.132	.370
26	N2P2K2S0	20.54	11.31	9.23	2.265	1.323	.942	11.7	10.2	.300	1.55	2.00	.104	.340	.290	2.85	0.68	.148	.330
	S1	18.08	9.20	8.88	2.056	1.150	.906	12.5	10.2	.350	1.70	2.12	.110	.345	.400	3.10	0.80	.114	.365
27	N2P1K0S0	20.52	10.88	9.64	2.309	1.306	1.003	12.0	10.4	.765	2.40	2.12	.096	.320	.665	3.70	0.86	.140	.380
	S1	20.64	10.74	9.90	2.297	1.267	1.030	11.8	10.4	.850	2.20	2.00	.092	.315	.825	3.50	0.86	.168	.375

TOTAL FRESH YIELD. (tons)

KALE. EXPERIMENT 2.

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 1.39)						±0.80
Ammonium Sulphate	0	12.41	11.90	12.33	10.79	12.97	12.89	12.22
	4	15.31	16.09	15.66	15.60	16.84	14.65	15.70
	8	16.59	18.77	20.10	18.33	18.41	18.71	18.45
Superphosphate	0				12.41	15.86	16.04	14.77
	3				16.13	15.14	15.49	15.59
	6				16.17	17.23	14.72	16.04
Mean		14.77	15.59	16.04	14.91	16.08	15.41	15.46

S.E. per plot. 2.41 Sig. Diff. of means. Central. 5% 4.80 1% 7.28
Marginal. 5% 2.76 1% 4.19

Interactions NP + 1.79 NK - 0.87 PK - 2.51

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(±1.00)						± 0.57
Ammonium Sulphate	0	+ 0.52	+ 0.81	+ 1.63	+ 2.38	+ 2.19	- 1.61	+ 0.99
	4	+ 0.50	+ 0.73	+ 2.26	+ 2.37	+ 1.91	- 0.15	+ 1.16
	8	+ 1.65	+ 0.77	- 0.34	+ 1.89	+ 0.79	- 0.60	+ 0.70
Superphosphate	0				+ 1.77	+ 2.21	- 1.30	+ 0.89
	3				+ 1.35	+ 1.19	- 0.22	+ 0.77
	6				+ 3.53	+ 0.85	- 0.83	+ 1.18
Mean		+ 0.89	+ 0.77	+ 1.18	+ 2.22	+ 1.42	- 0.78	+ 0.95*

S.E. per plot. 1.72 Sig. Diff. of means. Central. 5% 3.26 1% 4.74
Marginal. 5% 1.86 1% 2.70

Interactions NPS - 1.55 NKS + 0.75 PKS - 0.65
NS - 0.29 KS - 3.00** PS + 0.29

TOTAL DRY MATTER YIELD (tons)

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 0.218)						± 0.126
Ammonium Sulphate	0	1.595	1.579	1.628	1.473	1.674	1.655	1.600
	4	1.921	1.973	1.905	1.895	2.078	1.823	1.933
	8	1.960	2.105	2.274	2 .062	2 .143	2.134	2 .113
Superphosphate	0				1.549	1.946	1.981	1.825
	3				1.939	1.827	1.891	1.886
	6				1.941	2.122	1.744	1.935
Mean		1.825	1.886	1.935	1.809	1.965	1.872	1.882

S.E. per plot. 0 .378 Sig. Diff. of means. Central. 5% 0.754 1% 1.142
Marginal. 5% 0.436 1% 0.660

Interactions NP + 0.140 NK - 0.055 PK - 0.315

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .128)						±.074
Ammonium Sulphate	0	- .030	+ .018	+ .231	+ .306	+ .191	- .278	+ .073
	4	+ .100	+ .049	+ .247	+ .187	+ .068	+ .141	+ .132
	8	+ .169	+ .023	+ .082	+ .224	+ .188	- .138	+ .091
Superphosphate	0				+ .163	+ .254	- .178	+ .087
	3				+ .132	+ .012	- .054	+ .030
	6				+ .422	+ .181	- .042	+ .187
Mean		+ .087	+ .030	+ .187	+ .239	+ .149	- .092	+ .099*

S.E. per plot. 0.222 Sig. Diff. of means. Central. 5% .408 1% .608
Marginal. 5% .240 1% .351

Interactions NPS - 0.174 NKS + 0.111 PKS - 0.064
NS + 0.018 KS - 0.331* PS + 0.100

KALE. EXPERIMENT 2. Main N P K Effects. % Na. LEAF. Responses to Salt.

% Na. LEAF.

Main N P K Effects

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .025)						± .015
Ammonium Sulphate	0	.171	.162	.183	.167	.162	.187	.172
	4	.327	.392	.316	.469	.356	.311	.345
	8	.428	.439	.540	.778	.366	.264	.469
Superphosphate	0				.417	.300	.209	.309
	3				.508	.275	.211	.331
	6				.488	.309	.242	.346
Mean		.309	.331	.346	.471	.295	.221	.329

S.E. per plot. .044 Sig. Diff. of means. Central. 5% .087 1% .131

Marginal. 5% .052 1% .078

Interactions NP + .050 NK – .267** PK – .019

Responses to Salt

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .051)						± .030
Ammonium Sulphate	0	+ .112	+ .117	+ .145	+ .143	+ .080	+ .150	+ .124
	4	+ .192	+ .212	+ .130	+ .208	+ .243	+ .082	+ .178
	8	+ .270	+ .133	+ .163	+ .227	+ .235	+ .105	+ .189
Superphosphate	0				+.222	+ .217	+ .135	+ .191
	3				+ .127	+ .200	+ .135	+ .154
	6				+ .230	+ .142	+ .067	+ .146
Mean		+ .191	+ .154	+ .146	+ .193	+ .186	+ .112	+ .164**

S.E. per plot. .089 Sig. Diff. of means. Central. 5% .166 1% .308

Marginal. 5% .098 1% .142

Interactions NPS – .070 NKS – .065 PKS – .038

NS – .065 KS – .081 PS – .045

% Na. STEM.

Main N P K Effects

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .036)						± .021
Ammonium Sulphate	0	.190	.167	.163	.186	.154	.179	.173
	4.	.314	.387	.314	.463	.384	.169	.339
	8	.438	.429	.511	.731	.371	.277	.459
Superphosphate	0				.423	.293	.227	.314
	3				.522	.284	.178	.328
	6				.435	.332	.221	.329
Mean		.314	.328	.329	.460	.303	.208	.324

S.E. per plot. .064 Sig. Diff. of means. Central. 5% .124 1% .189

Marginal. 5% .072 1% .110

Interactions NP + .050 NK – .223** PK – .016

Responses to Salt

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .062)						± .036
Ammonium Sulphate	0	+ .153	+ .112	+ .112	+ .140	+ .102	+ .135	+ .126
	4.	+ .132	+ .217	+ .182	+ .205	+ .247	+ .078	+ .176
	8	+ .257	+ .142	+ .175	+ .268	+ .212	+ .093	+ .190
Superphosphate	0				+ .217	+ .212	+ .113	+ .181
	3				+ .213	+ .145	+ .112	+ .157
	6				+ .183	+ .203	+ .082	+ .156
Mean		+ .181	+ .157	+ .156	+ .204	+ .187	+ .102	+ .164**

S.E. per plot. .108 Sig. Diff. of means. Central. 5% .202 1% .294

Marginal. 5% .117 1% .171

Interactions NPS – .020 NKS – .085 PKS + .001

NS – .064 KS – .102 PS – .025

KALE. EXPERIMENT 2. Main N P K Effects. **% K. LEAF.** Responses to Salt.

Main N P K Effects

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean
		(± 0.18)						± 0.11
Ammonium Sulphate	0	1.52	1.84	1.67	1.51	1.55	1.97	1.68
	4	1.52	1.52	1.85	1.42	1.56	1.91	1.63
	8	1.44	1.92	1.48	1.63	1.43	1.78	1.61
Superphosphate	0				1.54	1.42	1.53	1.50
	3				1.67	1.55	2.05	1.76
	6				1.34	1.57	2.08	1.67
Mean		1.50	1.76	1.67	1.52	1.51	1.89	1.64

S.E. per plot. 0.32 Sig. Diff. of means. Central. 5% 0.62 1% 0.94; Marginal. 5% 0.38 1% 0.58

Interactions NP − 0.05 NK − 0.15 PK + 0.37

Responses to Salt

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean
		(± 0.14)						± 0.08
Ammonium Sulphate	0	+ 0.10	+ 0.25	− 0.20	+ 0.05	− 0.03	+ 0.13	+ 0.05
	4	+ 0.02	+ 0.27	− 0.23	+ 0.05	+ 0.22	− 0.22	+ 0.02
	8	− 0.05	+ 0.03	+ 0.08	− 0.02	− 0.12	+ 0.20	+ 0.02
Superphosphate	0				+ 0.05	+ 0.17	− 0.15	+ 0.02
	3				− 0.02	+ 0.20	+ 0.37	+ 0.18
	6				+ 0.05	− 0.30	− 0.10	− 0.12
Mean		+ 0.02	+ 0.18	− 0.12	+ 0.03	+ 0.02	+ 0.04	+ 0.03

S.E. per plot. 0.25 Sig. Diff. of means. Central. 5% 0.46 1% 0.66; Marginal. 5% 0.26 1% 0.38

Interactions NPS + 0.22 NKS + 0.07 PKS + 0.03
NS − 0.03 KS + 0.01 PS − 0.14

% K. STEM.

Main N P K Effects

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean
		(± 0.23)						± 0.13
Ammonium Sulphate	0	2.89	3.10	2.95	2.93	2.72	3.29	2.98
	4	3.09	3.07	3.39	2.95	3.04	3.56	3.18
	8	3.27	3.70	3.12	3.28	3.23	3.58	3.36
Superphosphate	0				3.12	2.91	3.23	3.08
	3				3.05	3.05	3.77	3.29
	6				3.00	3.03	3.44	3.16
Mean		3.08	3.29	3.16	3.06	3.00	3.48	3.18

S.E. per plot. 0.40 Sig. Diff. of means. Central. 5% 0.80 1% 1.21; Marginal. 5% 0.45 1% 0.68

Interactions NP − 0.15 NK − 0.03 PK + 0.16

Responses to Salt

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean
		(± 0.25)						± 0.14
Ammonium Sulphate	0	+ 0.28	.000	− 0.27	+ 0.13	− 0.07	− 0.05	+ 0.01
	4	− 0.18	− 0.10	− 0.22	− 0.23	− 0.08	− 0.18	− 0.17
	8	− 0.20	− 0.10	+ 0.12	− 0.17	+ 0.12	− 0.13	− 0.06
Superphosphate	0				− 0.17	+ 0.08	− 0.02	− 0.03
	3				− 0.07	+ 0.03	− 0.17	− 0.07
	6				− 0.03	− 0.15	− 0.18	− 0.12
Mean		− 0.03	− 0.07	− 0.12	− 0.09	− 0.01	− 0.12	− 0.07

S.E. per plot. 0.43 Sig. Diff. of means. Central. 5% 0.82 1% 1.19; Marginal. 5% 0.46 1% 0.66

Interactions NPS + 0.44 NKS + 0.11 PKS − 0.15
NS − 0.07 KS − 0.03 PS − 0.09

KALE. EXPERIMENT 2. Main N P K Effects. % Ca. LEAF. Response to Salt.

% Ca. LEAF — Main N P K Effects

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 0.13)						± 0.07
Ammonium Sulphate	0	2.07	2.33	2.35	2.30	2.26	2.25	2.27
	4	2.36	2.09	2.16	2.31	2.22	2.08	2.20
	8	2.07	2.18	2.00	2.03	2.19	2.09	2.12
Superphosphate	0				2.13	2.17	2.33	2.21
	3				2.26	2.34	2.00	2.20
	6				2.25	2.17	2.09	2.17
Mean		2.21	2.20	2.17	2.21	2.22	2.14	2.19

S.E. per plot. 0.22 Sig. Diff. of means. Central. 5% 0.45 1% 0.68; Marginal. 5% 0.24 1% 0.37

Interactions NP − 0.17 NK + 0.06 PK − 0.18

% Ca. LEAF — Response to Salt

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .13)						± .07
Ammonium Sulphate	0	− .17	.00	+ .01	+ .19	− .05	− .30	− .05
	4	− .40	− .01	+ .18	.00	− .15	− .07	− .08
	8	+ .12	+ .07	− .05	+ .03	+ .08	+ .08	+ .05
Superphosphate	0				+ .01	− .33	− .13	− .15
	3				+ .05	+ .09	− .07	+ .02
	6				+ .16	+ .07	− .08	+ .04
Mean		− .15	+ .02	+ .04	+ .08	− .06	− .10	− .03

S.E. per plot. .22 Sig. Diff. of means. Central. 5% .42 1% .62; Marginal. 5% .23 1% .33

Interactions NPS − 0.06 NKS + 0.27 PKS − 0.05; NS + 0.10 KS − 0.18 PS − 0.19

% Ca. STEM — Main N P K Effects

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .013)						± .008
Ammonium Sulphate	0	.86	.73	.77	.81	.78	.78	.79
	4	.82	.73	.75	.78	.79	.72	.76
	8	.77	.81	.80	.85	.80	.73	.78
Superphosphate	0				.84	.82	.79	.82
	3				.76	.79	.72	.76
	6				.83	.77	.72	.77
Mean		.82	.76	.77	.81	.79	.74	.78

S.E. per plot. .023 Sig. Diff. of means. Central. 5% .045 1% .068; Marginal. 5% .028 1% .042

Interactions NP + 0.06* NK − 0.05* PK − 0.03

% Ca. STEM — Response to Salt

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .09)						± .05
Ammonium Sulphate	0	+ .02	+ .05	− .10	− .07	+ .03	+ .02	− .01
	4	.00	+ .04	+ .07	+ .01	+ .12	− .02	+ .04
	8	− .06	− .09	+ .03	+ .06	− .17	− .01	− .04
Superphosphate	0				+ .03	− .03	− .05	− .01
	3				− .01	− .01	+ .03	.00
	6				− .02	+ .02	+ .01	.00
Mean		− .01	.00	.00	.00	− .01	.00	0.00

S.E. per plot. .15 Sig. Diff. of means. Central. 5% .29 1% .43; Marginal. 5% .16 1% .24

Interactions NPS + 0.10 NKS − 0.08 PKS + 0.02; NS − 0.03 KS 0.00 PS + 0.01

KALE. EXPERIMENT 2. Main N P K Effects. % Mg. LEAF. Responses to Salt.

Main N P K Effects

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .008)						± .004
Ammonium Sulphate	0	.078	.092	.088	.095	.077	.086	.086
	4	.090	.099	.070	.100	.083	.077	.086
	8	.089	.084	.101	.097	.095	.093	.095
Superphosphate	0				.092	.086	.079	.086
	3				.113	.090	.083	.095
	6				.087	.079	.093	.086
Mean		.086	.095	.086	.097	.085	.085	.089

S.E. per plot. .013 Sig. Diff. of means. Central. 5% .026 1% .039 Marginal. 5% .014 1% .021

Interactions NP + .001 NK + .003 PK + .009

Responses to Salt

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .014)						± .008
Ammonium Sulphate	0	− .008	+ .013	+ .007	+ .014	+ .005	− .007	+ .004
	4	− .024	+ .003	+ .020	− .009	+ .008	+ .001	.000
	8	+ .011	− .010	− .005	+ .005	+ .001	− .009	− .001
Superphosphate	0				+ .011	− .006	− .025	− .007
	3				− .007	+ .013	.000	+ .002
	6				+ .006	+ .007	+ .009	+ .007
Mean		− .007	+ .002	+ .007	+ .003	+ .004	− .005	+ .001

S.E. per plot. .025 Sig. Diff. of means. Central. 5% .046 1% .066 Marginal. 5% .026 1% .038

Interactions NPS − .015 NKS + .003 PKS + .019
NS − .005 KS − .008 PS + .014

% Mg. STEM.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .006)						± .003
Ammonium Sulphate	0	.128	.127	.123	.136	.119	.123	.126
	4	.134	.139	.122	.139	.129	.128	.132
	8	.136	.144	.143	.144	.142	.137	.141
Superphosphate	0				.142	.125	.130	.132
	3				.148	.134	.128	.137
	6				.128	.131	.129	.129
Mean		.132	.137	.129	.129	.130	.129	.133

S.E. per plot. .010 Sig. Diff. of means. Central. 5% .021 1% .031 Marginal. 5% .010 1% .016

Interactions NP + .006 NK + .003 PK + .007

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .014)						± .008
Ammonium Sulphate	0	+ .008	+ .014	+ .001	+ .014	+ .006	+ .003	+ .008
	4	− .001	+ .006	− .013	− .005	− .003	− .001	− .003
	8	− .019	+ .007	− .006	+ .007	− .007	− .017	− .006
Superphosphate	0				+ .005	− .007	− .011	− .004
	3				+ .009	+ .005	+ .014	+ .009
	6				+ .001	− .001	− .018	− .006
Mean		− .004	+ .009	− .006	+ .005	− .001	− .005	.000

S.E. per plot. .025 Sig. Diff. of means. Central. 5% .046 1% .066 Marginal. 5% .026 1% .038

Interactions NPS + .010 NKS + .010 PKS − .002
NS − .014 KS − .010 PS − .002

KALE. EXPERIMENT 2.

% P. LEAF.

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .017)						± .010
Ammonium Sulphate	0	.283	.271	.322	.272	.303	.300	.292
	4	.283	.331	.306	.300	.333	.285	.306
	8	.312	.320	.365	.333	.337	.326	.332
Superphosphate	0				.282	.297	.298	.292
	3				.302	.318	.301	.307
	6				.322	.359	.312	.331
Mean		.292	.307	.331	.302	.325	.304	.310

S.E. per plot. .029 Sig. Diff. of means. Central. 5% .059 1% .089 Marginal. 5% .035 1% .052

Interactions NP+ .007 NK - .018 PK - .018

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .011)						± .006
Ammonium Sulphate	0	+ .037	+ .027	+ .010	+ .022	+ .043	+ .008	+ .024
	4	- .005	+ .028	+ .008	+ .030	+ .003	- .002	+ .011
	8	+ .010	.000	+ .012	+ .020	+ .015	- .013	+ .007
Superphosphate	0				+ .003	+ .025	+ .013	+ .014
	3				+ .030	+ .045	- .020	+ .018
	6				+ .038	- .008	.000	+ .010
Mean		+ .014	+ .018	+ .010	+ .024	+ .021	- .003	+ .014

S.E. per plot. .019 Sig. Diff. of means. Central. 5% .036 1% .052 Marginal. 5% .019 1% .028

Interactions NPS + .015 NKS - .010 PKS - .023
NS - .017 KS - .027* PS - .004

% P. STEM.

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .017)						± .010
Ammonium Sulphate	0	.341	.365	.369	.334	.360	.381	.358
	4	.350	.366	.377	.372	.366	.355	.364
	8	.332	.359	.383	.360	.370	.343	.358
Superphosphate	0				.316	.360	.347	.341
	3				.364	.370	.363	.363
	6				.388	.366	.375	.376
Mean		.341	.363	.376	.356	.365	.359	.360

S.E. per plot. .030 Sig. Diff. of means. Central. 5% .060 1% .091 Marginal. 5% .035 1% .052

Interactions NP + .011 NK - .032 PK - .022

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .018)						± .011
Ammonium Sulphate	0	+ .015	.000	+ .008	+ .002	+ .020	+ .002	+ .008
	4	+ .023	+ .003	+ .005	+ .033	- .015	+ .013	+ .011
	8	+ .023	- .005	+ .018	+ .002	+ .010	+ .025	+ .012
Superphosphate	0				+ .005	+ .013	+ .043	+ .021
	3				+ .002	+ .003	- .007	- .001
	6				+ .030	- .002	+ .003	+ .011
Mean		+ .021	- .001	+ .011	+ .012	+ .005	+ .013	+ .010

S.E. per plot. .032 Sig. Diff. of means. Central. 5% .058 1% .085 Marginal. 5% .036 1% .052

Interactions NPS + .001 NKS + .011 PKS - .032
NS + .004 KS + .001 PS - .010

KALE. EXPERIMENT 3.

		FRESH YIELD tons			DRY MATTER tons			% D.M.		LEAF. % D.M.					STEM. % D.M.				
		Total	Leaf	Stem	Total	Leaf	Stem	Leaf	Stem	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
1	N2P0K0S0	16.88	12.98	3.90	2.129	1.583	.546	12.2	14.0	.550	1.70	2.26	.230	.210	.600	2.60	.990	.185	.185
	S1	16.52	13.22	3.30	2.174	1.758	.416	13.3	12.6	.825	1.75	2.66	.174	.190	.800	2.30	.920	.190	.205
2	N1P1K0S0	13.76	11.02	2.74	1.968	1.521	.447	13.8	16.3	.475	1.90	2.42	.190	.170	.300	2.10	.920	.182	.230
	S1	16.52	13.01	3.51	2.202	1.626	.576	12.5	16.4	.625	2.10	2.36	.198	.180	.580	2.30	.850	.174	.215
3	N0P1K1S0	12.12	8.67	3.45	1.726	1.222	.504	14.1	14.6	.140	2.85	2.34	.134	.210	.190	3.05	.745	.156	.265
	S1	12.08	9.91	2.17	1.784	1.437	.347	14.5	16.0	.245	2.25	2.60	.136	.185	.180	2.90	.780	.170	.215
4	N0P0K2S0	8.84	7.16	1.68	1.330	1.038	.292	14.5	17.4	.065	2.25	2.66	.130	.180	.040	2.40	.620	.110	.240
	S1	10.80	8.64	2.16	1.590	1.236	.354	14.3	16.4	.092	3.55	2.00	.120	.225	.070	3.50	.620	.164	.200
5	N2P2K1S0	18.32	14.85	3.47	2.363	1.871	.492	12.6	14.2	.345	2.45	2.20	.170	.225	.285	2.90	.780	.182	.180
	S1	20.88	16.71	4.17	2.631	2.022	.609	12.1	14.6	.425	2.90	2.20	.162	.245	.315	2.85	.750	.132	.215
6	N0P2K0S0	9.60	7.58	2.02	1.546	1.152	.394	15.2	19.5	.070	3.15	2.34	.130	.210	.125	2.75	.720	.190	.210
	S1	8.84	7.35	1.49	1.466	1.183	.283	16.1	19.0	.172	2.80	2.32	.126	.185	.155	2.70	.680	.140	.180
7	N1P2K2S0	14.12	10.67	3.45	2.070	1.515	.555	14.2	16.1	.090	3.10	2.28	.136	.280	.070	2.70	.780	.148	.280
	S1	14.00	10.25	3.75	1.817	1.251	.566	12.2	15.1	.195	3.85	2.32	.125	.270	.160	4.10	.820	.164	.285
8	N2P1K2S0	17.76	14.09	3.67	2.272	1.733	.539	12.3	14.7	.190	3.10	2.56	.152	.180	.125	3.45	.640	.156	.230
	S1	17.52	13.97	3.55	2.320	1.844	.476	13.2	13.4	.155	3.00	2.34	.130	.200	.110	3.65	.620	.110	.185
9	N1P0K1S0	17.24	13.99	3.25	2.139	1.707	.432	12.2	13.3	.185	3.10	2.20	.148	.210	.105	3.35	.700	.100	.170
	S1	20.84	17.20	3.64	2.529	2.012	.517	11.7	14.2	.250	3.55	2.28	.178	.175	.200	3.50	.720	.156	.190
10	N2P0K1S0	17.76	13.15	4.61	2.240	1.604	.636	12.2	13.8	.450	1.60	2.20	.196	.140	.495	2.20	.835	.160	.215
	S1	16.68	12.43	4.25	2.058	1.454	.604	11.7	14.2	.525	2.35	2.28	.190	.170	.650	2.65	.640	.148	.190
11	N0P0K0S0	9.12	7.70	1.42	1.388	1.132	.256	14.7	18.0	.200	2.45	2.10	.170	.180	.140	2.40	.920	.190	.225
	S1	11.48	8.24	3.24	1.742	1.178	.564	14.3	17.4	.450	2.40	2.50	.186	.200	.375	2.35	.800	.100	.170
12	N1P1K1S0	13.52	10.62	2.90	1.734	1.328	.406	12.5	14.0	.450	2.30	2.36	.175	.140	.315	2.80	.920	.164	.185
	S1	13.24	10.42	2.82	1.760	1.303	.457	12.5	16.2	.500	2.15	2.46	.180	.125	.360	2.60	.880	.184	.185
13	N2P1K0S0	13.56	10.59	2.97	1.723	1.292	.431	12.2	14.5	.875	1.25	2.46	.220	.120	.650	1.70	.920	.148	.230
	S1	15.32	11.65	3.67	1.832	1.298	.539	11.1	14.7	.975	1.40	2.52	.176	.160	.900	1.65	.880	.164	.185
14	N0P1K2S0	11.44	9.04	2.40	1.671	1.275	.396	14.1	16.5	.115	3.20	2.50	.150	.160	.070	3.30	.750	.156	.215
	S1	10.53	7.88	2.65	1.509	1.072	.437	13.6	16.5	.140	2.60	2.00	.136	.165	.105	3.30	.640	.186	.215
15	N2P2K2S0	18.88	15.45	3.43	2.493	1.978	.515	12.8	15.0	.185	3.95	2.26	.134	.175	.090	3.65	.735	.156	.200
	S1	18.64	14.95	3.69	2.303	1.794	.509	12.0	13.8	.190	3.60	2.22	.114	.180	.095	3.40	.700	.158	.185
16	N1P0K2S0	12.60	10.08	2.52	1.733	1.310	.423	13.0	16.8	.090	2.85	2.42	.172	.225	.055	3.15	.820	.190	.270
	S1	12.80	9.99	2.81	1.761	1.309	.452	13.1	16.1	.150	2.95	2.38	.170	.175	.115	3.00	.850	.206	.235
17	N0P2K1S0	7.92	6.18	1.74	1.268	0.970	.298	15.7	17.1	.040	2.65	2.30	.138	.190	.045	2.85	.700	.156	.260
	S1	9.16	7.42	1.74	1.452	1.113	.339	15.0	19.5	.045	2.50	2.30	.150	.165	.050	2.60	.770	.160	.200
18	N1P2K0S0	15.48	12.52	2.96	2.260	1.778	.482	14.2	16.3	.175	2.45	2.54	.150	.190	.135	2.80	.890	.182	.190
	S1	17.76	13.42	4.34	2.530	1.827	.703	13.6	16.2	.290	2.40	2.76	.146	.185	.140	2.85	.840	.104	.170
19	N2P2K0S0	15.92	12.95	2.97	2.041	1.580	.461	12.2	14.5	.800	1.45	2.30	.190	.160	.600	2.05	.850	.166	.235
	S1	17.56	14.13	3.43	2.207	1.724	.483	12.2	14.1	.675	1.70	2.10	.170	.175	.700	2.15	.950	.156	.210
20	N0P1K0S0	10.12	8.10	2.02	1.538	1.150	.388	14.2	19.2	.105	2.60	2.32	.180	.165	.190	1.90	.750	.144	.190
	S1	9.00	6.84	2.16	1.388	1.019	.369	14.9	17.1	.190	2.20	2.00	.104	.160	.205	2.50	.835	.150	.215
21	N1P2K1S0	11.32	9.10	2.22	1.780	1.374	.406	15.1	18.3	.170	2.05	2.20	.144	.180	.060	2.60	.850	.182	.200
	S1	14.60	11.39	3.21	2.013	1.503	.510	13.2	15.9	.275	2.50	2.30	.150	.180	.180	2.70	.880	.156	.165
22	N0P0K1S0	5.24	4.17	1.07	0.859	0.646	.213	15.5	19.9	.030	2.80	2.22	.134	.200	.025	2.70	.720	.156	.175
	S1	7.84	6.27	1.57	1.244	0.941	.303	15.0	19.3	.070	2.85	2.46	.146	.150	.077	2.85	.750	.168	.190
23	N1P1K2S0	13.48	10.23	3.25	1.933	1.391	.542	13.6	16.7	.125	2.90	2.36	.152	.165	.085	2.85	.785	.156	.205
	S1	12.64	9.82	2.82	1.852	1.375	.477	14.0	16.9	.135	3.20	2.20	.114	.160	.085	3.15	.640	.176	.195
24	N0P2K2S0	6.88	5.61	1.27	1.115	0.864	.251	15.4	19.8	.015	2.85	2.40	.110	.145	.020	2.70	.835	.186	.255
	S1	8.93	7.32	1.61	1.404	1.098	.306	15.0	19.0	.065	2.90	2.60	.110	.150	.025	3.15	.680	.174	.220
25	N1P0K0S0	11.36	8.90	2.46	1.712	1.299	.413	14.6	16.8	.155	2.40	2.40	.184	.175	.090	2.90	.620	.174	.175
	S1	10.12	8.09	2.23	1.686	1.254	.432	15.5	19.4	.200	2.40	2.02	.124	.135	.075	2.40	.820	.152	.190
26	N2P1K1S0	13.80	10.90	2.90	1.790	1.384	.406	12.7	14.0	.190	2.85	2.20	.140	.175	.120	3.60	.925	.180	.230
	S1	16.76	13.41	3.35	2.166	1.690	.476	12.6	14.2	.220	3.00	2.20	.160	.160	.270	3.15	.920	.168	.220
27	N2P0K2S0	17.28	13.03	4.25	2.224	1.629	.595	12.5	14.0	.100	3.55	2.40	.146	.170	.075	3.75	.990	.166	.215
	S2	19.32	15.52	3.80	2.518	1.940	.578	12.5	15.2	.130	3.40	2.26	.122	.135	.110	3.60	.720	.168	.260

KALE. EXPERIMENT 3.

TOTAL FRESH YIELD. (tons)

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 1.18)						± 0.68
Ammonium Sulphate	0	8.88	10.88	8.56	9.69	9.09	9.57	9.44
	4.	14.16	13.86	14.55	14.17	15.13	13.27	14.19
	8	17.41	15.79	18.37	15.96	17.37	18.23	17.19
Superphosphate	0				12.58	14.27	13.61	13.48
	3				13.05	13.59	13.89	13.51
	6				14.19	13.70	13.58	13.82
Mean		13.48	13.51	13.82	13.27	13.85	13.69	13.61

S.E. per plot. 2.04 Sig. Diff. of means. Central. 5% 4.08 1% 6.18 Marginal. 5% 2.35 1% 3.56

Interactions NP + 0.64 NK + 1.20 PK − 0.77

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 1.00)						± 0.59
Ammonium Sulphate	0	+ 2.31	+ 0.69	+ 0.84	+ 0.16	+ 1.27	+ 1.03	+ 0.82
	4.	+ 0.85	+ 0.55	+ 1.81	+ 1.27	+ 2.20	− 0.25	+ 1.07
	8	+ 0.23	+ 1.49	+ 1.32	+ 1.04	+ 1.48	+ 0.52	+ 1.02
Superphosphate	0				+ 0.29	+ 1.71	+ 1.40	+ 1.13
	3				+ 1.13	+0 .88	− 0.66	+ 0.45
	6				+ 1.05	+ 2.36	+ 0.56	+ 1.33
Mean		+ 1.13	+ 0.45	+ 1.33	+ 0.82	+ 1.65	+ 0.43	+ 0.97*

S.E. per plot. 1.79 Sig. Diff. of means. Central. 5% 3.26 1% 4.74 Marginal. 5% 1.85 1% 2.70

Interactions NPS + 1.28 NKS − 0.70 PKS − 0.80
NS + 0.20 KS − 0.39 PS + 0.20

TOTAL DRY MATTER. (tons)

Main N P K Effects.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 0.131)						± 0.075
Ammonium Sulphate	0	1.359	1.603	1.375	1.511	1.389	1.436	1.446
	4	1.927	1.908	2.080	2.061	1.993	1.861	1.972
	8	2.224	2.017	2.340	2.018	2.208	2.355	2.193
Superphosphate	0				1.805	1.845	1.859	1.836
	3				1.775	1.827	1.926	1.843
	6				2.010	1.918	1.867	1.932
Mean		1.836	1.843	1.932	1.863	1.863	1.884	1.870

S.E. per plot. 0.226 Sig. Diff. of means. Central. 5% 0.453 1% 0.686 Marginal. 5% 0.259 1% 0.393

Interactions NP+0.050 NK + 0.206 PK − 0.099

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .132)						± .076
Ammonium Sulphate	0	+ .333	− .085	+ .131	+ .041	+ .209	+ .129	+ .126
	4	+ .131	+ .066	+ .083	+ .160	+ .216	− .102	+ .091
	8	+ .052	+ .178	+ .081	+ .107	+ .154	+ .051	+ .106
Superphosphate	0				+ .124	+ .198	+ .194	+ .172
	3				+ .064	+ .153	− .065	+ .051
	6				+ .118	+ .228	− .051	+ .098
Mean		+ .172	+ .051	+ .098	+ .102	+ .193	+ .026	+ .107*

S.E. per plot. 0.228 Sig. Diff. of means. Central. 5% .430 1% .625 Marginal. 5% .248 1% .361

Interactions NPS + .116 NKS − .074 PKS − .120
NS − .020 KS − .076 PS − .074

KALE. EXPERIMENT 3. Main N P K Effects. % Na. LEAF. Responses to Salt.

Main N P K Effects — % Na. LEAF

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean
		(± .055					)	± .032
Ammonium Sulphate	0	.151	.156	.068	.195	.095	.082	.125
	4	.171	.385	.199	.319	.305	.131	.252
	8	.431	.435	.437	.784	.360	.159	.434
Superphosphate	0				.396	.252	.105	.251
	3				.508	.291	.144	.325
	6				.363	.317	.124	.235
Mean		.251	.325	.235	.434	.253	.124	.270

S.E. per plot. .096 Sig. Diff. of means. Central. 5% .190 1% .288 Marginal. 5% .110 1% .168

Interactions NP + .044 NK - .256* PK + .026

Responses to Salt — % Na. LEAF

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean
		(± .039					)	± .023
Ammonium Sulphate	0	+.106	+ .072	+ .052	+ .146	+ .050	+ .034	+ .076
	4	+ .057	+ .070	+ .108	+ .103	+ .073	+ .058	+ .078
	8	+ .093	+ .032	- .013	+ .050	+ .062	.000	+ .037
Superphosphate	0				+ .157	+ .060	+ .039	+ .085
	3				+ .112	+ .062	.000	+ .058
	6				+ .031	+ .063	+ .053	+ .049
Mean		+ .085	+ .058	+ .049	+ .100	+ .062	+ .031	+ .064**

S.E. per plot. .068 Sig. Diff. of means. Central. 5% .127 1% .185 Marginal. 5% .075 1% .109

Interactions NPS - .026 NKS + .031 PKS + .070
NS - .039 KS - .069 PS - .036

% Na. STEM.

Main N P K Effects — % Na. STEM

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean
		(± .044					)	± .025
Ammonium Sulphate	0	.121	.157	.070	.199	.095	.055	.116
	4	.107	.249	.124	.220	.199	.095	.171
	8	.439	.359	.348	.708	.336	.101	.382
Superphosphate	0				.347	.242	.078	.222
	3				.471	.231	.097	.266
	6				.309	.156	.077	.181
Mean		.222	.266	.181	.376	.210	.084	.223

S.E. per plot. .076 Sig. Diff. of means. Central. 5% .152 1% .230 Marginal. 5% .086 1% .131

Interactions NP - .020 NK - .232** PK + .018

Responses to Salt — % Na. STEM

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean
		(± .049					)	± .028
Ammonium Sulphate	0	+ .106	+ .013	+ .013	+ .093	+ .016	+ .023	+ .044
	4	+ .037	+ .108	+ .072	+ .090	+ .087	+ .050	+ .076
	8	+ .130	+ .128	+ .045	+ .183	+ .112	+ .008	+ .101
Superphosphate	0				+ .120	+ .101	+ .042	+ .094
	3				+ .182	+ .062	+ .007	+ .083
	6				+ .045	+ .052	+ .033	+ .043
Mean		+ .094	+ .083	+ .043	+ .122	+ .071	+ .027	+ .073**

S.E. per plot. .085 Sig. Diff. of means. Central. 5% .160 1% .232 Marginal. 5% .091 1% .133

Interactions NPS + .004 NKS - .102 PKS + .033
NS - .057 KS - .095* PS = .051

KALE. EXPERIMENT 3. Main N P K Effects. % K. LEAF. Responses to Salt.

% K. LEAF.

Main N P K Effects

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 0.25)						± 0.14
Ammonium Sulphate	0	2.73	2.62	2.81	2.60	2.65	2.89	2.72
	4	2.88	2.42	2.73	2.28	2.61	3.14	2.68
	8	2.40	2.43	2.69	1.54	2.54	3.44	2.51
Superphosphate	0				2.19	2.71	3.10	2.67
	3				1.91	2.57	3.00	2.49
	6				2.33	2.52	3.38	2.74
Mean		2.67	2.49	2.74	2.14	2.60	3.16	2.63

S.E. per plot. 0.43 Sig. Diff. of means. Central. 5% 0.87 1% 1.31; Marginal. 5% 0.48 1% 0.73

Interactions NP + 0.10 NK + 0.80 PK + 0.07

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 0.20)						± 0.11
Ammonium Sulphate	0	+ .43	- .53	- .12	- .27	- .23	+ .28	- .07
	4	+ .18	+ .12	+ .38	+ .05	+ .25	+ .38	+ .23
	8	+ .22	+ .07	+ .15	+ .15	+ .45	- .17	+ .14
Superphosphate	0				.00	+ .42	+ .42	+ .28
	3				- .02	- .20	- .13	- .12
	6				- .05	+ .25	+ .22	+ .14
Mean		+ .28	- .12	+ .14	- .02	+ .16	+ .17	+ .10

S.E. per plot. 0.34 Sig. Diff. of means. Central. 5% 0.66 1% 0.94; Marginal. 5% 0.36 1% 0.52

Interactions NPS + 0.24 NKS - 0.44 PKS - 0.07; NS + 0.21 KS + 0.19 PS - 0.14

% K. STEM.

Main N P K Effects

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 0.20)						± 0.12
Ammonium Sulphate	0	2.70	2.83	2.79	2.77	2.83	3.06	2.77
	4	3.05	2.63	3.01	2.56	2.93	3.21	2.90
	8	2.85	2.87	2.83	2.07	2.89	3.59	2.85
Superphosphate	0				2.49	2.88	3.24	2.87
	3				2.03	3.02	3.28	2.78
	6				2.55	2.75	3.33	2.88
Mean		2.87	2.78	2.88	2.36	2.88	3.28	2.84

S.E. per plot. 0.35 Sig. Diff. of means. Central. 5% 0.70 1% 1.05; Marginal. 5% 0.42 1% 0.63

Interactions NP - 0.05 NK + 0.62 PK + 0.01

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± 0.23)						± 0.13
Ammonium Sulphate	0	+ .40	+ .15	+ .05	+ .17	- .08	+ .52	+ .20
	4	- .17	+ .10	+ .52	- .08	+ .02	+ .52	+ .15
	8	.00	- .10	- .07	- .08	- .02	- .07	- .06
Superphosphate	0				- .28	+ .25	+ .27	+ .08
	3				+ .25	- .27	+ .17	+ .05
	6				+ .03	- .07	+ .53	+ .17
Mean		+ .08	+ .05	+ .17	.00	- .03	+ .32	+ .10

S.E. per plot. 0.40 Sig. Diff. of means. Central. 5% 0.75 1% 1.09; Marginal. 5% 0.42 1% 0.62

Interactions NPS + 0.14 NKS - 0.17 PKS - 0.02; NS - 0.26 KS + 0.32 PS + 0.09

KALE. EXPERIMENT 3. Main N P K Effects. % Ca. LEAF. Responses to Salt.

% Ca. LEAF.

Main N P K Effects

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean (± 0.05)
		(± 0.08)						
Ammonium Sulphate	0	2.32	2.29	2.38	2.26	2.37	2.36	2.33
	4	2.28	2.36	2.40	2.42	2.30	2.33	2.34
	8	2.34	2.38	2.21	2.38	2.21	2.34	2.31
Superphosphate	0				2.32	2.27	2.35	2.32
	3				2.35	2.36	2.33	2.34
	6				2.39	2.25	2.35	2.33
Mean		2.32	2.34	2.33	2.35	2.29	2.34	2.33

S.E. per plot. 0.14 Sig. Diff. of means. Central. 5% 0.28 1% 0.42 Marginal. 5% 0.17 1% 0.26

Interactions NP − 0.10 NK − 0.07 PK − 0.03

Responses to Salt

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean (± .08)
		(± .14)						
Ammonium Sulphate	0	− .01	− .19	+ .06	+ .02	+ .17	− .32	− .04
	4	− .11	− .04	+ .09	− .07	+ .09	− .08	− .02
	8	+ .11	− .05	− .08	+ .09	+ .03	− .13	− .01
Superphosphate	0				+ .14	+ .13	− .28	.00
	3				− .11	+ .12	− .29	− .09
	6				.00	+ .03	+ .04	+ .02
Mean		.00	− .09	+ .02	− .01	+ .09	− .13	− .02

S.E. per plot. .25 Sig. Diff. of means. Central. 5% .45 1% .66 Marginal. 5% .26 1% .38

Interactions NPS − .13 NS + .03 NKS + .06 KS − .14 PKS + .23 PS + .02

% Ca. STEM.

Main N P K Effects

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean (± .027)
		(± .047)						
Ammonium Sulphate	0	.738	.750	.731	.784	.744	.691	.739
	4	.755	.833	.843	.823	.825	.783	.810
	8	.849	.818	.794	.918	.809	.734	.820
Superphosphate	0				.845	.728	.770	.781
	3				.866	.862	.679	.800
	6				.822	.788	.759	.790
Mean		.781	.800	.790	.842	.793	.736	.790

S.E. per plot. .082 Sig. Diff. of means. Central. 5% .162 1% .246 Marginal. 5% .093 1% .141

Interactions NP − .024 NK − .045 PK + .006

Responses to Salt

CWT/ACRE		Superphosphate 0	Superphosphate 3	Superphosphate 6	Potassium Chloride 0	Potassium Chloride 1½	Potassium Chloride 3	Mean (± .028)
		(± .049)						
Ammonium Sulphate	0	− .030	+ .003	− .042	− .025	+ .045	− .088	− .023
	4	− .050	− .085	+ .007	− .107	+ .003	− .025	− .043
	8	− .178	− .022	+ .012	− .003	− .077	− .108	− .063
Superphosphate	0				− .130	− .048	− .080	− .086
	3				− .008	− .003	− .092	− .034
	6				+ .003	+ .023	− .050	− .008
Mean		− .086	− .034	− .008	− .045	− .009	− .074	− .053*

S.E. per plot. .085 Sig. Diff. of means. Central. 5% .160 1% .232 Marginal. 5% .091 1% .133

Interactions NPS + .101 NS − .040 NKS − .021 KS − .029 PKS − .051 PS + .078

KALE. EXPERIMENT 3.

% Mg. LEAF.

Main N P K Effectes.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN ± .006
		(± .010)						
Ammonium Sulphate	0	.148	.140	.127	.149	.139	.126	.139
	4	.163	.168	.142	.165	.163	.145	.158
	8	.176	.163	.140	.193	.153	.133	.160
Superphosphate	0				.178	.165	.143	.162
	3				.178	.154	.139	.157
	6				.152	.136	.122	.136
Mean		.162	.157	.136	.169	.152	.135	.152

S.E. per plot. .018 Sig. Diff. of means. Central. 5% .035 1% .052; Marginal. 5% .021 1% .031

Interactions NP - .007 NK - .018 PK + .002

Responses to Salt.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN ± .009
		(± .016)						
Ammonium Sulphate	0	+ .006	- .029	+ .003	- .021	+ .009	- .008	- .007
	4	- .011	- .008	- .002	- .019	+ .014	- .016	- .007
	8	- .028	- .016	- .016	- .041	+ .002	- .022	- .019
Superphosphate	0				- .033	+ .012	- .012	- .011
	3				- .038	+ .009	- .025	- .018
	6				- .009	+ .010	- .029	- .005
Mean		- .011	- .018	- .005	- .027	+ .008	- .015	- .011

S.E. per plot. .027 Sig. Diff. of means. Central. 5% .052 1% .076; Marginal. 5% .029 1% .043

Interactions NPS + .007 NKS + .003 PKS - .020; NS - .012 KS + .012 PS + .006

% Mg. STEM.

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN ± .007
		(± .012)						
Ammonium Sulphate	0	.148	.161	.168	.153	.161	.163	.159
	4	.163	.173	.156	.161	.157	.174	.164
	8	.169	.154	.157	.167	.160	.152	.160
Superphosphate	0				.164	.148	.167	.160
	3				.161	.170	.157	.163
	6				.156	.160	.164	.160
Mean		.160	.163	.160	.160	.159	.163	.161

S.E. per plot. .020 Sig. Diff. of means. Central. 5% .042 1% .063; Marginal. 5% .024 1% .037

Interactions NP - .016 NK - .012 PK + .002

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN ± .010
		(± .017)						
Ammonium Sulphate	0	- .008	- .003	- .019	- .045	+ .010	+ .004	- .010
	4	+ .017	- .003	- .029	- .036	+ .003	+ .017	- .005
	8	.000	- .014	- .019	+ .005	- .025	- .014	- .011
Superphosphate	0				- .034	+ .018	+ .024	+ .003
	3				+ .005	- .006	- .019	- .007
	6				- .046	- .024	+ .002	- .023
Mean		+ .003	- .007	- .023	- .025	- .004	+ .002	- .009

S.E. per plot. .030 Sig. Diff. of means. Central. 5% .055 1% .081; Marginal. 5% .032 1% .047

Interactions NPS - .004 NKS - .034 PKS - .005; NS - .001 KS + .027 PS - .026

KALE. EXPERIMENT 3. Main N P K Effects. % P. LEAF. Responses to Salt.

% P. LEAF — Main N P K Effects

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .005)						± .003
Ammonium Sulphate	0	.189	.175	.175	.184	.184	.171	.180
	4	.182	.157	.214	.173	.168	.213	.184
	8	.172	.166	.194	.169	.189	.173	.177
Superphosphate	0				.182	.177	.185	.181
	3				.159	.166	.172	.166
	6				.185	.198	.200	.194
Mean		.181	.166	.194	.175	.180	.186	.180

S.E. per plot. .009 Sig. Diff. of means. Central. 5% .017 1% .026; Marginal. 5% .010 1% .016

Interactions NP + .018* NK + .008 PK + .006

% P. LEAF — Responses to Salt

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .009)						± .005
Ammonium Sulphate	0	+ .002	- .008	- .015	- .003	- .033	+ .015	- .007
	4	- .042	- .003	- .005	- .012	- .017	- .022	- .017
	8	- .028	+ .015	+ .013	+ .012	- .008	- .003	.000
Superphosphate	0				- .013	- .038	- .017	- .023
	3				+ .015	- .018	+ .007	+ .001
	6				- .005	- .002	.000	- .002
Mean		- .023	+ .001	- .002	- .001	- .019	- .003	- .008*

S.E. per plot. .015 Sig. Diff. of means. Central. 5% .029 1% .043; Marginal. 5% .016 1% .024

Interactions NPS + .029* NS + .007 NKS - .012 KS - .002 PKS + .004 PS + .021*

% P. STEM — Main N P K Effects

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .015)						± .009
Ammonium Sulphate	0	.200	.219	.219	.197	.218	.224	.213
	4	.205	.203	.215	.196	.183	.245	.208
	8	.211	.213	.204	.208	.208	.212	.210
Superphosphate	0				.192	.188	.236	.205
	3				.211	.217	.207	.212
	6				.197	.204	.237	.213
Mean		.205	.212	.213	.200	.203	.227	.210

S.E. per plot. .026 Sig. Diff. of means. Central. 5% .052 1% .079; Marginal. 5% .031 1% .047

Interactions NP - .018 NK - .012 PK - .002

% P. STEM — Responses to Salt

CWT/ACRE		SUPERPHOSPHATE 0	SUPERPHOSPHATE 3	SUPERPHOSPHATE 6	POTASSIUM CHLORIDE 0	POTASSIUM CHLORIDE 1½	POTASSIUM CHLORIDE 3	MEAN
		(± .011)						± .006
Ammonium Sulphate	0	- .027	- .022	- .042	- .037	- .028	- .025	- .030
	4	- .023	- .008	- .017	- .017	- .018	- .013	- .016
	8	- .017	- .033	- .002	- .017	.000	- .035	- .017
Superphosphate	0				- .017	- .010	- .040	- .022
	3				- .028	- .017	- .018	- .021
	6				- .025	- .020	- .015	- .020
Mean		- .022	- .021	- .020	- .023	- .016	- .024	- .021**

S.E. per plot. .019 Sig. Diff. of means. Central. 5% .036 1% .052; Marginal. 5% .019 1% .028

Interactions NPS + .015 NS + .013 NKS - .015 KS - .001 PKS + .018 PS + .002

KALE. EXPERIMENT 4.

		FRESH YIELD tons			DRY MATTER tons			% D.M.		LEAF. % D.M.					STEM. % D.M.				
		Total	Leaf	Stem	Total	Leaf	Stem	Leaf	Stem	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
1	P1 K1 S1	12.92	6.20	6.72	1.531	.812	.719	13.1	10.7	.625	2.85	2.88	.116	.195	.675	4.30	1.14	.124	.210
2	P0 K1 S2	9.88	4.97	4.91	1.275	.666	.609	13.4	12.4	.445	2.80	3.40	.190	.170	.402	4.00	1.27	.184	.170
3	P0 K2 S1	12.52	6.19	6.33	1.476	.755	.721	12.2	11.4	.245	3.00	2.50	.150	.200	.340	4.30	0.95	.142	.210
4	P2 K2 S2	16.44	8.03	8.41	1.959	.923	1.026	11.5	12.2	.330	3.75	2.20	.144	.220	.395	4.15	0.88	.136	.275
5	P0 K0 S0	7.44	4.22	3.22	.960	.557	.403	13.2	12.5	.175	2.70	3.00	.140	.210	.205	3.90	1.29	.142	.185
6	P1 K2 S0	13.36	6.22	7.14	1.633	.833	.800	13.4	11.2	.280	2.50	2.96	.162	.165	.325	3.95	1.16	.174	.225
7	P2 K0 S1	14.78	7.40	7.38	1.833	.925	.908	12.5	12.3	.660	1.75	3.20	.240	.225	.900	2.65	0.97	.166	.300
8	P2 K1 S0	12.27	5.15	7.12	1.624	.741	.883	14.4	12.4	.375	2.20	2.64	.176	.240	.445	4.80	0.88	.150	.250
9	P1 K0 S2	15.34	8.31	7.03	1.773	1.014	.759	12.2	10.8	.810	1.85	2.42	.172	.220	.700	4.10	0.97	.150	.320
10	P2 K0 S0	16.93	8.88	8.05	2.249	1.154	1.095	13.0	13.6	.210	2.30	3.14	.188	.220	.315	3.20	0.94	.150	.340
11	P1 K1 S0	15.89	8.03	7.86	2.300	1.084	1.116	13.5	14.2	.095	2.90	3.00	.172	.180	.110	3.70	0.93	.142	.265
12	P1 K2 S2	13.21	6.44	6.77	1.737	.837	.900	13.0	13.3	.210	2.70	2.52	.140	.210	.140	4.40	0.84	.142	.315
13	P0 K1 S1	9.92	5.30	4.62	1.363	.684	.679	12.9	14.7	.720	2.90	2.60	.120	.230	1.320	4.70	0.97	.184	.250
14	P2 K1 S2	16.50	8.28	8.22	2.014	1.060	.954	12.8	11.6	.815	1.90	2.60	.180	.245	1.050	3.85	0.82	.134	.340
15	P1 K0 S1	14.04	7.04	7.00	1.825	.908	.917	12.7	13.3	.475	2.00	2.72	.200	.235	.487	3.30	0.82	.158	.330
16	P0 K0 S2	10.91	5.70	5.21	1.230	.667	.563	11.8	10.8	1.270	2.05	2.92	.192	.220	1.520	4.20	0.82	.188	.265
17	P2 K2 S1	16.06	7.67	8.39	1.811	.905	.906	11.8	10.8	.475	3.50	2.52	.176	.265	.387	5.00	0.88	.174	.320
18	P0 K2 S0	10.48	5.48	5.00	1.217	.652	.565	11.9	11.3	.300	3.00	2.25	.176	.265	.370	5.15	0.85	.208	.285
19	P1 K2 S1	16.28	8.16	8.12	1.946	.996	.950	12.2	11.7	.455	2.65	2.82	.212	.255	.380	4.50	0.85	.244	.315
20	P1 K1 S2	14.42	7.20	7.22	1.751	.900	.851	12.5	11.8	.460	2.00	2.58	.186	.200	.850	3.95	0.99	.166	.265
21	P0 K1 S0	11.71	5.71	6.00	1.371	.765	.606	13.4	10.1	.185	3.65	2.25	.160	.245	.262	5.50	0.72	.192	.305
22	P2 K2 S0	13.63	7.41	6.22	1.632	.904	.728	12.2	11.7	.160	3.00	2.56	.140	.235	.210	4.65	0.62	.160	.265
23	P2 K0 S2	16.26	8.01	8.25	2.080	1.049	1.031	13.1	12.5	1.100	2.05	2.21	.146	.210	1.525	3.90	0.72	.162	.230
24	P2 K1 S1	16.25	8.25	8.00	2.016	1.064	.952	12.9	11.9	.415	2.75	2.84	.162	.195	.495	4.00	0.68	.184	.270
25	P1 K0 S0	14.74	8.64	7.10	1.989	1.123	.866	13.0	12.2	.460	2.60	2.52	.160	.165	.462	4.10	0.72	.174	.275
26	P0 K2 S2	14.92	7.49	7.43	1.917	.981	.936	13.2	12.5	.410	3.00	2.00	.100	.160	.437	3.60	0.93	.134	.155
27	P0 K0 S1	9.01	5.01	4.00	1.210	.686	.524	13.7	13.1	.720	2.35	2.42	.108	.140	1.020	3.95	0.85	.140	.200

Total Fresh Yield. (tons)

CWT./ACRE		POTASSIUM CHLORIDE 0	1½	3	SALT 0	3	6	MEAN
				(± 0.87)				± 0.50
Superphosphate	0	9.12	10.50	12.64	9.88	10.48	11.90	10.75
	3	14.71	14.41	14.28	14.66	14.41	14.32	14.47
	6	15.99	15.01	15.38	14.28	15.69	16.40	15.46
Potassium chloride	0				13.03	12.61	14.17	13.27
	1½				13.29	13.03	13.60	13.31
	3				12.49	14.95	14.86	14.10
Mean		13.27	13.31	14.10	12.94	.3.53	14.21	13.56

S.E. per plot 1.51 Sig. Diff. of means. Central. 5% 3.01 1% 4.56
Marginal. 5% 1.73 1% 2.62

Interactions PK -2.06 PS +0.06 KS +0.62

Total Dry Matter. (tons)

CWT./ACRE		POTASSIUM CHLORIDE 0	1½	3	SALT 0	3	6	MEAN
				(± 0.106)				± 0.061
Superphosphate	0	1.133	1.336	1.537	1.183	1.359	1.474	1.335
	3	1.862	1.861	1.772	1.974	1.767	1.754	1.832
	6	2.054	1.885	1.801	1.835	1.887	2.018	1.913
Potassium chloride	0				1.733	1.623	1.694	1.683
	1½				1.765	1.637	1.680	1.694
	3				1.494	1.744	1.871	1.703
Mean		1.683	1.694	1.703	1.664	1.667	1.749	1.693

S.E. per plot 0.184 Sig. Diff. of means. Central. 5% 0.367 1% 0.555
Marginal. 5% 0.211 1% 0.320

Interactions PK -0.329 PS - 0.054 KS - 0.208

% Na. LEAF.

CWT./ACRE		Potassium chloride 0	Potassium chloride 1½	Potassium chloride 3	Salt 0	Salt 3	Salt 6	Mean
				(± .024)				± .014
Superphosphate	0	.723	.450	.318	.220	.562	.710	.497
	3	.582	.393	.315	.278	.518	.493	.430
	6	.657	.535	.322	.248	.517	.748	.505
Potassium chloride	0				.282	.618	1.062	.654
	1½				.218	.587	.573	.459
	3				.247	.392	.317	.318
Mean		.654	.459	.318	.249	.532	.651	.477

S.E. per plot .043 — Sig. Diff. of means. Central. 5% .083 1% .126; Marginal. 5% .048 1% .073

Interactions PK + .035 PS +.003 KS − .355**

% Na. STEM

CWT./ACRE		Potassium chloride 0	Potassium chloride 1½	Potassium chloride 3	Salt 0	Salt 3	Salt 6	Mean
				(± .060)				± .034
Superphosphate	0	.915	.661	.382	.279	.893	.786	.653
	3	.550	.545	.282	.299	.514	.563	.459
	6	.913	.623	.332	.323	.594	.990	.636
Potassium chloride	0				.327	.802	1.248	.793
	1½				.272	.830	.767	.623
	3				.302	.369	.324	.332
Mean		.793	.623	.332	.300	.667	.780	.582

S.E. per plot .103 — Sig. Diff. of means. Central. 5% .207 1% .314; Marginal. 5% .118 1% .178

Interactions PK − .025 PS + .079 KS − .222**

% K. LEAF.

CWT./ACRE		POTASSIUM CHLORIDE 0	1½	3	SALT 0	3	6	MEAN ± 0.08
				(± 0.14)				
Superphosphate	0	2.37	3.12	3.00	3.12	2.76	2.62	2.83
	3	2.15	2.58	2.62	2.67	2.50	2.18	2.45
	6	2.03	2.28	3.42	2.50	2.67	2.57	2.58
Potassium chloride	0				2.53	2.03	1.98	2.18
	1½				2.92	2.83	2.23	2.66
	3				2.83	3.05	3.15	3.03
Mean		2.18	2.66	3.03	2.76	2.64	2.46	2.62

S.E. per plot 0.24 — Sig. Diff. of means. Central. 5% 0.48 1% 0.73; Marginal. 5% 0.28 1% 0.42

Interactions PK + 0.38 PS + 0.28 KS + 0.43

% K. STEM.

CWT./ACRE		POTASSIUM CHLORIDE 0	1½	3	SALT 0	3	6	MEAN ± 0.15
				(± 0.27)				
Superphosphate	0	4.02	4.73	4.35	4.85	4.32	3.93	4.37
	3	3.83	3.98	4.28	3.92	4.03	4.15	4.03
	6	3.25	4.22	4.60	4.22	3.88	3.97	4.02
Potassium chloride	0				3.73	3.30	4.07	3.70
	1½				4.67	4.33	3.93	4.31
	3				4.58	4.60	4.05	4.41
Mean		3.70	4.31	4.41	4.33	4.09	4.02	4.14

S.E. per plot 0.46 — Sig. Diff. of means. Central. 5% 0.93 1% 1.41; Marginal. 5% 0.52 1% 0.79

Interactions PK + 0.51 PS + 0.33 KS - 0.43

% Ca. LEAF.

CWT./ACRE		POTASSIUM CHLORIDE 0	1½	3	SALT 0	3	6	MEAN
				(± 0.13)				± 0.07
Superphosphate	0	2.78	2.75	2.25	2.50	2.51	2.77	2.59
	3	2.55	2.82	2.77	2.83	2.81	2.51	2.71
	6	2.85	2.69	2.43	2.78	2.85	2.34	2.66
Potassium chloride	0				2.89	2.78	2.52	2.73
	1½				2.63	2.77	2.86	2.75
	3				2.59	2.61	2.24	2.48
Mean		2.73	2.75	2.48	2.70	2.72	2.54	2.65

S.E. per plot 0.22

Sig. Diff. of means. Central. 5% 0.45 1% 0.68
Marginal. 5% 0.24 1% 0.37

Interactions PK + 0.05 PS - 0.36 KS + 0.01

% Ca. STEM.

CWT./ACRE		POTASSIUM CHLORIDE 0	1½	3	SALT 0	3	6	MEAN
				(± 0.07)				± 0.04
Superphosphate	0	.99	.99	.91	.95	.92	1.01	.96
	3	.84	1.02	.95	.94	.94	.93	.94
	6	.88	.79	.79	.81	.84	.81	.82
Potassium chloride	0				.98	.88	.84	.90
	1½				.84	.93	1.03	.93
	3				.88	.89	.88	.88
Mean		.90	.93	.88	.90	.90	.92	.91

S.E. per plot 0.12

Sig. Diff. of means. Central. 5% 0.24 1% 0.37
Marginal. 5% 0.14 1% 0.21

Interactions PK 0.00 PS - 0.03 KS + 0.08

% Mg. LEAF.

CWT./ACRE		POTASSIUM CHLORIDE 0	1½	3	SALT 0	3	6	MEAN
				(± .017)				± .010
Superphosphate	0	.147	.157	.142	.159	.126	.161	.148
	3	.177	.158	.171	.165	.176	.166	.168
	6	.191	.173	.153	.168	.193	.157	.172
Potassium chloride	0				.163	.183	.170	.172
	1½				.169	.133	.185	.162
	3				.159	.179	.128	.156
Mean		.172	.162	.156	.164	.165	.161	.163

S.E. per plot .030 Sig. Diff. of means. Central. 5% .059 1% .089
Marginal. 5% .035 1% .052

Interactions PK -.017 PS -.007 KS - .019

% Mg. STEM

CWT./ACRE		POTASSIUM CHLORIDE 0	1½	3	SALT 0	3	6	MEAN
				(± .016)				± .009
Superphosphate	0	.157	.187	.161	.181	.165	.169	.168
	3	.161	.144	.187	.163	.175	.153	.164
	6	.159	.156	.157	.153	.175	.144	.157
Potassium chloride	0				.155	.155	.167	.159
	1½				.161	.164	.161	.162
	3				.181	.187	.137	.168
Mean		.159	.162	.168	.166	.168	.155	.163

S.E. per plot .027 Sig. Diff. of means. Central. 5% .055 1% .084
Marginal. 5% .031 1% .047

Interactions PK - .007 PS + .003 KS - .028

% P. LEAF

CWT./ACRE		POTASSIUM CHLORIDE 0	1½	3	SALT 0	3	6	MEAN
				(± .013)				± .007
Superphosphate	0	.190	.215	.208	.240	.190	.183	.204
	3	.207	.192	.210	.170	.228	.210	.202
	6	.218	.227	.240	.232	.228	.225	.228
Potassium chloride	0				.198	.200	.217	.205
	1½				.222	.210	.205	.211
	3				.222	.240	.197	.219
Mean		.205	.211	.219	.214	.216	.206	.212

S.E. per plot .022 — Sig. Diff. of means. Central. 5% .045 1% .068; Marginal. 5% .024 1% .037

Interactions PK + .002 PS + .025 KS − .022

% P. STEM.

CWT./ACRE		POTASSIUM CHLORIDE 0	1½	3	SALT 0	3	6	MEAN
				(± .024)				± .014
Superphosphate	0	.217	.242	.217	.258	.220	.197	.225
	3	.308	.247	.285	.255	.285	.300	.280
	6	.290	.287	.287	.285	.297	.282	.288
Potassium chloride	0				.267	.277	.272	.272
	1½				.273	.243	.258	.258
	3				.258	.282	.248	.263
Mean		.272	.258	.263	.266	.267	.259	.264

S.E. per plot .042 — Sig. Diff. of means. Central. 5% .083 1% .126; Marginal. 5% .048 1% .073

Interactions PK − .003 PS + .029 KS − .009

		FRESH YIELD tons			% D.M.		DRY MATTER tons			LEAF % D.M.					STEM % D.M.				
		Total	Leaf	Stem	Leaf	Stem	Total	Leaf	Stem	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
1	N	10.10	6.75	3.35	11.9	13.9	1.269	.803	.466	.270	2.45	3.25	.110	.260	.260	3.70	0.95	.210	.235
2	K	11.12	8.02	3.10	11.9	14.0	1.250	.954	.296	.125	2.70	2.78	.110	.210	.100	4.05	1.32	.198	.290
3	P K S	17.28	12.24	5.04	11.2	13.1	2.031	1.371	.660	.365	2.40	2.78	.158	.260	.270	3.90	0.75	.174	.330
4	S	9.72	6.12	3.60	12.3	14.2	1.264	.753	.511	.400	1.60	2.42	.118	.200	.462	2.60	0.88	.174	.260
5	N P K	21.36	15.28	6.08	10.9	12.9	2.450	1.666	.784	.105	2.60	3.00	.160	.255	.125	4.60	1.00	.196	.280
6	N K S	11.00	8.00	3.00	12.0	13.8	1.354	.960	.414	.155	2.80	2.60	.140	.215	.180	4.80	1.11	.196	.280
7	P	11.68	8.12	3.56	11.9	13.7	1.454	.966	.488	.300	1.20	3.75	.130	.255	.420	2.90	1.25	.198	.330
8	N P S	15.85	11.55	4.30	11.8	13.0	1.922	1.363	.559	.900	1.55	2.92	.130	.250	.750	3.25	1.25	.182	.320
9	-	9.22	6.02	3.20	12.2	14.2	1.188	.734	.454	.350	1.55	2.70	.132	.215	.390	2.70	1.10	.200	.265
10	N P K S	23.80	17.60	6.20	11.0	13.2	2.754	1.936	.818	.305	2.90	3.00	.130	.260	.410	4.50	1.10	.196	.260
11	K S	12.22	9.12	3.10	12.0	13.6	1.516	1.094	.422	.375	2.90	3.12	.182	.275	.285	4.70	1.14	.182	.260
12	N P	15.76	10.72	5.04	11.2	13.3	1.871	1.201	.670	.270	1.50	3.20	.194	.210	.290	3.45	1.32	.214	.320
13	N S	12.85	8.55	4.30	11.9	13.6	1.602	1.017	.585	.680	2.55	3.15	.128	.245	.595	3.80	0.90	.196	.255
14	P S	15.32	10.28	5.04	11.5	13.5	2.502	1.822	.680	1.070	1.40	2.46	.158	.245	.850	3.05	0.88	.166	.290
15	P K	23.04	17.00	6.04	11.0	13.2	2.667	1.870	.797	.195	2.90	3.36	.160	.200	.340	3.70	0.95	.198	.290
16	N K	12.56	9.00	3.56	11.8	13.7	1.550	1.062	.488	.160	2.70	2.50	.174	.230	.175	4.80	1.18	.206	.275
17	P	14.00	10.50	3.50	11.5	13.4	1.677	1.208	.469	.310	1.60	3.25	.166	.265	.410	3.20	1.27	.188	.295
18	N	10.72	8.02	2.70	12.2	13.6	1.345	.978	.367	.135	2.55	3.46	.174	.290	.200	4.15	1.25	.222	.220
19	P K S	20.12	16.08	4.04	11.0	13.2	2.302	1.769	.533	.335	2.35	2.89	.116	.290	.305	4.30	1.06	.226	.290
20	K	11.04	8.00	3.04	12.0	13.8	1.380	.960	.420	.065	2.70	2.70	.134	.210	.070	4.80	1.02	.214	.300
21	S	9.12	6.12	3.00	12.5	13.7	1.176	.765	.411	.530	1.80	2.70	.154	.220	.515	2.90	1.10	.188	.255
22	N K S	9.76	6.44	3.32	12.2	14.1	1.254	.786	.468	.140	2.85	2.70	.124	.200	.165	4.70	1.25	.214	.235
23	N.P K	22.48	16.24	6.24	12.0	13.8	2.810	1.949	.861	.085	2.50	3.08	.140	.260	.105	4.15	1.25	.190	.330
24	N P S	20.06	15.06	5.00	10.9	13.0	2.292	1.642	.650	.700	2.00	3.00	.142	.260	.750	3.65	1.25	.222	.260
25	-	8.68	6.08	2.60	12.2	14.2	1.111	.742	.369	.355	1.50	3.00	.112	.210	.365	2.65	0.95	.176	.260
26	N P K S	23.12	17.10	6.02	10.8	13.2	2.642	1.847	.795	.225	2.00	3.08	.116	.210	.305	4.60	0.95	.222	.260
27	N K	10.92	7.82	3.10	11.9	13.7	1.355	.931	.424	.065	2.85	2.58	.124	.190	.105	5.00	1.18	.214	.290
28	N P	18.12	12.10	6.02	11.2	13.2	2.150	1.355	.795	.325	1.20	3.60	.150	.220	.285	3.50	1.06	.244	.300
29	P S	14.12	10.06	4.06	11.5	13.6	1.709	1.157	.552	.780	1.55	2.76	.156	.235	.770	3.60	1.10	.188	.290
30	P K	16.00	10.50	5.50	11.6	13.5	1.961	1.218	.743	.295	2.05	3.20	.130	.210	.355	4.25	0.88	.230	.280
31	N S	12.21	9.12	3.09	11.8	13.6	1.496	1.076	.420	.520	1.95	2.92	.118	.235	.405	4.50	0.78	.198	.275
32	K S	17.10	12.10	5.00	11.5	13.4	2.061	1.391	.670	.235	2.85	2.58	.106	.210	.165	4.70	0.96	.180	.290

KALE. EXPERIMENT 5.

DIFFERENTIAL RESPONSES Fresh and Dry Yields. (tons)

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	Fresh	+ 1.06	–	–	+ 1.28	+ 0.84	+ 1.21	+ 0.91	+ 1.38	+ 0.74
	Dry	+ .149	–	–	+ .233	+ .065	+ .158	+ .140	+ .237	+ .061
Ammonium Sulphate 3 + 3 T.D.	Fresh	+ 1.93**	+ 2.15**	+ 1.71	–	–	+ 0.24	+ 3.62**	+ 2.97**	+ 0.89
	Dry	+ .179**	+ .263*	+ .095	–	–	+ .035	+ .323*	+ .242*	+ .125
Superphosphate 3	Fresh	+ 7.11**	+ 7.26**	+ 6.96**	+ 5.40**	+ 8.82**	–	–	+ 5.28**	+ 8.92**
	Dry	+ .814**	+ .823**	+ .805**	+ .670**	+ .958**	–	–	+ .641**	+ .987**
Potassium Chloride 3	Fresh	+ 3.40**	+ 3.72**	+ 3.08**	+ 4.45**	+ 2.35*	+ 1.58	+ 5.22**	–	–
	Dry	+ .332**	+ .420**	+ .244*	+ .386**	+ .278*	+ .159	+ .505**		

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	INTERACTIONS PS	INTERACTIONS NP	INTERACTIONS KS	INTERACTIONS NK	INTERACTIONS PK
Fresh	14.70	1.78	0.89	0.63	– 0.22	– 0.15	+ 1.69*	– 0.32	– 1.04	+ 1.82*
Dry	1.793	.242	.121	.086	– .084	– .009	+ .144	– .088	– .054	+ .173

KALE. EXPERIMENT 5..

DIFFERENTIAL RESPONSES % Na.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Leaf Stem	+ .269** +.199**	- -	- -	+ .262** + .146**	+ .276** + .252**	+ .189** + .139**	+ .349** + .259**	+ .408** + .309**	+ .130** + .089*
Ammonium Sulphate 3 + 3 T.D.	Leaf Stem	- .065* - .060	- .072 - .113*	- .058 - .007	- -	- -	- .038 - .120**	- .092* .000	- .037 - .080	- .093* - .040
Superphosphate 3.	Leaf Stem	+ .124** + .115**	+ .044 + .055	+ .204** + .175**	+ .151** + .142**	+ .097* + .088*	- -	- -	+ .176* + .131**	+ .072 + .099*
Potassium Chloride 3.	Leaf Stem	- .292** - .266**	- .153** - .156**	- .431** - .376**	- .264** - .286**	- .320** - .246**	- .240** - .250**	- .344** - .282**	- -	- -

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Leaf Stem	.348 .349	.081 .077	.040 .038	.028 .027	+ .007 + .053	+ .080* + .060	- .027 - .027	- .139** - .266**	- .028 - .020	- .052 - .016

KALE. EXPERIMENT 5.

DIFFERENTIAL RESPONSES % K.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	Leaf	+ 0.06	-	-	+ 0.09	+ 0.03	+ 0.05	+ 0.07	+ 0.11	+ 0.01
	Stem	+ 0.12	-	-	+ 0.19	+ 0.05	+ 0.10	+ 0.14	+ 0.14	+ 0.10
Ammonium Sulphate 3 + 3 T.D.	Leaf	+ 0.24*	+ 0.27	+ 0.21	-	-	+ 0.35*	+ 0.10	+ 0.44*	+ 0.04
	Stem	+ 0.57**	+ 0.64**	+ 0.50**	-	-	+ 0.79**	+ 0.35*	+ 0.80**	+ 0.34*
Superphosphate 3	Leaf	- 0.41**	- 0.42*	- 0.40*	- 0.27	- 0.65*	-	-	- 0.49*	- 0.33*
	Stem	- 0.25**	- 0.27*	- 0.23	- 0.03	- 0.47**	-	-	- 0.05	- 0.45**
Potassium Chloride 3	Leaf	+ 0.88**	+ 0.93**	+ 0.83**	+ 1.08**	+ 0.68*	+ 0.80**	+ 0.96**	-	-
	Stem	+ 1.12**	+ 1.14**	+ 1.10**	+ 1.35**	+ 0.89**	+ 1.32**	+ 0.92**	-	-

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	INTERACTIONS PS	INTERACTIONS NP	INTERACTIONS KS	INTERACTIONS NK	INTERACTIONS PK
Leaf	2.19	0.30	0.15	0.11	- 0.03	+ 0.01	- 0.14	- 0.05	-0.20	+ 0.08
Stem	3.91	0.24	0.12	0.08	- 0.07	+ 0.02	- 0.22*	- 0.02	- 0.23*	- 0.20*

KALE. EXPERIMENT 5.

DIFFERENTIAL RESPONSES % Ca.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	Leaf	- 0.27**	-	-	- 0.38**	- 0.16	- 0.10	- 0.44**	- 0.48**	- 0.06
	Stem	- 0.09	-	-	- 0.11	- 0.07	- 0.10	- 0.08	- 0.12	- 0.06
Ammonium Sulphate 3 + 3 T.D.	Leaf	+ 0.10	- 0.01	+ 0.21*	-	-	+ 0.15	+ 0.05	+ 0.31**	- 0.11
	Stem	+ 0.07	+ 0.05	+ 0.09	-	-	+ 0.01	+ 0.13*	+ 0.03	+ 0.11
Superphosphate 3.	Leaf	+ 0.26**	+ 0.43**	+ 0.09	+ 0.31*	+ 0.21*	-	-	+ 0.17	+ 0.35**
	Stem	+ 0.02	+ 0.01	+ 0.03	- 0.04	+ 0.08	-	-	+ 0.19**	- 0.15*
Potassium Chloride 3	Leaf	- 0.16*	- 0.39**	+ 0.05	+ 0.05	- 0.39**	- 0.25*	- 0.07	-	-
	Stem	- 0.01	- 0.04	+ 0.02	- 0.05	+ 0.03	+ 0.16*	- 0.18**	-	-

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	INTERACTIONS PS	INTERACTIONS NP	INTERACTIONS KS	INTERACTIONS NK	INTERACTIONS PK
Leaf	2.95	0.20	0.10	0.07	+ 0.11	- 0.17*	- 0.05	+ 0.21**	- 0.21**	+ 0.09
Stem	1.07	0.13	0.06	0.04	+ 0.02	+ 0.01	+ 0.06	+ 0.03	+ 0.04	- 0.17**

DIFFERENTIAL RESPONSES % Mg.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Leaf	− .008	−	−	+ .009	− .025*	.000	− .016	− .008	− .008
	Stem	− .012	−	−	− .015	− .009	− .014	− .010	− .017	− .007
Ammonium Sulphate 3 + 3 T.D.	Leaf	+ .002	+ .019	− .015	−	−	+ .006	− .002	+ .003	+ .001
	Stem	+ .015*	+ .012	+ .018	−	−	+ .018	+ .012	+ .026*	+ .004
Superphosphate 3.	Leaf	+ .012	+ .020	+ .004	+ .016	+ .008	−	−	+ .022*	+ .002
	Stem	+ .004	+ .002	+ .006	+ .007	+ .001	−	−	+ .005	+ .003
Potassium Chloride 3.	Leaf	− .004	− .004	− .004	− .003	− .005	+ .006	− .014	−	−
	Stem	+ .004	− .001	+ .009	+ .015	− .007	+ .005	+ .003	−	−

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Leaf	.140	.021	.010	.007	− .017	− .008	− .004	.000	− .001	− .010
Stem	.200	.019	.010	.007	+ .003	+ .002	− .003	+ .005	− .011	− .001

DIFFERENTIAL RESPONSES % P.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Leaf Stem	- .003 - .022	- -	- -	+ .022 - .025	- .028* - .019	.000 - .003	- .006 - .041*	+ .009 - .003	- .015 - .041*
Ammonium Sulphate 3 + 3 T.D.	Leaf Stem	- .008 - .011	+ .017 - .014	- .033* - .008	- -	- -	+ .014 - .014	- .030* - .008	+ .003 - .007	- .014 - .015
Superphosphate 3.	Leaf Stem	+ .004 + .018	+ .007 + .037*	+ .001 - .001	+ .026 + .015	- .018 + .021	- -	- -	- .005 + .048*	+ .013 - .012
Potassium Chloride 3.	Leaf Stem	- .008 - .006	+ .004 + .013	- .020 - .025	+ .003 - .002	- .019 - .010	- .017 + .024	+ .001 - .036*	- -	- -

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Leaf Stem	.234 .280	.023 .028	.012 .014	.009 .010	- .025* + .003	- .003 - .019	- .022* + .003	- .012 - .019	- .011 - .004	+ .009 - .030*

KALE. EXPERIMENT 6.

		FRESH YIELD tons			% D.M.		DRY MATTER tons			LEAF % D.M.					STEM % D.M.				
		Total	Leaf	Stem	Leaf	Stem	Total	Leaf	Stem	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
1	K	18.15	12.95	5.20	10.9	14.6	2.171	1.412	.759	.050	3.65	2.50	.090	.290	.050	3.05	.820	.124	.305
2	N P S	23.00	16.92	6.08	10.6	15.0	2.706	1.794	.912	.205	2.90	3.08	.100	.305	.130	2.70	.820	.136	.350
3	N K S	21.25	14.17	7.08	10.9	15.2	2.621	1.545	1.076	.175	3.10	2.58	.110	.325	.160	2.50	.820	.136	.290
4	P	20.76	14.22	6.54	10.9	15.2	2.544	1.550	.994	.060	3.10	2.96	.110	.290	.045	2.60	.820	.100	.365
5	N P K	23.25	16.55	6.70	11.1	15.5	2.875	1.837	1.038	.140	3.30	2.64	.080	.290	.105	2.45	.920	.122	.370
6	P K S	19.82	12.42	7.40	11.0	13.6	2.342	1.366	1.006	.110	3.50	3.04	.106	.340	.085	3.05	.950	.122	.390
7	N	20.00	12.95	7.05	11.1	14.4	2.452	1.437	1.015	.180	3.30	2.58	.136	.345	.150	2.80	.820	.130	.365
8	S	21.95	15.23	6.72	10.8	14.0	2.586	1.645	.941	.155	3.50	2.70	.110	.315	.125	3.25	.920	.130	.365
9	P K	18.75	12.85	5.90	11.7	16.2	2.459	1.503	.956	.035	3.45	2.64	.136	.265	.017	2.70	.750	.080	.280
10	-	16.18	11.18	5.00	11.6	17.9	2.192	1.297	.895	.110	2.50	2.70	.110	.280	.105	2.45	.785	.110	.325
11	K S	18.75	12.75	6.00	11.8	16.8	2.513	1.505	1.008	.085	3.10	2.83	.106	.280	.070	3.25	.750	.124	.350
12	N K	21.00	14.70	6.30	10.9	15.6	2.585	1.602	.983	.125	2.90	2.78	.106	.315	.105	3.35	.820	.100	.365
13	N P	21.95	15.10	6.85	11.8	13.4	2.700	1.782	.918	.155	3.20	2.83	.116	.305	.150	2.80	.950	.130	.385
14	N S	17.30	12.00	5.30	10.5	14.0	2.002	1.260	.742	.305	3.15	2.78	.136	.305	.185	3.05	.920	.110	.325
15	N P K S	21.25	14.45	6.80	10.7	14.1	2.505	1.546	.959	.255	3.25	3.00	.122	.290	.215	3.15	.925	.140	.370
16	P S	17.50	12.55	4.95	12.6	16.2	2.382	1.581	.801	.125	2.45	2.92	.100	.290	.100	2.45	.820	.122	.340
17	N K S	18.60	12.82	5.78	11.0	14.4	2.242	1.410	.832	.125	3.25	2.96	.136	.325	.115	3.10	.950	.122	.305
18	N P S	22.66	14.74	7.92	11.1	14.1	2.753	1.636	1.117	.175	3.40	2.78	.130	.290	.125	3.10	.850	.110	.385
19	P K S	18.38	12.38	6.00	11.8	16.0	2.421	1.461	.960	.100	3.00	2.50	.090	.350	.070	2.60	.785	.110	.380
20	P	19.70	14.10	5.60	12.1	15.6	2.580	1.706	.874	.140	2.70	3.20	.100	.315	.095	2.55	.680	.136	.315
21	K	19.82	14.14	5.68	10.8	15.0	2.379	1.527	.852	.045	3.90	2.83	.110	.260	.030	3.35	.750	.120	.290
22	N P K	20.20	14.76	5.44	11.0	14.6	2.418	1.624	.794	.105	3.30	2.64	.110	.290	.060	2.80	.880	.124	.340
23	S	18.40	13.66	4.74	10.7	14.6	2.154	1.462	.692	.125	3.75	2.62	.130	.290	.165	3.30	.785	.124	.365
24	N	20.30	14.74	5.56	11.3	15.2	2.511	1.666	.845	.115	3.00	2.58	.130	.305	.075	2.50	.880	.130	.325
25	N P K S	21.10	14.58	6.52	10.8	14.4	2.514	1.575	.939	.140	3.40	2.42	.106	.290	.105	3.00	.950	.110	.305
26	P K	18.60	13.95	4.65	11.2	16.2	2.315	1.562	.753	.040	3.10	2.50	.110	.250	.025	2.65	.880	.126	.250
27	P S	14.76	10.58	4.18	11.5	15.7	1.873	1.217	.656	.077	2.90	2.85	.106	.280	.085	2.85	.880	.122	.315
28	N S	16.30	12.24	4.06	11.0	12.9	2.870	1.346	.524	.210	2.90	2.74	.106	.300	.170	3.25	.900	.106	.340
29	N K	19.62	13.48	6.14	11.3	14.3	2.401	1.523	.878	.115	3.30	2.92	.122	.290	.075	3.15	.820	.110	.325
30	-	15.62	11.06	4.56	11.2	16.3	1.982	1.239	.743	.075	3.30	2.64	.122	.250	.065	2.70	.680	.120	.315
31	K S	19.95	14.33	5.62	11.4	14.9	2.471	1.634	.837	.100	3.15	2.83	.110	.305	.120	3.20	.750	.106	.365
32	N P	22.20	15.72	6.48	10.8	14.1	2.612	1.698	.914	.215	2.60	2.74	.130	.280	.230	2.45	.920	.130	.350

KALE. EXPERIMENT 6.

DIFFERENTIAL RESPONSES Fresh and Dry Yields (tons)

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Fresh Dry	- 0.35 - .016	- -	- -	+ 0.21 + .015	- 0.91 - .047	+ 0.20 + .098	- 0.90 - .130	- 0.63 - .031	- 0.07 - .001
Ammonium Sulphate 3 +3 T.D.	Fresh Dry	+ 2.02** + .210*	+ 2.58** + .241*	+ 1.46* + .179	- -	- -	+ 0.66 + .154	+ 3.38** + .266*	+ 2.32** + .289*	+ 1.72* + .131
Superphosphate 3.	Fresh Dry	+ 1.28** + .115	+ 1.83** + .229*	+ 0.73 + .001	- 0.08 + .059	+ 2.64** + .171	- -	- -	+ 2.05** + .176	+ 0.51 + .054
Potassium Chloride 3	Fresh Dry	+ 0.62 + .019	+ 0.34 + .004	+ 0.90 + .034	+ 0.92 + .098	+ 0.32 - 0.060	+ 1.39* + .080	- 0.15 - .042	- -	- -

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Fresh Dry	19.60 2.443	1.14 .214	0.57 .107	0.40 .076	- 0.56 - .031	- 0.55 - .114	+ 1.36** + .056	+ 0.28 + .015	- 0.30 - .079	- 0.77 - .061

KALE. EXPERIMENT <u>6</u>.

DIFFERENTIAL RESPONSES % Na.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	Leaf	+ .048**	–	–	+ .040**	+ .055**	+ .058**	+ .037**	+ .041**	+ .054**
	Stem	+ .040**	–	–	+ .047*	+ .034	+ .057**	+ .023	+ .021	+ .059**
Ammonium Sulphate 3 + 3 T.D.	Leaf	+ .082**	+ .075**	+ .089**	–	–	+ .076**	+ .088**	+ .087**	+ .077**
	Stem	+ .056**	+ .063**	+ .050*	–	–	+ .038*	+ .075**	+ .054**	+ .059**
Superphosphate 3.	Leaf	-.001	+ .010	- .012	- .007	+ .005	–	–	- .015	+ .013
	Stem	- .008	+ .009	- .024	- .026	+ .011	–	–	- .010	- .005
Potassium Chloride 3.	Leaf	- .043**	- .049**	- .036**	- .038**	- .047**	- .057**	- .028*	–	–
	Stem	- .037**	- .056**	- .018	- .040*	- .033	- .039*	- .034	–	–

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	PS	NP	KS	NK	PK
Leaf	.130	.025	.012	.009	+ .007	- .011	+ .006	+ .007	- .005	+ .014
Stem	.106	.036	.018	.013	- .007	- .017	+ .018	+ .019	+ .003	+ .002

KALE. EXPERIMENT 6.

DIFFERENTIAL RESPONSES % K.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Leaf	+ .01	-	-	- .04	+ .06	+ .01	+ .01	+ .16	- .14
	Stem	+ .22*	-	-	+ .24**	+ .20**	+ .20**	+ .24**	+ .38**	+ .06
Ammonium Sulphate 3 + 3 T.D.	Leaf	- .05	- .10	.00	-	-	- .25	+ .10	- .03	- .13
	Stem	+ .01	+ .03	- .01	-	-	- .11	+ .13	- .02	.00
Superphosphate 3.	Leaf	- .14	- .14	- .14	- .34*	+ .06	-	-	- .27	- .01
	Stem	- .27**	- .29**	- .25**	- .39**	- .15	-	-	- .26**	- .28**
Potassium Chloride 3.	Leaf	+ .25*	+ .40*	+ .10	+ .33*	+ .17	+ .12	+ .38*	-	-
	Stem	+ .16	+ .32**	.00	+ .17	+ .15	+ .17	+ .15	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Leaf	3.17	.30	.15	.11	+ .05	.00	+ .20	- .15	- .08	+ .13
Stem	2.88	.23	.11	.08	- .02	+ .02	+ .12	- .16*	- .01	- .01

KALE. EXPERIMENT 6.

DIFFERENTIAL RESPONSES % Ca.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Leaf	+ .060	–	–	+ .040	+ .079	+ .064	+ .055	+ .030	+ .089
	Stem	+ .038	–	–	+ .059	+ .017	+ .053	+ .023	+ .045	+ .031
Ammonium Sulphate 3 + 3 T.D.	Leaf	– .013	– .032	+ .006	–	–	+ .033	– .060	– .060	+ .033
	Stem	+ .084**	+ .106**	+ .063*	–	–	+ .085**	+ .083**	+ .144**	+ .025
Superphosphate 3.	Leaf	+ .073	+ .077	+ .069	+ .120	+ .026	–	–	+ .252*	– .106
	Stem	+ .039	+ .054	+ .024	+ .041	+ .037	–	–	+ .007	+ .071*
Potassium Chloride 3.	Leaf	– .067	– .096	– .037	– .114	– .020	+ .113	– .246*	–	–
	Stem	+ .006	+ .013	– .001	+ .065*	– .053	– .026	+ .039	–	–

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Leaf	2.760	.186	.093	.066	+ .019	– .004	– .047*	+ .029	+ .047*	– .179*
Stem	.842	.055	.028	.020	– .021	– .015	– .002	– .007	– .059*	+ .032

DIFFERENTIAL RESPONSES % Mg.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Leaf Stem	- .001 + .002	- -	- -	- .004 + .005	+ .002 - .001	+ .002 + .002	- .004 + .003	- .005 - .003	+ .003 + .008
Ammonium Sulphate 3 + 3 T.D.	Leaf Stem	+ .009 + .004	+ .006 + .007	+ .012 + .001	- -	- -	+ .012 - .002	+ .006 + .010	+ .012 + .001	+ .006 + .007
Superphosphate 3.	Leaf Stem	- .007 + .001	- .004 + .001	- .010 + .001	- .004 - .005	- .010 + .007	- -	- -	- .011 + .003	- .002 - .001
Potassium Chloride 3.	Leaf Stem	- .007 - .004	- .011 - .010	- .003 + .001	- .010 - .007	- .004 - .001	- .011 - .001	- .002 - .007	- -	- -

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Leaf Stem	.113 .119	.015 .014	.008 .007	.005 .005	+ .003 - .003	- .003 + .001	- .003 + .006	+ .004 + .006	- .003 + .002	+ .004 - .002

KALE. EXPERIMENT 6.

DIFFERENTIAL RESPONSES % P.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Leaf	+ .033	–	–	+ .031	+ .035	+ .013	+ .054*	– .001	+ .067*
	Stem	+ .017*	–	–	+ .053**	– .019	+ .011	+ .023*	+ .005	+ .029**
Ammonium Sulphate 3 + 3 T.D.	Leaf	+ .030	+ .028	+ .032	–	–	+ .030	+ .030	+ .016	+ .044
	Stem	+ .011	+ .047*	– .025*	–	–	– .005	+ .027*	+ .015	+ .007
Superphosphate 3.	Leaf	+ .014	– .007	+ .034	+ .014	+ .014	–	–	– .004	+ .032
	Stem	+ .011	+ .005	+ .016	– .006	+ .027*	–	–	+ .010	+ .011
Potassium Chloride 3.	Leaf	+ .018	+ .016	+ .052*	+ .004	+ .032	.000	+ .036	–	–
	Stem	– .016*	– .028*	– .004	– .012	– .019	– .016	– .015	–	–

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Leaf	.288	.048	.024	.017	+ .002	+ .021	.000	+ .034	+ .014	+ .018
Stem	.388	.020	.010	.007	– .036*	+ .006	+ .016*	+ .012	– .004	+ .001

TURNIPS. EXPERIMENT 1.

		Roots (tons)			Tops (tons)			Roots % D.M.					Tops % D.M.				
		Fresh	Dry	%DM.	Fresh	Dry	%DM.	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
1	P2 K0 S2	20.40	1.715	8.4	3.88	.469	12.1	.175	3.05	.630	.088	.350	.200	3.00	2.24	.188	.150
2	P0 K2 S2	16.65	1.300	7.8	3.69	.473	12.8	.155	3.40	.680	.110	.320	.200	3.00	2.12	.180	.175
3	P1 K0 S0	16.65	1.465	8.8	4.08	.510	12.5	.077	2.90	.630	.100	.345	.175	2.95	2.50	.228	.140
4	P2 K2 S0	15.52	1.490	9.6	3.11	.433	13.9	.035	2.80	.630	.100	.225	.065	3.25	2.70	.176	.260
5	P1 K2 S1	17.43	1.430	8.2	2.72	.348	12.8	.130	3.45	.700	.100	.245	.110	3.55	1.78	.180	.150
6	P0 K1 S0	14.92	1.135	7.6	3.49	.464	13.3	.155	3.40	.630	.114	.255	.180	3.40	2.42	.240	.220
7	P2 K1 S1	12.90	1.185	9.2	3.59	.452	12.6	.105	2.60	.630	.110	.330	.140	2.60	2.70	.220	.220
8	P1 K1 S2	21.80	2.050	9.3	4.17	.525	12.6	.090	2.80	.595	.092	.280	.175	2.95	2.85	.220	.155
9	P0 K0 S1	16.78	1.340	8.0	5.78	.700	12.1	.185	2.75	.660	.110	.285	.180	2.80	2.24	.170	.100
10	P0 K2 S1	20.50	1.495	7.3	4.08	.498	12.2	.125	3.40	.680	.104	.305	.260	3.00	2.28	.196	.160
11	P1 K0 S2	19.82	1.665	8.4	3.49	.430	12.3	.215	3.25	.720	.100	.310	.310	2.90	2.16	.216	.160
12	P1 K1 S1	19.78	1.580	8.0	2.91	.351	12.1	.125	3.30	.620	.100	.300	.140	4.05	1.89	.220	.175
13	P2 K2 S2	14.62	1.435	9.8	2.53	.336	13.3	.077	3.05	.700	.084	.270	.175	3.50	2.50	.220	.220
14	P1 K2 S0	13.58	1.340	9.9	2.91	.390	13.4	.030	2.95	.700	.092	.225	.090	4.00	2.64	.224	.165
15	P0 K0 S0	15.55	1.420	9.2	3.30	.439	13.3	.060	2.90	.700	.110	.215	.120	2.80	2.28	.210	.130
16	P2 K0 S1	18.35	1.520	8.3	5.32	.670	12.6	.140	2.85	.620	.100	.310	.180	3.10	2.12	.188	.130
17	P0 K1 S2	20.50	1.699	8.3	4.08	.502	12.3	.155	3.05	.680	.096	.260	.225	3.30	2.16	.190	.135
18	P2 K1 S0	20.81	1.540	7.4	4.01	.465	11.6	.110	3.10	.660	.100	.275	.100	3.10	2.12	.212	.140
19	P1 K1 S0	16.47	1.435	8.7	3.88	.483	12.4	.077	3.25	.640	.110	.295	.110	3.00	1.89	.188	.160
20	P1 K0 S1	13.85	1.245	9.0	3.39	.439	12.9	.170	2.95	.630	.110	.340	.195	3.25	2.06	.188	.170
21	P2 K1 S2	22.00	1.755	8.0	2.91	.361	12.4	.140	3.50	.620	.104	.300	.220	3.40	2.02	.192	.230
22	P2 K2 S1	20.25	1.945	9.6	3.20	.435	13.6	.065	3.00	.665	.092	.300	.125	5.10	2.28	.212	.240
23	P0 K1 S1	22.80	2.150	9.3	4.36	.619	14.2	.180	3.10	.630	.104	.270	.225	2.90	2.35	.212	.115
24	P1 K2 S2	23.10	2.290	9.9	4.56	.580	12.7	.045	2.90	.680	.110	.295	.180	3.00	1.89	.204	.130
25	P0 K0 S2	20.70	1.550	7.5	3.98	.467	11.7	.200	3.00	.620	.114	.300	.305	2.50	3.00	.230	.095
26	P2 K0 S0	18.82	1.435	7.6	3.78	.515	13.6	.180	2.90	.735	.114	.330	.150	2.25	2.64	.230	.155
27	P0 K2 S0	21.31	1.680	7.9	3.49	.436	12.5	.030	3.10	.660	.110	.300	.077	2.95	2.46	.192	.115

Fresh Yield. Roots. (tons)

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± 1.93)				± 1.11
Superphosphate	0	17.68	19.41	19.49	17.26	20.03	19.28	18.86
	3	16.77	19.35	18.04	15.57	17.02	21.57	18.05
	6	19.19	18.57	16.59	18.38	17.17	19.01	18.19
Potassium chloride	0				17.01	16.33	20.31	17.88
	1				17.40	18.49	21.43	19.11
	2				16.80	19.39	18.12	18.11
Mean		17.88	19.11	18.11	17.07	18.07	19.95	18.36

S.E. per plot 3.34 Sig. Diff. of means. Central. 5% 6.55 1% 10.10
Marginal. 5% 3.85 1% 5.82

Interactions PK - 2.10 PS - 0.69 KS - 0.99

Fresh Yield. Tops. (tons)

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± 0.17)				± 0.29
Superphosphate	0	4.35	3.98	3.75	3.43	4.74	3.92	4.03
	3	3.65	3.65	3.39	3.62	3.01	4.07	3.57
	6	4.33	3.50	2.95	3.63	4.04	3.11	3.59
Potassium chloride	0				3.72	4.83	3.78	4.12
	1				3.76	3.62	3.72	3.71
	2				3.17	3.33	3.59	3.36
Mean		4.12	3.71	3.36	3.56	3.93	3.70	3.73

S.E. per plot 0.50 Sig. Diff. of means. Central. 5% 1.00 1% 1.52
Marginal. 5% 0.59 1% 0.89

Interactions PK - 0.39 PS - 0.50 KS + 0.18

Dry Matter Yield. Roots. (tons)

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± 0.172)				± 0.099
Superphosphate	0	1.437	1.662	1.492	1.412	1.662	1.517	1.530
	3	1.458	1.688	1.687	1.413	1.418	2.002	1.611
	6	1.557	1.493	1.623	1.488	1.550	1.635	1.558
Potassium chloride	0				1.440	1.368	1.643	1.484
	1				1.370	1.638	1.835	1.614
	2				1.503	1.623	1.675	1.600
Mean		1.484	1.614	1.600	1.438	1.543	1.718	1.566

S.E. per plot 0.298 Sig. Diff. of means. Central. 5% 0.595 1% 0.901 Marginal. 5% 0.343 1% 0.519

Interactions PK + 0.006 PS + 0.021 KS − 0.015

Dry Matter Yield. Tops. (tons)

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .035)				± .020
Superphosphate	0	.535	.528	.469	.446	.603	.481	.511
	3	.459	.453	.439	.461	.379	.512	.451
	6	.551	.426	.401	.471	.519	.389	.461
Potassium chloride	0				.485	.603	.455	.515
	1				.471	.474	.463	.469
	2				.419	.427	.463	.437
Mean		.515	.469	.437	.459	.501	.460	.474

S.E. per plot .060 Sig. Diff. of means. Central. 5% .120 1% .181 Marginal. 5% .069 1% .105

Interactions PK − 0.042 PS − 0.058 KS + 0.037

% Na. Roots.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .014)				± .008
Superphosphate	0	.148	.163	.103	.082	.163	.170	.138
	3	.154	.097	.068	.061	.142	.117	.106
	6	.165	.118	.059	.108	.103	.131	.114
Potassium chloride	0				.106	.165	.197	.156
	1				.114	.137	.128	.126
	2				.032	.106	.092	.077
Mean		.156	.126	.077	.084	.136	.139	.120

S.E. per plot .024 Sig. Diff. of means. Central. 5% .048 1% .073
Marginal. 5% .028 1% .042

Interactions PK - .030 PS - .032 KS - .015

% Na. Tops.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(±.017)				± .010
Superphosphate	0	.202	.210	.179	.126	.222	.243	.197
	3	.227	.142	.127	.125	.148	.222	.165
	6	.177	.153	.122	.105	.148	.198	.151
Potassium chloride	0				.148	.185	.272	.202
	1				.130	.168	.206	.168
	2				.077	.165	.185	.142
Mean		.202	.168	.142	.119	.173	.221	.171

S.E. per plot .030 Sig. Diff. of means. Central. 5% .059 1% .089
Marginal. 5% .035 1% .052

Interactions PK - .016 PS - .033 KS - .008

% K. ROOTS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(±0.13	)			± 0.08
Superphosphate	0	2.88	3.18	3.30	3.13	3.08	3.15	3.12
	3	3.03	3.15	3.10	3.03	3.23	2.98	3.08
	6	2.93	3.07	2.95	2.93	2.82	3.20	2.98
Potassium chloride	0				2.90	2.85	3.10	2.95
	1				3.25	3.00	3.12	3.12
	2				2.95	3.28	3.12	3.12
Mean		2.95	3.12	3.12	3.03	3.04	3.11	3.06

S.E. per plot 0.23 Sig. Diff. of means. Central. 5% 0.45 1% 0.68
Marginal. 5% 0.28 1% 0.42

Interactions PK - 0.20 PS + 0.13 KS - 0.02

% K. TOPS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± 0.30	)			± 0.17
Superphosphate	0	2.70	3.20	2.98	3.05	2.90	2.93	2.96
	3	3.03	3.33	3.52	3.32	3.62	2.95	3.30
	6	2.78	3.03	3.95	2.87	3.60	3.30	3.25
Potassium chloride	0				2.67	3.05	2.80	2.85
	1				3.17	3.18	3.22	3.19
	2				3.40	3.88	3.17	3.48
Mean		2.85	3.19	3.48	3.08	3.37	3.06	3.17

S.E. per plot 0.51 Sig. Diff. of means. Central. 5% 1.03 1% 1.57
Marginal. 5% 0.59 1% 0.89

Interactions PK + 0.45 PS + 0.28 KS - 0.18

% Ca. ROOTS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .046)				± .026
Superphosphate	0	.660	.647	.673	.663	.657	.660	.660
	3	.660	.618	.693	.657	.650	.665	.657
	6	.662	.637	.665	.675	.638	.650	.654
Potassium chloride	0				.688	.637	.657	.661
	1				.643	.627	.632	.634
	2				.663	.682	.687	.677
Mean		.661	.634	.677	.665	.648	.658	.657

S.E. per plot .079 Sig. Diff. of means. Central. 5% .159 1% .241

Marginal. 5% .090 1% .136

Interactions PK - .005 PS - .011 KS - .028

% Ca. TOPS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± 0.24)				± 0.14
Superphosphate	0	2.51	2.31	2.29	2.39	2.29	2.42	2.37
	3	2.24	2.21	2.10	2.34	1.91	2.30	2.18
	6	2.33	2.28	2.49	2.49	2.37	2.25	2.37
Potassium chloride	0				2.47	2.14	2.47	2.36
	1				2.14	2.31	2.34	2.27
	2				2.60	2.11	2.17	2.29
Mean		2.36	2.27	2.29	2.40	2.19	2.33	2.31

S.E. per plot 0.42 Sig. Diff. of means. Central. 5% 0.83 1% 1.25

Marginal. 5% 0.48 1% 0.73

Interactions PK + 0.19 PS - 0.13 KS - 0.22

% Mg. ROOTS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .005)				± .003
Superphosphate	0	.111	.105	.108	.111	.106	.107	.108
	3	.103	.101	.101	.101	.103	.101	.101
	6	.101	.105	.092	.105	.101	.092	.099
Potassium chloride	0				.108	.107	.101	.105
	1				.108	.105	.097	.103
	2				.101	.102	.101	.100
Mean		.105	.103	.100	.106	.103	.100	.103

S.E. per plot .008 — Sig. Diff. of means. Central. 5% .016 1% .024; Marginal. 5% .009 1% .014

Interactions PK - .003 PS - .007 KS + .004

% Mg. TOPS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .015)				± .009
Superphosphate	0	.203	.214	.189	.214	.193	.200	.202
	3	.211	.209	.203	.213	.196	.213	.207
	6	.202	.208	.203	.206	.207	.200	.204
Potassium chloride	0				.223	.182	.211	.205
	1				x.213	.217	.201	.210
	2				.197	.196	.201	.198
Mean		.205	.210	.198	.211	.198	.204	.204

S.E. per plot .026 — Sig. Diff. of means. Central. 5% .052 1% .079; Marginal. 5% .031 1% .047

Interactions PK + .007 PS + .004 KS + .008

% P. ROOTS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .013)				± .008
Superphosphate	0	.267	.262	.308	.257	.287	.293	.278
	3	.332	.292	.255	.288	.297	.295	.293
	6	.330	.302	.265	.277	.313	.307	.299
Potassium chloride	0				.293	.312	.320	.309
	1				.275	.300	.280	.285
	2				.250	.283	.295	.276
Mean		.309	.285	.276	.274	.298	.298	.291

S.E. per plot .023

Sig. Diff. of means. Central. 5% .045 1% .068
Marginal. 5% .028 1% .042

Interactions PK - .053* PS - .003 KS + .009

% P. TOPS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .020)				± .011
Superphosphate	0	.108	.157	.150	.155	.125	.133	.138
	3	.157	.163	.148	.155	.165	.148	.156
	6	.145	.197	.240	.185	.197	.200	.194
Potassium chloride	0				.142	.133	.135	.137
	1				.173	.170	.173	.172
	2				.180	.183	.175	.179
Mean		.137	.172	.179	.165	.162	.161	.163

S.E. per plot .034

Sig. Diff. of means. Central. 5% .069 1% .105
Marginal. 5% .038 1% .058

Interactions PK + .027 PS + .018 KS + .001

		ROOTS (tons)			TOPS (tons)			ROOTS. % D.M.					TOPS. % D.M.				
		Fresh	Dry	%DM.	Fresh	Dry	%DM.	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
1	P2 K2 S1	17.68	1.574	8.9	3.04	.365	12.0	.135	2.05	.430	.088	.210	.160	4.05	1.99	.200	.150
2	P2 K0 S0	16.92	1.641	9.7	3.04	.353	11.6	.055	2.10	.400	.074	.165	.135	2.70	2.50	.216	.155
3	P0 K2 S0	10.32	0.918	8.9	2.48	.293	11.8	.060	2.90	.315	.072	.085	.110	3.50	1.85	.204	.125
4	P1 K1 S0	12.88	1.172	9.1	1.84	.212	11.5	.055	2.55	.380	.096	.165	.100	3.45	1.81	.145	.120
5	P2 K1 S2	19.08	1.660	8.7	3.20	.371	11.6	.185	3.15	.400	.060	.220	.430	4.60	1.89	.160	.250
6	P0 K1 S1	15.68	1.427	9.1	3.72	.402	10.8	.165	2.50	.415	.068	.155	.420	3.00	2.06	.216	.145
7	P1 K0 S1	20.16	1.734	8.6	2.96	.305	10.3	.215	2.30	.430	.068	.235	.355	2.50	2.16	.280	.115
8	P0 K0 S2	12.88	1.108	8.6	2.56	.261	10.2	.155	2.70	.350	.094	.175	.355	4.00	1.98	.208	.110
9	P1 K2 S2	20.72	1.886	9.1	3.20	.390	12.2	.170	3.25	.400	.068	.255	.510	4.30	1.98	.208	.170
10	P0 K2 S2	12.64	1.150	9.1	2.52	.270	10.7	.185	2.35	.350	.084	.105	.500	2.10	2.12	.216	.125
11	P0 K1 S0	15.92	1.544	9.7	3.44	.344	10.0	.075	2.25	.315	.080	.140	.275	3.60	2.09	.216	.075
12	P1 K0 S0	17.28	1.417	8.2	3.56	.377	10.6	.155	2.50	.315	.088	.160	.235	2.70	2.12	.216	.150
13	P2 K0 S2	23.96	2.132	8.9	3.76	.421	11.2	.265	3.00	.500	.076	.265	.900	3.80	2.12	.274	.175
14	P2 K1 S1	24.08	1.999	8.3	2.88	.311	10.8	.175	2.40	.460	.088	.170	.375	3.15	1.85	.240	.210
15	P0 K0 S1	12.00	1.164	9.7	1.60	.166	10.4	.115	2.00	.365	.072	.085	.225	3.40	1.98	.200	.140
16	P1 K2 S1	15.28	1.314	8.6	2.40	.254	10.6	.095	2.65	.365	.092	.105	.195	3.80	1.83	.200	.150
17	P1 K1 S2	23.64	2.103	8.9	3.84	.464	12.1	.175	3.10	.480	.084	.200	.400	2.70	1.92	.138	.120
18	P2 K2 S0	24.56	2.137	8.7	2.92	.310	10.6	.085	2.30	.365	.072	.135	.175	3.60	2.42	.224	.140
19	P0 K1 S2	11.96	1.064	8.9	1.20	.131	10.9	.185	2.10	.415	.084	.085	.500	2.50	2.12	.236	.120
20	P1 K1 S1	18.48	1.515	8.2	2.64	.296	11.2	.140	2.70	.415	.094	.105	.310	4.05	1.94	.188	.090
21	P2 K1 S0	16.76	1.659	9.9	3.00	.372	12.4	.115	2.45	.410	.076	.225	.315	3.10	2.12	.224	.130
22	P0 K2 S1	16.80	1.462	8.7	2.64	.267	10.1	.170	2.70	.380	.080	.100	.300	3.85	1.77	.212	.095
23	P2 K2 S2	23.04	1.820	7.9	3.20	.326	10.2	.215	2.85	.485	.076	.170	.420	3.40	1.98	.216	.095
24	P0 K0 S0	13.28	1.062	8.0	3.12	.312	10.0	.155	2.85	.365	.096	.170	.290	3.30	2.09	.200	.085
25	P1 K0 S2	22.00	1.914	8.7	3.70	.377	10.2	.195	2.65	.400	.092	.130	.480	3.10	1.68	.230	.170
26	P1 K2 S0	21.60	1.836	8.5	3.20	.355	11.1	.085	2.80	.415	.098	.095	.175	3.35	1.81	.184	.085
27	P2 K0 S1	19.92	1.594	8.0	4.32	.475	11.0	.175	3.05	.400	.088	.145	.325	3.10	2.38	.176	.150

Fresh Yield. Roots. (tons)

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± 2.03)				± 1.17
Superphosphate	0	12.72	14.52	13.25	13.17	14.83	12.49	13.50
	3	19.81	18.33	19.20	17.25	17.97	22.12	19.11
	6	20.27	19.97	21.76	19.41	20.56	22.03	20.67
Potassium chloride	0				15.83	17.36	19.61	17.60
	1				15.19	19.41	18.23	17.61
	2				18.83	16.59	18.80	18.07
Mean		17.60	17.61	18.07	16.61	17.79	18.83	17.76

S.E. per plot 3.52

Sig. Diff. of means. Central. 5% 7.02 1% 10.63

Marginal. 5% 4.04 1% 6.15

Interactions PK + 0.48 PS + 1.65 KS − 1.92

Fresh Yield. Tops. (tons)

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(±0.54)				± 0.31
Superphosphate	0	2.43	2.79	2.55	3.01	2.65	2.09	2.59
	3	3.41	2.77	2.93	2.87	2.67	3.58	3.04
	6	3.71	3.03	3.05	2.99	3.41	3.39	3.26
Potassium chloride	0				3.24	2.96	3.34	3.18
	1				2.76	3.08	2.76	2.86
	2				2.87	2.69	2.97	2.84
Mean		3.18	2.86	2.84	2.96	2.91	3.02	2.96

S.E. per plot 0.93

Sig. Diff. of means. Central. 5% 1.87 1% 2.83

Marginal. 5% 1.07 1% 1.62

Interactions PK − 0.39 PS + 0.66 KS 0.00

Dry Matter Yields. Roots. (tons)

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± 0.171)				± 0.098
Superphosphate	0	1.111	1.345	1.177	1.175	1.351	1.107	1.211
	3	1.688	1.597	1.679	1.475	1.521	1.968	1.655
	6	1.789	1.773	1.844	1.812	1.723	1.871	1.802
Potassium chloride	0				1.373	1.497	1.718	1.530
	1				1.458	1.647	1.609	1.572
	2				1.630	1.450	1.619	1.557
Mean		1.530	1.572	1.567	1.487	1.531	1.649	1.556

S.E. per plot 0.295

Sig. Diff. of means. Central. 5% 0.592 1% 0.896
Marginal. 5% 0.339 1% 0.513

Interactions PK − 0.005 PS +0.063 KS − 0.028

Dry Matter Yields. Tops. (tons)

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .060)				±.031
Superphosphate	0	.246	.293	.277	.316	.278	.221	.272
	3	.353	.324	.333	.315	.285	.410	.337
	6	.416	.351	.334	.325	.316	.335	.367
Potassium chloride	0				.347	.315	.353	.339
	1				.309	.336	.322	.323
	2				.319	.295	.329	.314
Mean		.339	.323	.314	.325	.316	.335	.325

S.E. per plot .103

Sig. Diff. of means. Central. 5% .208 1% .314
Marginal. 5% .107 1% .162

Interactions PK − .057 PS + .052 KS − .002

% Na. ROOTS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .017)				± .010
Superphosphate	0	.142	.142	.138	.097	.150	.175	.141
	3	.185	.158	.145	.098	.150	.180	.143
	6	.165	.158	.145	.085	.161	.222	.156
Potassium chloride	0				.122	.168	.205	.165
	1				.082	.160	.182	.141
	2				.077	.133	.190	.133
Mean		.165	.141	.133	.093	.154	.192	.146

S.E. per plot .030 | Sig. Diff. of means. | Central. 5% .058 1% .089 | Marginal. 5% .035 1% .052

Interactions PK - .008 PS + .029 KS + .015

% Na. TOPS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .034)				± .020
Superphosphate	0	.290	.398	.303	.225	.315	.452	.331
	3	.357	.270	.293	.170	.287	.463	.307
	6	.453	.373	.253	.208	.287	.583	.359
Potassium chloride	0				.220	.302	.578	.367
	1				.230	.368	.443	.346
	2				.153	.218	.477	.283
Mean		.367	.347	.283	.201	.296	.499	.332

S.E. per plot .060 | Sig. Diff. of means. | Central. 5% .117 1% .178 | Marginal. 5% .069 1% .105

Interactions PK - .107 PS + .074 KS - .017

% K. ROOTS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± 0.21)				± 0.12
Superphosphate	0	2.52	2.28	2.65	2.67	2.40	2.38	2.48
	3	2.48	2.78	2.90	2.62	2.55	3.00	2.72
	6	2.72	2.67	2.40	2.28	2.50	3.00	2.59
Potassium chloride	0				2.48	2.45	2.78	2.57
	1				2.42	2.53	2.78	2.58
	2				2.67	2.47	2.82	2.65
Mean		2.57	2.58	2.65	2.52	2.48	2.79	2.60

S.E. per plot 0.36 Sig. Diff. of means. Central. 5% 0.73 1% 1.10
Marginal. 5% 0.42 1% 0.63

Interactions PK − 0.27 PS + 0.50 KS − 0.07

% K. TOPS

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± 0.25)				± 0.14
Superphosphate	0	3.57	3.03	3.15	3.47	3.42	2.87	3.25
	3	2.77	3.40	3.82	3.17	3.45	3.37	3.33
	6	3.20	3.62	3.68	3.13	3.43	3.93	3.50
Potassium chloride	0				2.90	3.00	3.63	3.18
	1				3.38	3.40	3.27	3.35
	2				3.48	3.90	3.27	3.55
Mean		3.18	3.35	3.55	3.26	3.43	3.39	3.36

S.E. per plot 0.43 Sig. Diff. of means. Central. 5% 0.86 1% 1.31
Marginal. 5% 0.48 1% 0.73

Interactions PK + 0.45 PS + 0.70 KS − 0.47

% Ca. ROOTS.

CWT./ACRE		POTASSIUM CHLORIDE			SALT			MEAN
		0	1	2	0	3	6	
				(± .032)				± .018
Superphosphate	0	.360	.382	.348	.332	.387	.372	.363
	3	.382	.425	.393	.370	.403	.427	.400
	6	.433	.423	.427	.392	.430	.462	.428
Potassium chloride	0				.360	.398	.417	.392
	1				.368	.430	.432	.410
	2				.365	.392	.412	.388
Mean		.392	.410	.388	.364	.407	.420	.397

S.E. per plot .055

Sig. Diff. of means. Central. 5% .111 1% .168
Marginal. 5% .063 1% .094

Interactions PK + .003 PS + .015 KS -.005

% Ca. TOPS.

CWT./ACRE		POTASSIUM CHLORIDE			SALT			MEAN
		0	1	2	0	3	6	
				(± 0.06)				± 0.04
Superphosphate	0	2.02	2.09	1.91	2.01	1.94	2.07	2.01
	3	1.98	1.89	1.87	1.91	1.98	1.82	1.92
	6	2.33	1.95	2.13	2.35	2.07	2.00	2.14
Potassium chloride	0				2.24	2.17	1.93	2.11
	1				2.01	1.95	1.98	1.98
	2				2.03	1.86	2.03	1.97
Mean		2.11	1.98	1.97	2.09	2.00	1.97	2.02

S.E. per plot 0.11

Sig. Diff. of means. Central. 5% 0.21 1% 0.32
Marginal. 5% 0.12 1% 0.18

Interactions PK - 0.04 PS - 0.20 KS + 0.15

% Mg. Roots.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .003)				± .002
Superphosphate	0	.087	.077	.078	.083	.073	.087	.081
	3	.083	.091	.086	.094	.085	.081	.087
	6	.079	.075	.079	.074	.088	.071	.078
Potassium chloride	0				.086	.076	.087	.083
	1				.084	.083	.076	.081
	2				.081	.087	.076	.081
Mean		.083	.081	.081	.084	.082	.080	.082

S.E. per plot .005

Sig. Diff. of means. Central. 5% .010 1% .015

Marginal. 5% .007 1% .010

Interactions PK + .004 PS + .002 KS + .003

% Mg. Tops.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .019)				± .011
Superphosphate	0	.203	.223	.211	.207	.209	.220	.212
	3	.242	.157	.195	.182	.223	.192	.199
	6	.222	.208	.213	.221	.205	.217	.214
Potassium chloride	0				.211	.219	.237	.222
	1				.195	.215	.178	.196
	2				.204	.204	.213	.207
Mean		.222	.196	.207	.203	.212	.210	.208

S.E. per plot .033

Sig. Diff. of means. Central. 5% .066 1% .099

Marginal. 5% .038 1% .058

Interactions PK – .008 PS – .008 KS – .008

% P. ROOTS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .014)				± .008
Superphosphate	0	.143	.127	.097	.132	.113	.122	.122
	3	.175	.157	.152	.140	.148	.195	.161
	6	.218	.178	.172	.148	.202	.218	.189
Potassium chloride	0				.165	.182	.190	.179
	1				.150	.143	.168	.154
	2				.105	.138	.177	.140
Mean		.179	.154	.140	.140	.154	.178	.157

S.E. per plot .024 Sig. Diff. of means. Central. 5% .048 1% .073
Marginal. 5% .027 1% .041

Interactions PK .000 PS + .013 KS + .023

% P. TOPS.

CWT./ACRE		POTASSIUM CHLORIDE 0	1	2	SALT 0	3	6	MEAN
				(± .014)				± .008
Superphosphate	0	.112	.113	.115	.095	.123	.118	.113
	3	.145	.110	.135	.118	.118	.153	.130
	6	.160	.197	.128	.142	.170	.173	.162
Potassium chloride	0				.130	.135	.152	.139
	1				.108	.148	.163	.140
	2				.117	.132	.130	.126
Mean		.139	.140	.126	.118	.138	.148	.135

S.E. per plot .025 Sig. Diff. of means. Central. 5% .048 1% .073
Marginal. 5% .027 1% .041

Interactions PK -.018 PS + .004 KS - .004

TURNIPS. EXPERIMENT 3.

	TOPS. (tons)			ROOTS (tons)			TOPS. % D.M.					ROOTS. % D.M.				
	Fresh	%DM.	Dry	Fresh	%DM	Dry	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
1 P	3.42	12.4	.424	13.90	7.9	1.10	.280	2.05	1.62	.150	.180	.105	2.00	.420	.096	.195
2 N P S	3.44	12.4	.426	16.92	7.4	1.25	.462	1.90	1.50	.146	.210	.255	1.80	.370	.068	.170
3 N P K	3.72	12.1	.450	19.04	7.5	1.43	.110	2.60	1.50	.108	.180	.050	2.30	.390	.072	.180
4 P K S	3.12	12.7	.396	18.70	7.6	1.42	.320	1.75	1.98	.142	.190	.135	1.90	.375	.084	.240
5 K	3.66	12.8	.468	14.06	9.0	1.27	.140	2.65	1.81	.124	.180	.050	2.35	.330	.060	.240
6 N	2.98	12.4	.370	11.48	8.2	0.94	.280	2.00	2.06	.160	.175	.085	1.60	.385	.092	.165
7 N K S	3.82	13.0	.497	17.42	7.8	1.36	.170	2.70	1.81	.116	.190	.090	2.10	.340	.076	.190
8 S	2.72	12.1	.329	15.94	8.4	1.34	.250	2.50	2.20	.142	.180	.100	1.65	.345	.068	.220
9 N P	3.30	12.8	.422	16.00	8.0	1.28	.330	2.25	1.85	.146	.185	.110	1.90	.400	.084	.200
10 P K	2.70	12.3	.332	16.30	8.6	1.40	.175	2.60	2.24	.138	.200	.040	1.95	.365	.076	.250
11 N K	3.82	12.6	.481	15.70	8.0	1.26	.105	2.50	1.75	.108	.265	.060	2.30	.360	.084	.240
12 K S	3.44	12.7	.436	16.52	7.9	1.30	.205	2.20	1.85	.134	.165	.070	1.90	.360	.088	.210
13 N S	2.88	11.5	.331	14.46	8.6	1.24	.305	2.70	1.81	.130	.195	.085	1.95	.430	.076	.220
14. N P K S	4.14	12.2	.505	15.44	7.8	1.20	.290	2.05	1.89	.142	.210	.130	2.05	.350	.084	.215
15 -	2.56	12.4	.317	15.48	8.8	1.36	.140	2.40	1.81	.142	.140	.050	2.00	.420	.096	.220
16 P S	3.12	12.1	.378	18.54	8.2	1.52	.275	2.20	1.94	.134	.230	.115	1.80	.395	.084	.225
17 S	2.98	12.4	.370	14.42	7.8	1.12	.255	2.85	1.94	.116	.180	.077	2.30	.375	.096	.260
18 N	3.12	12.4	.387	14.90	7.5	1.12	.245	2.00	1.78	.136	.130	.095	1.70	.395	.092	.165
19 K	3.70	11.9	.440	16.12	8.0	1.29	.140	2.90	1.68	.120	.235	.045	2.65	.320	.084	.180
20 P K S	3.66	12.0	.439	18.28	8.1	1.48	.320	1.90	1.89	.124	.250	.085	1.85	.380	.068	.275
21 N P S	3.40	12.1	.411	14.92	7.9	1.18	.280	2.30	1.81	.120	.190	.115	2.05	.330	.072	.240
22 N P K	3.50	12.4	.434	17.56	8.6	1.51	.190	2.35	1.85	.124	.200	.065	1.95	.345	.072	.220
23 N K S	3.72	12.2	.454	16.74	8.2	1.37	.200	2.65	1.62	.116	.140	.060	2.30	.380	.068	.235
24 P	3.60	12.6	.453	15.94	7.5	1.20	.155	2.20	1.62	.116	.180	.070	2.00	.430	.088	.220
25 P S	3.86	12.6	.486	15.36	8.2	1.26	.290	2.45	1.81	.134	.175	.125	2.10	.360	.076	.215
26 -	2.82	12.8	.360	15.86	8.3	1.32	.195	2.35	1.75	.134	.130	.082	1.85	.460	.092	.130
27 N P K S	4.02	12.0	.482	16.42	8.0	1.31	.285	2.60	1.43	.134	.195	.085	2.40	.400	.076	.225
28 N S	3.24	13.0	.421	16.16	8.0	1.29	.355	2.25	1.68	.142	.185	.165	1.85	.415	.076	.200
29 N K	3.52	12.4	.436	14.22	8.3	1.18	.095	2.85	1.82	.142	.205	.045	2.50	.365	.084	.160
30 K S	3.48	12.2	.425	16.50	8.2	1.35	.130	2.90	1.89	.142	.200	.060	2.20	.400	.084	.200
31 N P	3.36	12.0	.403	17.30	7.7	1.33	.105	2.80	1.50	.130	.200	.045	2.20	.440	.092	.210
32 P K	3.58	12.8	.458	12.24	8.7	1.50	.135	2.80	1.94	.140	.180	.050	2.20	.460	.078	.220

TURNIPS. EXPERIMENT 3.

DIFFERENTIAL RESPONSES Fresh and Dry Yields. (tons)

CWT./ACRE			MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4 cwt.	Tops	Fresh	+ 0.11	-	-	+ 0.04	+ 0.17	+ 0.10	+ 0.11	+ 0.07	+ 0.14
		Dry	+ 0.009	-	-	0.000	+ 0.018	0.000	+ 0.018	+ 0.002	+ 0.016
	Roots	Fresh	+ 0.73	-	-	+ 1.17	+ 0.28	+ 2.12**	- 0.68	+ 0.73	+ 0.73
		Dry	+ 0.03	-	-	+0.04	+ 0.02	+ 0.08	- 0.02	+ 0.07	- 0.01
Ammonium Sulphate 2 cwt.	Tops	Fresh	+ 0.22*	+ 0.16	+ 0.28*	-	-	+ 0.21	+ 0.23*	+ 0.08	+ 0.36**
		Dry	+ 0.025	+ 0.016	+ 0.034	-	-	+ 0.029	+ 0.021	+ 0.007	+ 0.043*
	Roots	Fresh	- 0.28	+ 0.16	- 0.73	-	-	- 0.48	- 0.08	- 0.41	- 0.15
		Dry	- 0.06	- 0.05	- 0.07	-	-	- 0.07	- 0.05	- 0.07	- 0.05
Superphosphate 3 cwt.	Tops	Fresh	+ 0.22*	+ 0.13	+ 0.31*	+ 0.21	+ 0.23*	-	-	+ 0.51**	- 0.08
		Dry	+ 0.024	+ 0.015	+ 0.033	+ 0.028	+ 0.020	-	-	+ 0.065**	- 0.017
	Roots	Fresh	+ 1.37**	+ 1.95**	+ 0.80	+ 1.84*	+ 0.92	-	-	+ 1.27	+ 1.36
		Dry	+ 0.08*	+ 0.13**	+ 0.03	+ 0.07	+ 0.09	-	-	+ 0.05	+ 0.11
Potassium Chloride 2 cwt.	Tops	Fresh	+ 0.42**	+ 0.39**	+ 0.46**	+ 0.28**	+ 0.56**	+ 0.72**	- 0.13	-	-
		Dry	+ 0.053**	+ 0.046*	+ 0.060**	+ 0.035	+ 0.071**	+ 0.094**	+ 0.012	-	-
	Roots	Fresh	+ 1.17*	+ 1.17	+ 1.17	+ 1.03	+ 1.30	+ 1.07	+ 1.27	-	-
		Dry	+ 0.11**	+ 0.15**	+ 0.09*	+ 0.10*	+ 0.12*	+ 0.08	+ 0.14**	-	-

		MEAN	STANDARD ERRORS ±			INTERACTIONS					
			SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Tops	Fresh	3.39	0.21	0.11	0.08	+ 0.06	+ 0.09	+ 0.01	+ 0.03	+ 0.14	- 0.29*
	Dry	0.419	0.037	0.019	0.013	+ 0.009	- 0.009	- 0.004	+ 0.007	+ 0.018	- 0.041**
Roots	Fresh	16.06	1.30	0.65	0.46	+ 0.44	- 0.57	+ 0.20	- 0.01	+ 0.13	+ 0.09
	Dry	1.30	0.09	0.04	0.03	- 0.01	- 0.05	+ 0.01	- 0.04	+ 0.01	+ 0.03

TURNIPS. EXPERIMENT 3.

DIFFERENTIAL RESPONSES % Na.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Tops	+ .098**	–	–	+ .086*	+ .111**	+ .049	+ .148**	+ .093**	+ .104**
	Roots	+ .044**	–	–	+.034 *	+ .054**	+ .024	+ .064**	+ .049**	+ .037*
Ammonium Sulphate 2.	Tops	+ .025	+ .013	+ .037	–	–	– .007	+ .058	– .015	+ .064
	Roots	+ .018	+ .008	+ .027	–	–	– .002	+ .037*	+ .029	+ .006
Superphosphate 3.	Tops	+ .050*	+ .018	+ .082*	+ .062	+ .038	–	–	+ .019	+ .080*
	Roots	+ .023	+ .003	+ .042*	+ .024	+ .022	–	–	+ .025	+ .020
Potassium Chloride 2.	Tops	–.074**	– .080*	– .069*	– .115**	– .034	– .105**	– .044	–	–
	Roots	–.035**	– .029	– .040*	– .024	– .046**	– .032	– .038*	–	–

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Tops	0.226	.062	.031	.022	+ .013	+ .032	– .012	+ .005	– .040	+ .030
Roots	0.175	.031	.015	.011	+ .01o	+ .020	– .013	– .005	– .011	– .002

TURNIPS. EXPERIMENT 3.

DIFFERENTIAL RESPONSES % K.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Tops	- .03	-	-	- .09	+ .03	+ .14	- .19	+ .20	- .26
	Roots	- .08	-	-	- .16	0.00	- .16	- .10	+ .03	- .19
Ammonium Sulphate 2.	Tops	- .01	- .07	+ .05	-	-	- .15	+ .13	- .09	+ .08
	Roots	- .01	- .09	+ .07	-	-	- .10	+ .08	- .08	+ .06
Superphosphate 3.	Tops	- .23*	- .06	- .40*	- .37*	- .09	-	-	- .34*	- .12
	Roots	- .05	- .03	-.07	- .14	+ .04	-	-	+ .11	- .21
Potassium Chloride 2.	Tops	+ .18	+ .41**	- .05	+ .09	+ .27	+ .07	+ .29*	-	-
	Roots	+ .24*	+ .35**	+ .13	+ .17	+ .31*	+ .40**	+ .08	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Tops	2.41	.27	.14	.10	+ .06	- .17	+ .14	- .23*	+ .09	+ .11
Roots	2.05	.21	.11	.08	+ .08	- .02	+ .09	- .11	+ .07	- .16

TURNIPS. EXPERIMENT 3.

DIFFERENTIAL RESPONSES % Ca.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Tops Roots	+ .029 - .017	- -	- -	+ .129 - .028	- .070 - .006	+ .085 .000	- .024 - .034	+ .088 - .041*	- .028 + .007
Ammonium Sulphate 2.	Tops Roots	- .145** - .006	- .045 - .017	- .244** + .006	- -	- -	- .075 + .007	-.215** - .018	- .087 - .005	- .202** - .006
Superphosphate 3.	Tops Roots	- .055 + .008	- .042 + .025	- .069 - .009	- .014 + .020	- .125 - .004	- -	- -	- .172* - .010	+ .061 + .026
Potassium Chloride 2.	Tops Roots	- .045 - .026*	+ .012 - .051**	- .104 - .002	+ .011 - .026	- .103 - .026	- .162* - .045*	+ .072 - .008	- -	- -

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Tops Roots	1.800 0.384	.135 .032	.067 .016	.048 .011	- .099 + .011	- .013 - .018	- .069 - .013	- .058 + .024	- .056 - .006	- .117* + .018

TURNIPS. EXPERIMENT 3.

DIFFERENTIAL RESPONSES % Mg.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	Tops	.000	-	-	+ .001	- .001	- .002	+ .001	- .006	+ .006
	Roots	- .006*	-	-	- .003	- .010*	- .005	- .007	- .001	- .013*
Ammonium Sulphate 2.	Tops	- .002	- .001	- .004	-	-	.000	- .004	- .001	- .003
	Roots	- .003	.000	- .006	-	-	- .002	- .004	- .001	- .005
Superphosphate 3.	Tops	+ .002	- .002	+ .005	+ .003	.000	-	-	- .003	+ .006
	Roots	- .003	- .003	- .003	- .002	- .004	-	-	- .004	- .002
Potassium Chloride 2.	Tops	- .008	- .014	- .002	- .007	- .008	- .013	- .003	-	-
	Roots	- .007*	+ .015*	+ .001	- .009*	- .004	- .007	- .007	-	-

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	INTERACTIONS PS	INTERACTIONS NP	INTERACTIONS KS	INTERACTIONS NK	INTERACTIONS PK
Tops	.132	.013	.006	.004	- .001	+ .004	- .002	+ .006	- .001	+ .005
Roots	.081	.008	.004	.003	- .003	+ .001	- .001	+ .008**	+ .002	+ .001

TURNIPS. EXPERIMENT 3.

DIFFERENTIAL RESPONSES % P.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Tops Roots	+ .008 + .015	– –	– –	+ .018 + .017	– .003 + .013	– .003 + .023	+ .018 + .007	+ .027* + .024	– .013 + .006
Ammonium Sulphate 2.	Tops Roots	+ .004 – .019	+ .014 – .022	– .007 – .017	– –	– –	+ .009 – .026	– .002 – .013	+ .009 – .015	– .002 – .024
Superphosphate 3.	Tops Roots	+ .016 + .017	+ .006 + .024	+ .027* + .009	+ .022 + .023	+ .011 + .011	– –	– –	+ .003 + .012	+ .029* + .021
Potassium Chloride 2.	Tops Roots	+ .020* + .014	+ .041** + .023	– .001 + .005	+ .026* + .016	+ .014 + .012	+ .033* + .009	+ .007 + .019	– –	– –

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Tops Roots	.189 .210	.025 .029	.013 .014	.008 .010	– .011 – .002	+ .011 – .008	+ .006 – .006	– .021* – .009	– .006 – .002	– .013 + .005

TURNIPS. EXPERIMENT 4.

		TOPS. (tons)			ROOTS. (tons)			TOPS. % D.M.					ROOTS. % D.M.				
		Fresh	Dry	%DM.	Fresh	Dry	%DM.	Na	K	Ca	Mg	P	Na	K	Ca	Mg	P
1	N P S	4.05	.547	13.5	23.22	2.14	9.2	.500	1.70	1.62	.124	.205	.160	1.90	.330	.084	.175
2	N	2.89	.480	16.6	16.00	1.55	9.7	.210	1.95	1.68	.120	.175	.065	1.70	.415	.080	.135
3	K	3.12	.402	12.9	16.50	1.58	9.6	.270	2.70	1.75	.108	.135	.075	1.90	.365	.076	.135
4	P K S	5.20	.603	11.6	25.68	2.13	8.3	.400	2.40	1.81	.142	.220	.155	1.90	.365	.064	.200
5	N K S	6.22	.790	12.7	22.68	1.97	8.7	.355	2.50	1.89	.134	.200	.110	2.10	.330	.084	.200
6	P	6.41	.820	12.8	23.54	2.00	8.5	.270	1.85	1.98	.160	.190	.085	1.40	.365	.088	.190
7	S	5.85	.708	12.1	23.22	2.00	8.6	.525	1.60	2.09	.150	.205	.195	1.65	.390	.092	.145
8	N P K	7.73	1.020	13.2	24.88	2.14	8.6	.240	1.70	1.72	.150	.225	.077	1.45	.330	.084	.190
9	P S	3.93	.515	13.1	22.62	2.22	9.8	.347	2.00	1.81	.116	.195	.105	1.65	.330	.068	.180
10	N P	5.81	.825	14.2	20.38	1.81	8.9	.235	2.15	1.75	.120	.195	.075	1.60	.365	.068	.165
11	N P K S	4.05	.510	12.6	22.70	2.00	8.8	.510	2.15	1.39	.138	.250	.165	2.00	.315	.068	.175
12	P K	5.55	.672	12.1	25.60	2.36	9.2	.250	2.50	1.43	.150	.210	.090	1.90	.420	.060	.200
13	N S	5.42	.764	14.1	20.06	1.81	9.0	.462	1.70	1.58	.132	.165	.150	1.65	.430	.092	.160
14	-	4.15	.486	11.7	14.44	1.36	9.4	.275	1.65	1.94	.142	.085	.070	1.50	.365	.076	.140
15	K S	4.25	.570	13.4	18.74	1.59	8.5	.425	2.20	1.68	.112	.180	.095	2.00	.415	.068	.160
16	N K	4.96	.635	12.8	19.86	1.81	9.1	.165	2.20	1.58	.124	.150	.050	1.60	.315	.068	.140
17	P	6.15	.892	14.5	19.82	1.66	8.4	.445	1.45	1.98	.146	.180	.180	1.50	.460	.076	.170
18	K	3.45	.466	13.5	16.48	1.55	9.4	.225	2.55	2.24	.104	.135	.082	1.80	.330	.068	.110
19	N	4.50	.639	14.2	19.26	1.75	9.1	.500	1.70	1.68	.124	.160	.130	1.55	.330	.076	.150
20	N P S	6.25	.756	11.8	22.34	1.97	8.8	.600	1.75	1.68	.176	.210	.280	1.50	.330	.076	.170
21	N K S	4.75	.575	12.1	20.50	1.82	8.9	.495	2.10	1.43	.142	.210	.140	1.80	.300	.060	.135
22	P K S	5.32	.665	12.5	23.50	2.14	9.1	.600	1.95	1.25	.116	.230	.190	1.90	.330	.084	.160
23	N P K	7.40	.969	13.1	26.36	2.49	9.4	.290	1.85	1.43	.150	.230	.085	1.70	.330	.084	.160
24	S	5.83	.740	12.7	21.34	1.98	9.3	.700	1.90	1.58	.150	.180	.185	1.40	.315	.060	.135
25	N P K S	4.65	.558	12.0	23.50	2.12	9.0	.750	1.50	1.98	.124	.225	.190	1.65	.400	.068	.145
26	N K	3.36	.467	13.9	16.40	1.48	9.0	.225	2.90	1.89	.092	.195	.082	1.80	.330	.068	.160
27	K S	3.48	.487	14.0	19.56	1.74	8.9	.410	2.60	2.02	.092	.150	.175	2.10	.365	.060	.165
28	-	4.65	.586	12.6	14.24	1.27	8.9	.200	1.45	1.46	.160	.120	.145	1.30	.400	.092	.125
29	P K	7.65	.979	12.8	27.78	2.64	9.5	.400	1.80	1.75	.116	.265	.110	1.70	.400	.084	.180
30	N S	5.80	.719	12.4	23.92	2.06	8.6	.650	1.40	1.85	.176	.250	.230	1.50	.330	.076	.135
31	N P	5.18	.736	14.2	25.96	2.39	9.2	.330	1.45	1.62	.176	.265	.125	1.35	.330	.092	.170
32	P S	4.40	.664	15.1	25.94	2.41	9.3	.600	1.90	1.32	.168	.225	.225	1.25	.340	.060	.175.

DIFFERENTIAL RESPONSES

Fresh and Dry Yields (tons)

CWT./ACRE			MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4 cwt	Tops	Fresh	- 0.34	-	-	- 0.39	- 0.29	+ 1.29**	- 1.96**	- 0.20	- 0.87*
		Dry	- 0.056	-	-	- 0.043	- 0.069	+ 0.149**	- 0.261**	- 0.006	- 0.106
	Roots	Fresh	+ 1.87*	-	-	+ 2.64*	+ 1.10	+ 4.46**	- 0.73	+ 3.48**	+ 0.24
		Dry	+ 0.14*	-	-	+ 0.22*	+ 0.06	+ 0.33**	- 0.05	+ 0.35**	- 0.07
Ammonium Sulphate 2 cwt	Tops	Fresh	+ 0.14	+ 0.09	+ 0.18	-	-	+ 0.39	- 0.12	- 0.18	+ 0.44
		Dry	+ 0.039	+ 0.052	+ 0.026	-	-	+ 0.071	+ 0.007	0.000	+ 0.078
	Roots	Fresh	+ 0.56	+ 1.34	- 0.22	-	-	+ 1.77	- 0.65	+ 0.75	+ 0.37
		Dry	+ 0.04	+ 0.12	- 0.04	-	-	+ 0.15	- 0.07	+ 0.07	+ 0.01
Superphosphate 3 cwt	Tops	Fresh	+ 0.97**	+ 2.60**	- 0.65	+ 1.23**	+ 0.72	-	-	+ 0.39	+ 1.56**
		Dry	+ 0.119**	+ 0.324**	- 0.086	+ 0.151**	- 0.237**	-	-	+ 0.060	+ 0.178**
	Roots	Fresh	+ 5.02**	+ 7.56**	+ 2.45**	+ 6.24**	+ 3.82**	-	-	+ 3.91**	+ 6.15**
		Dry	+ 0.46**	+ 0.65**	+ 0.27**	+ 0.57**	+ 0.35**	-	-	+ 0.36**	+ 0.56**
Potassium Chloride 2 cwt	Tops	Fresh	- 0.10	+ 0.43	- 0.64	- 0.41	+ 0.22	- 0.69	+ 0.49	-	-
		Dry	- 0.032	+ 0.018	- 0.082	- 0.071	+ 0.007	- 0.091	+ 0.027	-	-
	Roots	Fresh	+ 0.90	+ 2.52*	- 0.73	+ 1.09	+ 0.71	+ 0.22	+ 2.02*	-	-
		Dry	+ 0.07	+ 0.28*	- 0.14	+ 0.10	+ 0.04	- 0.03	+ 0.17*	-	-

		MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	INTERACTIONS PS	INTERACTIONS NP	INTERACTIONS KS	INTERACTIONS NK	INTERACTIONS PK
Tops	Fresh	5.08	0.685	0.342	0.243	+ 0.05	- 1.62**	- 0.25	- 0.53*	+ 0.32	+ 0.59*
	Dry	0.664	0.115	0.058	0.041	- 0.013	- 0.205**	-0.032	- 0.050	+ 0.039	+ 0.059
Roots	Fresh	21.47	1.798	0.894	0.633	- 0.78	- 2.61**	- 1.21	- 1.63*	- 0.19	+ 1.12
	Dry	1.94	0.17	0.08	0.06	- 0.08	- 0.19**	- 0.11	- 0.21**	- 0.03	+ 0.10

TURNIPS. EXPERIMENT 4.

DIFFERENTIAL RESPONSES % Na.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Tops	+ .237**	-	-	+ .234**	+ .241**	+ .269**	+ .206**	+ .240**	+ .235**
	Roots	+ .064*	-	-	+ .061**	+ .067**	+ .060**	+ .068**	+ .025	+ .103**
Ammonium Sulphate 2.	Tops	+ .011	+ .007	+ .014	-	-	+ .029	- .007	+ .015	+ .006
	Roots	- .015	- .018	- .012	-	-	- .027	- .004	- .009	- .022
Superphosphate 3.	Tops	+ .042	+ .074	+ .011	+ .061	+ .024	-	-	- .019	+ .103*
	Roots	+ .020	+ .016	+ .024	+ .009	+ .031	-	-	+ .021	+ .019
Potassium Chloride 2.	Tops	- .078*	- .075	- .080	- .082	- .073	-.138**	- .016	-	-
	Roots	- .033**	- .072**	+ .006	- .027	- .039*	- .032	- .034*	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Tops	.402	.078	.039	.028	+ .003	- .032	- .018	- .002	- .005	+ .062*
Roots	.134	.031	.015	.011	+ .003	+ .004	+ .011	+ .039*	- .006	- .001

TURNIPS. EXPERIMENT 4.

DIFFERENTIAL RESPONSES % K.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Tops Roots	- .03 + .13*	- -	- -	+ 0.08 + .10*	- .14 + .16 *	- .14 + .13*	+ .08 + .13*	- .03 + .07	- .03 + .19*
Ammonium Sulphate 2.	Tops Roots	- .12 .00	-.01 - .03	- .23 + .03	- -	- -	- .03 + .01	- .21 - .01	.00 + .14*	- .24 - .14*
Superphosphate 3.	Tops Roots	- .19 - .07	- .30* - .07	- .08 - .07	- .10 - .06	- .28 - .08	- -	- -	- .50** - .02	+ .12 - .12
Potassium Chloride 2.	Tops Roots	+ .49** + .31**	+ .50** + .25**	+ .49** + .37**	+ .61** + .45**	+ .37* + .16*	+ .18* + .36**	+ .80** + .26**	- -	- -

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFERENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Tops Roots	1.98 1.68	0.28 0.13	0.14 0.07	0.09 0.05	- .11 + .03	+ .11 .00	- .09 - .01	.00 + .06	- .12 - .14**	+ .31* - .05

DIFFERENTIAL RESPONSES % Ca.

CWT./ACRE			MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	Tops Roots	- .056 - .015	- -	- -	- .121 - .032	+ .009 + .003	- .013 + .003	- .100 - .031	- .070 - .030	- .042 .000
Ammonium Sulphate	2.	Tops Roots	- .083 - .028*	- .148 - .045*	- .017 - .011	- -	- -	- .148 - .021	- .017 - .035	- .087 - .013	- .078 - .042*
Superphosphate	3.	Tops Roots	- .111 + .001	- .070 + .018	- .157 - .016	- .179 + .008	- .049 - .007	- -	- -	- .013 - .016	- .215 + .018
Potassium Chloride	2.	Tops Roots	- .024 - .012	- .038 - .026	- .009 + .003	- .029 + .003	- .019 - .026	- .077 - .028	- .125 + .005	- -	- -

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Tops Roots	1.713 .355	.272 .039	.136 .019	.096 .014	+ .065 + .017	- .044 - .018	+ .065 - .007	+ .014 + .015	+ .005 - .015	- .101 + .016

TURNIPS. EXPERIMENT 4.

DIFFERENTIAL RESPONSES % Mg.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Tops Roots	+ .003 - .004	- -	- -	- .005 - .008	+ .011 .000	+ .014 - .001	- .008 - .007	+ .005 - .005	+ .001 - .003
Ammonium Sulphate 2.	Tops Roots	+ .004 + .004	- .004 .000	+ .013 + .008	- -	- -	+ .003 + .002	+ .006 + .006	- .006 + .004	+ .014 + .004
Superphosphate 3.	Tops Roots	+ .013 + .001	+ .024* + .004	+.002 - .002	+ .012 - .001	+ .014 + .003	- -	- -	+ .004 - .004	+ .022 + .006
Potassium Chloride 2.	Tops Roots	- .021* - .006	- .019 - .007	- .023 - .006	- .031* - .006	- .011 - .006	- .030* - .011	- .012 - .001	- -	- -

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Tops Roots	.135 .075	.022 .014	.011 .005	.008 .004	+ .008 + .004	- .011 - .003	+ .001 + .002	- .002 + .001	+ .010 .000	+ .009 + .005

TURNIPS. EXPERIMENT 4.

DIFFERENTIAL RESPONSES % P.

CWT./ACRE			MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	Tops	+ .024*	–	–	+ .033*	+ .015	+ .048**	.000	+ .033*	+ .015
		Roots	+ .005	–	–	+ .009	+ .001	+ .019**	– .018	+ .003	+ .008
Ammonium Sulphate	2.	Tops	+ .025*	+ .034*	+ .016	–	–	+ .040*	+ .011	+ .030*	+ .020
		Roots	.000	+ .003	– .003	–	–	+ .013**	– .013**	+ .001	– .001
Superphosphate	3.	Tops	+ .051**	+ .075**	+ .027	+ .066**	+ .037*	–	–	+ .041**	+ .062**
		Roots	+ .030**	+ .041**	+ .018**	+ .043**	+ .016**	–	–	+ .034**	+ .025**
Potassium Chloride	2.	Tops	+ .013	+ .022	+ .004	+ .018	+ .008	+ .002	+ .024	–	–
		Roots	+ .006	+ .004	+ .008	+ .007	+ .005	+ .011	+ .001	–	–

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Tops	.194	.027	.014	.010	– .009	– .024*	– .014	– .009	– .005	+ .011
Roots	.161	.010	.005	.003	– .003	– .016**	– .013**	+ .002	– .001	– .005

		DRY MATTER YIELD. CWT / ACRE.						% DRY MATTER.			
		Total		Grass		Clover		Grass		Clover	
		B	C	B	C	B	C	B	C	B	C
1	N K S	24.9	19.3	23.1	18.1	1.8	1.2	14.4	25.0	10.3	17.6
2	N	26.1	20.4	21.7	17.5	4.4	2.9	15.9	24.1	11.8	17.1
3	K	15.1	13.4	10.0	8.9	5.1	4.5	19.3	22.4	12.0	17.1
4	P K S	15.6	15.4	8.2	8.7	7.4	6.7	18.8	22.4	11.7	15.5
5	N P S	22.2	21.5	19.0	18.5	3.2	3.0	13.6	25.0	10.6	17.5
6	N P K	24.7	22.5	17.7	14.8	7.0	7.7	14.9	21.7	10.8	15.6
7	S	9.8	18.3	5.6	11.9	4.2	6.4	17.6	23.6	12.1	15.8
8	P	17.2	17.6	9.6	10.2	7.6	7.4	18.4	21.8	12.2	15.7
9	K S	10.5	17.9	8.3	10.4	2.2	7.5	20.7	24.8	13.7	17.4
10	N K	25.5	26.8	18.8	21.8	6.7	5.0	15.4	24.7	10.6	17.0
11	N S	27.2	19.9	25.7	17.3	1.5	2.6	15.0	26.7	10.8	19.5
12	N P	25.5	25.6	20.0	19.1	5.5	6.5	16.5	26.5	11.8	19.6
13	-	14.8	21.4	5.9	12.4	8.9	9.0	18.9	25.3	12.2	17.4
14	N P K S	25.3	24.1	22.0	20.7	3.3	3.4	14.4	25.8	10.8	18.4
15	P K	16.3	24.6	10.0	14.4	6.3	10.2	19.0	23.7	11.8	16.4
16	P S	18.6	21.0	10.8	10.4	7.8	10.6	19.4	23.0	12.7	17.2
17	P K S	12.4	21.1	9.9	10.0	2.5	11.1	20.9	24.6	13.5	16.9
18	N K S	26.6	24.0	23.2	19.5	3.4	4.5	15.5	24.6	11.2	16.1
19	K	14.9	22.7	8.7	7.4	6.2	15.3	20.4	23.3	12.8	16.6
20	N	30.1	24.9	27.2	19.2	2.9	5.7	16.9	24.6	12.6	16.9
21	N P S	26.6	17.6	23.9	14.5	1.6	3.1	13.5	26.3	11.7	18.7
22	P	18.2	31.0	8.5	10.0	9.7	21.0	19.3	21.1	11.6	16.8
23	N P K	28.8	28.1	24.0	19.0	4.8	9.1	16.7	23.7	11.0	17.0
24	S	20.0	29.6	10.4	10.4	9.6	19.2	17.4	20.8	11.5	15.3
25	P S	16.9	31.8	12.1	18.8	4.8	13.0	17.6	26.8	11.1	17.7
26	N K	29.2	27.3	26.1	18.7	3.1	8.6	14.0	22.1	10.1	15.4
27	N P	35.9	26.8	32.5	22.3	3.4	4.5	17.0	25.9	11.6	18.9
28	K S	12.7	19.2	10.9	10.5	1.8	8.7	21.6	25.4	14.1	17.9
29	N P K S	34.3	22.8	32.6	20.1	1.7	2.7	16.5	26.2	10.0	17.1
30	-	19.3	25.9	9.7	9.9	9.6	16.0	18.0	23.1	11.8	16.2
31	P K	21.2	26.9	10.8	12.8	10.4	14.1	17.8	22.0	11.4	15.9
32	N S	32.6	27.8	24.1	21.7	8.5	6.1	16.4	25.0	11.2	17.4
Additional Plots.											
33	N2 S2	29.7	30.8	29.6	29.7	0.1	1.1	13.5	18.8	10.6	14.3
34	S2	11.8	13.9	10.2	11.0	1.6	2.9	18.0	24.4	13.2	17.2
35	K2 S2	11.5	11.4	11.0	9.6	0.5	1.8	19.7	24.8	13.0	17.8
36	N2	34.2	26.5	32.1	21.4	2.1	5.1	14.0	17.8	10.7	14.5
37	K2	19.9	22.6	13.7	14.0	6.2	8.6	19.6	24.6	12.5	17.0
38	N2 K2 S2	30.1	34.0	30.1	32.6	.02	1.4	14.2	18.0	10.4	16.2
39	N2 K2	41.7	34.5	38.2	31.5	3.5	3.0	14.5	18.2	10.6	16.0
40	-	24.6	22.7	12.7	12.5	11.9	9.9	18.3	24.7	12.8	17.4

Grass Composition.

	Na %				K %				Ca %				Mg %				P %			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
1 N K S	.315	.290	.120	.060	3.95	2.90	2.05	3.35	.570	.540	.540	.640	.126	.102	.104	.130	.305	.275	.215	.330
2 N	.355	.255	.135	.075	2.75	1.65	1.75	1.95	.630	.575	.600	.520	.134	.110	.132	.182	.295	.290	.245	.350
3 K	.085	.045	.030	.022	3.15	2.20	2.30	2.70	.630	.500	.560	.630	.100	.096	.120	.146	.280	.275	.300	.400
4 P K S	.220	.105	.075	.060	3.30	2.25	2.25	2.85	.600	.575	.525	.620	.106	.092	.108	.124	.315	.300	.245	.345
5 N P S	.375	.300	.105	.055	4.25	3.00	2.05	2.60	.620	.555	.490	.460	.130	.096	.090	.098	.320	.315	.185	.220
6 N P K	.077	.070	.017	.015	4.65	3.20	2.30	3.15	.600	.575	.490	.600	.114	.102	.090	.118	.290	.260	.260	.230
7 S	.360	.175	.085	.085	3.55	2.50	2.20	2.45	.630	.575	.490	.480	.114	.092	.096	.098	.275	.240	.260	.265
8 P	.185	.070	.030	.140	3.20	2.15	2.40	3.00	.720	.555	.560	.540	.100	.096	.110	.136	.280	.260	.285	.315
9 K S	.387	.135	.090	.077	2.95	1.90	2.05	2.30	.540	.500	.420	.466	.106	.076	.096	.124	.255	.235	.230	.230
10 N K	.235	.155	.065	.035	4.30	2.50	1.80	2.50	.680	.500	.490	.540	.140	.102	.104	.130	.250	.250	.190	.210
11 N S	.800	.525	.195	.140	3.40	2.10	1.35	2.00	.570	.460	.460	.540	.140	.118	.108	.124	.275	.240	.185	.200
12 N P	.405	.200	.150	.090	3.05	1.95	1.30	1.85	.700	.550	.450	.460	.148	.102	.100	.130	.295	.275	.170	.180
13 -	.225	.055	.035	.030	2.90	2.25	2.05	2.70	.640	.520	.490	.480	.122	.070	.108	.126	.275	.250	.215	.200
14 N P K S	.470	.295	.110	.065	4.25	3.10	1.90	2.35	.600	.500	.450	.520	.136	.080	.080	.102	.260	.230	.185	.170
15 P K	.165	.035	.017	.010	3.20	2.30	2.55	2.80	.660	.480	.450	.430	.096	.060	.092	.102	.270	.210	.225	.180
16 P S	.285	.110	.150	.135	3.00	2.00	2.20	2.50	.640	.520	.720	.720	.096	.088	.112	.124	.265	.250	.330	.400
17 P K S	.230	.105	.075	.065	2.90	2.00	1.90	2.50	.660	.500	.460	.620	.106	.092	.096	.158	.290	.300	.250	.275
18 N K S	.365	.450	.115	.060	3.70	2.50	1.60	2.15	.680	.520	.460	.620	.142	.110	.092	.130	.265	.210	.210	.290
19 K	.082	.060	.025	.022	2.65	1.90	1.95	2.30	.660	.460	.500	.620	.106	.070	.096	.124	.225	.200	.235	.330
20 N	.290	.245	.105	.095	2.60	1.30	1.45	1.60	.660	.520	.575	.620	.148	.096	.118	.142	.245	.210	.200	.260
21 N P S	.500	.505	.120	.070	3.45	1.85	1.30	2.10	.540	.500	.400	.550	.100	.070	.076	.118	.270	.250	.165	.220
22 P	.060	.050	.030	.065	2.80	2.05	2.10	2.30	.820	.500	.520	.680	.110	.080	.118	.182	.305	.290	.235	.275
23 N P K	.075	.060	.015	.015	4.80	2.80	1.80	2.40	.680	.520	.430	.540	.130	.100	.096	.130	.310	.290	.190	.230
24 S	.230	.120	.090	.060	2.75	2.30	2.10	2.75	.680	.575	.500	.570	.096	.106	.106	.128	.270	.250	.250	.315
25 P S	.215	.160	.065	.082	3.20	2.20	1.45	1.95	.630	.400	.385	.700	.086	.080	.088	.140	.290	.270	.275	.330
26 N K	.150	.155	.025	.035	4.05	2.80	1.80	2.35	.600	.460	.430	.600	.122	.116	.088	.150	.225	.200	.175	.220
27 N P	.185	.200	.070	.120	2.85	1.50	1.35	1.80	.640	.500	.445	.640	.110	.090	.092	.158	.275	.260	.170	.240
28 K S	.200	.077	.065	.040	2.50	1.65	1.70	2.35	.560	.430	.460	.520	.076	.084	.076	.124	.240	.210	.190	.230
29 N P K S	.290	.160	.040	.022	4.10	2.70	1.50	2.10	.560	.430	.430	.480	.114	.096	.076	.102	.300	.260	.175	.240
30 -	.070	.065	.025	.040	2.60	2.10	1.85	2.55	.560	.480	.445	.570	.100	.084	.084	.124	.305	.250	.180	.220
31 P K	.070	.035	.015	.015	3.15	2.40	2.05	2.60	.660	.520	.480	.540	.076	.088	.070	.120	.315	.255	.195	.220
32 N S	.550	.395	.140	.095	3.50	1.85	1.40	2.00	.680	.520	.500	.620	.140	.102	.084	.110	.320	.315	.200	.330

Additional Plots.

	Na A	Na B	Na C	Na D	K A	K B	K C	K D	Ca A	Ca B	Ca C	Ca D	Mg A	Mg B	Mg C	Mg D	P A	P B	P C	P D
33 N2 S2	.750	.900	.505	.370	2.90	2.05	0.95	1.40	.575	.480	.460	.720	.144	.106	.110	.124	.325	.290	.205	.185
34 S2	.462	.135	.095	.140	2.30	1.70	1.60	1.90	.540	.385	.400	.620	.074	.088	.096	.110	.365	.200	.230	.250
35 K2 S2	.295	.140	.077	.130	2.40	1.75	1.60	2.15	.620	.415	.415	.620	.082	.070	.092	.084	.340	.220	.225	.235
36 N2	.290	.275	.225	.195	2.65	1.50	1.10	1.50	.575	.520	.540	.785	.108	.106	.124	.136	.340	.250	.215	.210
37 K2	.082	.040	.022	.030	2.65	2.20	2.10	2.90	.640	.460	.575	.575	.060	.084	.110	.096	.290	.260	.250	.275
38 N2 K2 S2	.280	.395	.130	.082	4.05	3.25	1.85	2.40	.500	.480	.460	.540	.114	.118	.092	.110	.280	.250	.210	.220
39 N2 K2	.060	.055	.010	.010	4.90	3.30	2.20	2.50	.560	.520	.500	.550	.154	.080	.096	.102	.350	.305	.190	.215
40 -	.040	.022	.022	.017	2.60	2.55	2.20	2.70	.680	.460	.520	.640	.114	.096	.114	.118	.320	.260	.290	.275.

Clover Composition.

	Na %.				K %				Ca %				Mg %				P %			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
1 N K S	.120	.060	.075	.075	3.50	3.10	1.85	1.90	1.98	1.75	1.98	2.28	.248	.250	.256	.280	.355	.235	.140	.200
2 N	.052	.060	.080	.130	2.60	1.90	1.25	1.05	1.85	1.62	1.81	2.28	.300	.296	.312	.296	.340	.275	.190	.235
3 K	.050	.030	.055	.075	3.35	3.05	2.40	1.80	2.12	1.98	1.78	2.24	.266	.280	.244	.206	.300	.235	.185	.215
4 P K S	.155	.090	.075	.085	3.40	2.95	2.50	2.10	2.06	1.85	1.94	2.06	.248	.250	.222	.214	.325	.180	.190	.185
5 N P S	.065	.075	.140	.090	4.00	3.50	1.90	2.20	1.72	1.46	1.54	2.24	.242	.206	.190	.178	.295	.195	.100	.140
6 N P K	.025	.015	.022	.015	4.20	3.30	2.65	2.35	1.89	1.75	1.72	2.09	.256	.214	.190	.174	.410	.295	.150	.185
7 S	.170	.110	.082	.085	3.35	2.80	2.50	2.20	1.94	1.89	1.78	2.02	.204	.214	.190	.182	.290	.170	.180	.190
8 P	.040	.025	.085	.040	3.10	2.60	2.20	1.85	2.06	1.78	1.89	2.12	.232	.206	.214	.206	.325	.220	.195	.190
9 K S	.215	.125	.135	.130	2.80	2.75	2.10	1.90	1.89	1.62	1.75	1.98	.228	.230	.244	.222	.220	.120	.110	.175
10 N K	.035	.025	.070	.070	3.15	2.75	1.70	1.55	1.94	1.46	2.06	2.02	.260	.230	.262	.238	.310	.185	.140	.100
11 N S	.190	.135	.360	.155	2.95	2.15	0.95	1.25	1.98	1.43	1.81	2.20	.234	.242	.280	.256	.215	.210	.070	.105
12 N P	.030	.017	.105	.100	2.90	2.35	1.90	1.25	1.78	1.58	1.81	2.12	.292	.238	.280	.214	.370	.250	.085	.095
13 –	.055	.022	.065	.077	3.10	2.90	1.80	1.70	2.09	1.98	1.72	2.06	.260	.244	.230	.230	.305	.195	.105	.185
14 N P K S	.100	.075	.105	.075	3.55	3.40	1.90	1.95	1.81	1.65	1.94	2.38	.256	.206	.226	.214	.260	.190	.095	.140
15 P K	.082	.030	.025	.030	3.25	3.20	2.45	2.30	2.16	1.94	1.75	2.09	.220	.182	.182	.158	.250	.200	.155	.180
16 P S	.335	.125	.165	.175	3.10	3.10	1.80	1.65	2.20	2.20	1.94	2.20	.228	.238	.244	.190	.370	.220	.195	.210
17 P K S	.120	.085	.065	.100	2.90	2.85	1.90	1.85	2.35	2.16	1.78	2.12	.228	.214	.206	.198	.315	.250	.140	.190
18 N K S	.085	.085	.120	.060	3.20	3.00	1.50	1.95	1.89	1.72	2.06	2.28	.282	.250	.266	.238	.350	.275	.150	.190
19 K	.055	.630	.050	.075	2.90	2.90	1.90	2.10	2.20	2.20	1.75	2.12	.254	.256	.206	.182	.260	.195	.155	.185
20 N	.058	.045	.095	.110	2.05	1.70	1.20	1.05	2.24	1.94	1.81	2.16	.310	.230	.222	.214	.340	.230	.155	.165
21 N P S	.215	.135	.125	.185	3.10	2.85	1.70	1.85	1.85	1.58	1.96	2.50	.254	.206	.244	.230	.355	.230	.075	.100
22 P	.060	.025	.030	.110	2.75	2.50	1.60	1.50	2.42	2.12	1.68	2.24	.300	.244	.214	.230	.320	.275	.170	.175
23 N P K	.024	.022	.017	.030	4.00	3.30	2.35	2.50	1.89	1.78	1.89	2.28	.290	.222	.222	.238	.390	.230	.140	.175
24 S	.115	.090	.090	.105	2.85	3.05	1.75	2.40	2.20	1.89	1.78	2.12	.232	.222	.214	.230	.355	.220	.155	.190
25 P S	.120	.120	.170	.140	2.75	2.65	1.45	1.50	2.16	1.89	1.98	2.28	.290	.230	.244	.264	.390	.250	.150	.110
26 N K	.040	.017	.025	.045	3.30	3.10	1.80	1.65	1.89	1.46	1.89	2.16	.318	.214	.244	.238	.325	.215	.100	.120
27 N P	.040	.035	.045	.135	2.65	1.85	2.50	1.20	2.02	1.68	2.02	2.28	.290	.198	.222	.214	.360	.220	.110	.130
28 K S	.130	.100	.100	.077	3.00	2.90	1.85	2.40	1.98	2.20	1.98	2.20	.228	.206	.250	.214	.235	.150	.100	.150
29 N P K S	.135	.060	.050	.060	3.30	3.70	2.05	2.50	1.89	1.58	1.94	2.54	.248	.202	.198	.230	.340	.260	.125	.125
30 –	.050	.025	.025	.045	2.70	2.80	1.85	2.20	2.35	2.09	1.65	2.16	.280	.214	.198	.206	.295	.190	.080	.150
31 P K	.105	.017	.030	.025	3.10	3.45	2.20	2.30	2.06	1.98	1.85	2.06	.252	.214	.202	.182	.340	.220	.120	.150
32 N S	.155	.100	.300	.240	3.00	2.85	1.50	1.50	2.06	1.89	1.85	2.35	.276	.214	.214	.206	.315	.315	.170	.195

Additional Plots.

	Na A	Na B	Na C	Na D	K A	K B	K C	K D	Ca A	Ca B	Ca C	Ca D	Mg A	Mg B	Mg C	Mg D	P A	P B	P C	P D
33 N2 S2	.295	.285	.480	.305	2.60	2.90	0.80	1.05	1.81	1.29	2.09	2.12	.270	.222	.250	.280	.215	.290	.110	.140
34 S2	.280	.140	.115	.185	2.30	2.55	1.75	1.80	1.98	1.78	1.94	1.94	.234	.230	.238	.190	.120	.190	.120	.085
35 K2 S2	.195	.055	.065	.055	2.90	2.90	2.15	2.40	2.20	2.12	2.02	2.12	.216	.238	.202	.206	.140	.170	.145	.080
36 N2	.050	.035	.065	.140	2.30	2.00	0.85	0.90	2.04	1.62	2.24	2.28	.284	.216	.234	.250	.155	.290	.140	.150
37 K2	.035	.025	.035	.045	3.25	3.25	2.10	2.50	2.28	2.09	2.06	2.02	.252	.222	.208	.206	.130	.230	.165	.120
38 N2 K2 S2	.065	.100	.060	.030	3.05	2.90	2.40	2.85	1.98	2.30	2.06	2.28	.230	.210	.202	.190	.180	.205	.140	.130
39 N2 K2	.040	.017	.005	.017	3.40	3.70	3.05	2.55	1.81	1.62	1.89	2.28	.226	.190	.176	.190	.185	.260	.145	.140
40 –	.040	.022	.015	.030	3.25	3.00	2.25	2.50	2.02	2.35	1.85	2.12	.216	.230	.176	.198	.245	.290	.185	.200

GRASS. EXPERIMENT 1..

1st Cut. (Sample B.) DIFFERENTIAL RESPONSES Dry Matter Yield. (cwt)

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Grass	+ 0.54	-	-	+ 0.38	+ 0.70	+ 0.40	+ 0.68	- 0.44	+ 1.51
	Clover	- 2.26*	-	-	- 2.92*	- 1.60	- 1.70	- 2.78*	- 1.35	- 3.19*
	Total	- 1.73	-	-	- 2.56	- 0.90	- 1.34	- 2.13	- 1.79	- 1.68
Ammonium Sulphate 3.	Grass	+ 14.50**	+ 14.40**	+ 14.60**	-	-	+ 15.10**	+ 14.02**	+ 15.25**	+ 12.75**
	Clover	- 2.58**	- 3.26**	- 1.92	-	-	- 1.92	- 3.26**	- 3.90*	- 1.27
	Total	+ 11.93**	+ 11.12**	+ 12.72**	-	-	+ 13.20**	+ 10.70**	+ 11.35**	+ 12.50**
Superphosphate 3	Grass	+ 0.76	+ 0.63	+ 0.90	+ 1.30	+ 0.22	-	-	+ 0.76	+ 0.76
	Clover	+ 0.44	+ 0.97	- 0.09	+ 1.11	- 0.25	-	-	- 0.75	+ 1.64
	Total	+ 1.21	+ 1.60	+ 0.81	+ 2.41	0.00	-	-	+ 0.01	+ 2.40
Potassium Chloride 2.	Grass	- 0.15	- 1.12	+ 0.82	+ 0.52	- 0.82	- 0.15	- 0.15	-	-
	Clover	- 1.22	- 0.30	- 2.14	- 2.54	+ 0.10	- 2.48	- 0.03	-	-
	Total	- 1.37	- 1.43	- 1.32	- 2.02	- 0.73	- 2.56	- 0.18	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Grass	16.41	2.58	1.29	0.96	+ 0.16	+ 0.14	- 0.54	+ 0.98	- 0.67	0.00
Clover	5.23	2.46	1.28	0.91	+ 0.66	- 0.53	- 0.66	- 0.92	+ 1.31	+ 1.20
Total	21.64	2.72	1.36	0.95	+ 0.84	- 0.39	- 1.21	+ 0.06	+ 0.64	+ 1.21

2nd Cut. (Sample C.)

DIFFERENTIAL RESPONSES

Dry Matter Yield. (cwt)

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	Grass	+ 0.19	-	-	+ 0.64	- 0.25	+ 0.50	- 0.11	+ 0.36	+ 0.03
	Clover	- 2.36	-	-	- 1.79	- 2.93	- 1.35	- 3.35*	- 1.15	- 3.56*
	Total	- 2.16	-	-	- 1.15	- 3.16	- 0.85	- 3.48	- 0.76	- 3.58*
Ammonium Sulphate 3.	Grass	+ 7.84**	+ 8.30**	+ 7.41**	-	-	+ 9.00**	+ 6.61**	+ 7.01**	+ 8.70**
	Clover	- 6.51**	- 5.92**	- 7.08**	-	-	- 6.26**	- 6.80**	- 8.51**	- 4.50**
	Total	+ 1.35	+ 2.36	+ 0.34	-	-	+ 2.67	+ 0.03	- 1.52	+ 4.42*
Superphosphate 3.	Grass	+ 0.54	+ 0.85	+ 0.24	+ 1.72	- 0.63	-	-	+ 0.37	+ 0.65
	Clover	+ 0.68	+ 1.69	- 0.33	+ 0.94	+ 0.43	-	-	+ 0.15	+ 1.21
	Total	+ 1.21	+ 2.54	- 0.09	+ 2.62	- 0.18	-	-	+ 0.56	+ 1.86
Potassium Chloride 2.	Grass	- 0.52	- 0.35	- 0.69	- 1.37	+ 0.32	- 0.63	- 0.41	-	-
	Clover	- 1.04	+ 0.16	- 2.25	- 3.06	+ 0.97	- 1.58	- 0.51	-	-
	Total	- 1.56	- 0.16	- 2.95	- 4.42*	+ 1.30	- 2.20	- 0.93	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Grass	15.00	2.47	1.24	0.87	- 0.44	- 0.31	- 1.14	- 0.18	+ 0.84	+ 0.11
Clover	8.05	3.04	1.53	1.08	- 0.57	- 1.01	- 0.26	- 1.21	+ 2.01	+ 0.53
Total	23.04	3.35	1.68	1.19	- 1.01	- 1.31	- 1.40	- 1.40	+ 2.86*	+ 0.64

GRASS. DIFFERENTIAL RESPONSES % Na.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	A.	+ .167**	−	−	+ .123**	+ .212**	+ .190**	+ .146**	+ .168**	+ .168**
	B.	+ .134**	−	−	+ .071*	+ .197**	+ .141**	+ .127**	+ .144**	+ .125**
	C.	+ .053**	−	−	+ .061**	+ .045**	+ .057**	+ .049**	+ .046**	+ .060**
	D.	+ .022*	−	−	+ .033**	+ .011	+ .033**	+ .011	+ .009	+ .035**
Ammonium Sulphate 3.	A.	+ .148**	+ .104**	+ .192**	−	−	+ .202**	+ .094*	+ .254**	+ .042
	B.	+ .179**	+ .116**	+ .241**	−	−	+ .186**	+ .172**	+ .227**	+ .131**
	C.	+ .039**	+ .047**	+ .031**	−	−	+ .057**	+ .021**	+ .064**	+ .014*
	D.	+ .006	+ .017	− .005	−	−	+ .027*	− .015	+ .013	− .001
Superphosphate 3.	A.	− .055*	− .033	− .077*	− .001	− .099*	−	−	− .058	− .052
	B.	− .046	− .039	− .053	− .008	− .085*	−	−	− .030	− .062
	C.	− .017	− .013*	+ .020**	+ .001	− .034**	−	−	− .022**	− .011
	D.	+ .003	+ .014	− .008	+ .024	− .018	−	−	+ .017	− .011
Potassium Chloride 2.	A.	− .105**	− .105**	− .105**	+ .001	− .211**	− .108**	− .102**	−	−
	B.	− .075**	− .065*	− .084*	− .026	− .124**	− .059	− .091*	−	−
	C.	− .040**	− .046**	− .033**	− .015*	− .064**	− .030**	− .045**	−	−
	D.	− .047**	− .060**	− .034**	− .040*	− .054**	− .033**	− .061**	−	−

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	PS	NP	KS	NK	PK
A.	.266	.069	.034	.024	+ .044	− .022	− .054*	.000	− .106**	+ .003
B.	.177	.064	.032	.023	+ .063*	− .007	− .038	− .009	− .048*	− .016
C.	.076	.017	.008	.006	− .008	− .004	− .018**	+ .007	− .025**	+ .005
D.	.062	.022	.011	.008	− .011	− .011	− .021*	+ .013	− .007	− .014

Clover. DIFFERENTIAL RESPONSES % Na.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	A.	+ .102**	–	–	+ .108**	+ .096**	+ .099**	+ .105**	+ .123**	+ .081**
	B.	+ .069**	–	–	+ .080**	+ .057**	+ .069**	+ .069**	+ .079**	+ .058**
	C.	+ .083**	–	–	+ .065*	+ .102**	+ .100**	+ .067*	+ .113**	+ .054
	D.	+ .033**	–	–	+ .053*	+ .013	+ .038**	+ .028*	+ .041*	+ .025
Ammonium Sulphate 3.	A.	– .030	– .024	– .036	–	–	– .013	– .047	– .017	– .043
	B.	– .007	+ .004	– .019*	–	–	– .006	– .008	+ .007	– .022*
	C.	+ .030	+ .012	+ .049	–	–	+ .065*	– .004	+ .067*	– .006
	D.	.000	+ .020	– .020	–	–	+ .005	– .005	+ .008	– .008
Superphosphate 3	A.	+ .005	+ .002	+ .008	+ .022	– .012	–	–	+ .008	+ .002
	B.	– .009	– .009	– .009	– .008	– .010	–	–	– .004	– .014
	C.	– .029	– .013	– .046	+ .005	– .064*	–	–	– .028	– .030
	D.	– .022*	– .017	– .027*	+ .005	– .049**	–	–	– .009	– .035*
Potassium Chloride 2.	A.	– .017	+ .004	– .038	– .004	– .030	– .014	– .020	–	–
	B.	– .019**	– .009	– .030**	– .005	– .034**	– .014	– .024*	–	–
	C.	– .059**	– .030	– .088**	– .022	– .096**	– .058	– .060	–	–
	D.	– .056**	– .048**	– .064**	– .023	– .089**	– .043**	– .069**	–	–

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	INTERACTIONS PS	INTERACTIONS NP	INTERACTIONS KS	INTERACTIONS NK	INTERACTIONS PK
A.	.101	.052	.026	.018	– .006	+ .003	– .017	– .021	– .013	– .003
B.	.064	.017	.008	.005	– .011	.000	– .001	– .011	– .015*	– .005
C.	.093	.058	.029	.020	+ .019	– .015	– .035	– .030	– .037	– .001
D.	.092	.024	.026	.027	– .020*	– .005	– .027**	– .008	– .033**	– .013

GRASS. DIFFERENTIAL RESPONSES % K.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	A.	+ .13	–	–	+ .06	+ .20*	+ .16	+ .10	+ .55**	– .29**
	B.	+ .11	–	–	+ .07	+ .23*	+ .14	+ .08	+ .29*	– .14
	C.	– .11*	–	–	– .18*	– .05	– .06	– .16*	– .03	– .20**
	D.	– .02	–	–	– .16	+ .12	+ .09	– .13	+ .07	– .11
Ammonium Sulphate 3.	A.	+ .74**	+ .67**	+ .81**	–	–	+ .65**	+ .83**	+ .23*	+1.21**
	B.	+ .22*	+ .04	+ .40**	–	–	+ .10	+ .35**	+ .29*	+ .73**
	C.	– .46**	– .53**	– .40**	–	–	– .44**	– .49**	– .68**	– .21**
	D.	– .28**	– .42**	– .14	–	–	– .17	– .39**	– .54*	– .02
Superphosphate 3.	A.	+ .30**	+ .33**	+ .27**	+ .21**	+ .39**	–	–	+ .22**	+ .38**
	B.	+ .19*	+ .22*	+ .16	+ .07	+ .31*	–	–	+ .08	+ .30*
	C.	+ .06	+ .11	+ .01	+ .09	– .04	–	–	.00	+ .13
	D.	+ .05	+ .16	– .06	+ .05	+ .05	–	–	+ .01	+ .09
Potassium Chloride 2.	A.	+ .48**	+ .90**	+ .06	– .03	+ .99**	+ .40**	+ .48**	–	–
	B.	+ .40**	+ .65**	+ .15	– .12	+ .91**	+ .29*	+ .50**	–	–
	C.	+ .20**	+ .29**	+ .11	– .01	+ .41**	+ .14	+ .26**	–	–
	D.	+ .29**	+ .38**	+ .20	+ .03	+ .55**	+ .25	+ .33*	–	–

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	INTERACTIONS PS	INTERACTIONS NP	INTERACTIONS KS	INTERACTIONS NK	INTERACTIONS PK
A.	3.36	.19	.09	.07	+ .07	– .03	+ .09	– .42**	+ .51**	+ .08
B.	2.25	.21	.11	.08	+ .18*	– .03	+ .12	– .25**	+ .52**	+ .11
C.	1.87	.13	.07	.05	+ .01	– .01	.00	– .09	+ .21**	+ .01
D.	2.40	.23	.12	.08	+ .14	– .11	.00	– .09	+ .26**	+ .04

GRASS. EXPERIMENT 1.

CLOVER. DIFFERENTIAL RESPONSES % K.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	A.	+ .10	–	–	– .02	+ .22*	+ .18*	+ .02	+ .40**	– .20*
	B.	– .38*	–	–	– .67**	– .09	– .44*	– .32	– .08	– .68**
	C.	– .16	–	–	– .07	– .25**	.00	– .32**	– .09	– .23*
	D.	+ .17*	–	–	+ .03	+ .31**	+ .30**	+ .04	+ .34**	.00
Ammonium Sulphate 3.	A.	+ .19**	+ .07	+ .29**	–	–	– .04	+ .42**	– .06	+ .44**
	B.	– .13	– .42*	+ .16	–	–	– .35	+ .09	– .43*	+ .17
	C.	– .22*	– .13	– .31**	–	–	– .55**	+ .11	– .25**	– .19*
	D.	– .25**	– .39**	– .11	–	–	– .60**	+ .10	– .45**	– .05
Superphosphate 3	A.	+ .27**	+ .35**	+ .19*	+ .04	+ .50**	–	–	+ .22*	+ .27**
	B.	+ .24	+ .18	+ .30	+ .02	+ .48*	–	–	+ .16	+ .32
	C.	+ .32**	+ .48*	+ .16	– .01	+ .55**	–	–	+ .28**	+ .36**
	D.	+ .14	+ .27*	+ .01	– .21*	+ .49**	–	–	– .04	+ .32**
Potassium Chloride 2.	A.	+ .37**	+ .67**	+ .07	+ .12	+ .62**	+ .32**	+ .42**	–	–
	B.	+ .51**	+ .81**	+ .21	+ .21	+ .81**	+ .43*	+ .59**	–	–
	C.	+ .33**	+ .40**	+ .26**	+ .30**	+ .36**	+ .29**	+ .37**	–	–
	D.	+ .42**	+ .59**	+ .25*	+ .22*	+ .62**	+ .24*	+ .60**	–	–

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
A.	3.12	.16	.08	.06	+ .12	– .08	+ .23**	– .30**	+ .25**	+ .05
B.	2.85	.39	.19	.13	+ .29	+ .06	+ .22*	– .30**	+ .30**	+ .08
C.	1.90	.23	.12	.08	– .09	– .16	+ .33**	– .07	+ .03	+ .04
D.	1.86	.19	.10	.07	+ .14	+ .14	– .13	– .17*	+ .20**	+ .18*

GRASS. DIFFERENTIAL RESPONSES % Ca.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	A.	- .049**	-	-	- .052**	- .046*	- .019	- .079**	- .048**	- .050**
	B.	- .007	-	-	+ .008	- .022	+ .013	- .027	- .012	- .002
	C.	.000	-	-	+ .007	- .007	- .020	+ .020	+ .005	- .002
	D.	+ .007	-	-	+ .025	- .011	- .014	+ .030	+ .016	- .002
Ammonium Sulphate 3.	A.	- .018	- .021	- .015	-	-	+ .021	- .057**	.000	- .036*
	B.	+ .008	+ .023	- .007	-	-	+ .006	+ .010	+ .006	+ .010
	C.	- .018	- .011	- .025	-	-	+ .024	- .060	- .023	- .013
	D.	- .016	+ .002	- .034	-	-	+ .043	- .077**	- .043	+ .011
Superphosphate 3.	A.	+ .023	+ .057**	- .007	+ .061**	- .016	-	-	+ .033	+ .013
	B.	+ .003	+ .023	- .017	+ .001	+ .005	-	-	- .018	+ .021
	C.	- .013	- .033	+ .007	+ .029	- .055	-	-	- .011	- .015
	D.	+ .004	- .017	+ .027	+ .065*	- .057*	-	-	+ .043	- .035
Potassium Chloride 2.	A.	- .026*	- .025	- .027	- .008	- .044*	- .016	- .036*	-	-
	B.	- .018	- .023	- .016	- .020	- .016	- .039*	+ .003	-	-
	C.	- .027	- .022	- .033	- .033	- .022	- .025	- .029	-	-
	D.	- .010	- .001	- .019	- .037	+ .017	+ .029	- .049	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
A.	.634	.032	.016	.011	+ .003	- .030*	- .039**	- .001	- .018	- .010
B.	.510	.030	.015	.010	- .015	- .020	+ .002	+ .005	+ .002	- .002
C.	.487	.081	.040	.029	- .007	+ .020	- .042	- .005	+ .005	- .002
D.	.567	.050	.025	.018	- .018	+ .023	- .061**	- .009	+ .027	- .039

GRASS. EXPERIMENT 1.

CLOVER.

DIFFERENTIAL RESPONSES % Ca.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	A.	- .06	-	-	- .08	- .04	- .09	- .03	- .09	- .03
	B.	- .04	-	-	- .05	- .03	- .04	- .03	- .07	.00
	C.	+ .06	-	-	+ .10	+ .02	+ .08	+ .04	+ .03	+ .09
	D.	+ .08*	-	-	- .01	+ .17**	+ .03	+ .13**	+ .02	+ .14**
Ammonium Sulphate 3.	A.	- .22**	- .24**	- .20**	-	-	- .11	- .33**	- .16**	- .28**
	B.	- .34**	- .35**	- .33**	-	-	- .36**	- .32**	- .33**	- .35**
	C.	+ .07	+ .11	+ .03	-	-	+ .14	.00	+ .03	+ .12
	D.	+ .13**	+ .04	+ .22**	-	-	+ .10*	+ .16**	+ .11*	+ .15**
Superphosphate 3.	A.	- .02	- .05	+ .01	+ .09	- .13*	-	-	- .07	+ .03
	B.	- .01	- .02	.00	- .01	- .02	-	-	- .03	+ .01
	C.	+ .01	+ .03	- .01	+ .08	- .06	-	-	+ .08	- .06
	D.	+ .06	+ .01	+ .11*	+ .03	+ .09*	-	-	+ .08	+ .04
Potassium Chloride 2.	A.	- .06	- .09	- .03	- .08	- .04	- .11	- .01	-	-
	B.	+ .00	- .02	+ .02	+ .02	- .02	- .02	+ .02	-	-
	C.	+ .06	+ .04	+ .09	+ .02	+ .11	+ .14	- .01	-	-
	D.	- .03	- .09*	+ .03	- .05	- .01	- .01	- .05	-	-

	MEAN	STANDARD ERRORS ± SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	INTERACTIONS NS	PS	NP	KS	NK	PK
A.	2.03	.11	.06	.04	+ .02	+ .03	- .11*	+ .03	+ .02	+ .05
B.	1.82	.16	.08	.06	+ .01	+ .01	- .02	+ .03	- .01	+ .02
C.	1.85	.12	.06	.04	- .04	- .02	- .07	+ .03	+ .04	- .07
D.	2.19	.09	.04	.03	+ .09*	+ .05	+ .03	+ .06	+ .02	- .02

GRASS. DIFFERENTIAL RESPONSES % Mg.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	A.	- .003	-	-	- .003	- .003	- .004	- .002	- .009	+ .003
	B.	+ .001	-	-	+ .008	- .006	+ .006	- .004	+ .003	- .001
	C.	- .008*	-	-	- .002	- .014**	- .011**	- .005	- .013**	- .003
	D.	- .017*	-	-	- .005	- .029**	- .020*	- .014	- .030*	- .004
Ammonium Sulphate 3.	A.	+ .030**	+ .030**	+ .030**	-	-	+ .034**	+ .026**	+ .046**	+ .014*
	B.	+ .015**	+ .022**	+ .008	-	-	+ .022**	+ .008	+ .011*	+ .019**
	C.	- .003	+ .003	- .009	-	-	+ .006	- .012**	- .003	- .003
	D.	- .002	- .010	- .014	-	-	+ .013	- .017*	.000	- .004
Superphosphate 3.	A.	- .010*	- .011	- .009	- .006	- .004	-	-	- .015*	- .005
	B.	- .008*	- .003	- .013*	.000	- .015*	-	-	- .010	- .006
	C.	- .007*	- .010*	- .004	+ .002	- .016**	-	-	- .006	- .008*
	D.	- .003	- .006	.000	+ .012	- .018*	-	-	+ .007	- .013
Potassium Chloride 2.	A.	- .005	- .011	- .001	+ .011	- .021*	- .010	.000	-	-
	B.	- .001	+ .001	- .003	- .005	+ .003	- .003	+ .001	-	-
	C.	- .009**	- .013**	- .004	- .009*	- .009*	- .008*	- .010*	-	-
	D.	- .001	- .014	+ .012	+ .001	- .003	+ .009	- .011	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
A.	.115	.012	.006	.004	.000	+ .001	- .004	+ .006	- .016*	+ .005
B.	.092	.011	.005	.003	- .007	- .004	- .007	- .002	+ .004	+ .002
C.	.097	.007	.004	.003	- .006	+ .003	- .008	+ .004	.000	- .001
D.	.129	.017	.008	.006	- .012	+ .003	- .015*	+ .013*	- .002	- .010

CLOVER. DIFFERENTIAL RESPONSES % Mg.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	A.	- .028	-	-	- .022	- .034	- .039	- .017	- .038	- .018
	B.	- .006	-	-	- .004	- .008	- .017	+ .004	- .012	.000
	C.	+ .003	-	-	+ .016	- .010	- .001	+ .006	- .009	+ .015
	D.	- .005	-	-	+ .002	- .012	- .010	.000	- .022	+ .012
Ammonium Sulphate 3	A.	+ .025	+ .031	+ .019	-	-	+ .034	+ .016	+ .021	+ .029
	B.	- .002	.000	- .004	-	-	+ .007	- .010	+ .003	- .006
	C.	+ .020	+ .033*	+ .007	-	-	+ .035*	+ .005	+ .027	+ .013
	D.	+ .017	+ .024	+ .010	-	-	+ .032*	+ .002	+ .004	+ .030
Superphosphate 3.	A.	- .003	- .014	+ .008	+ .006	- .012	-	-	+ .004	- .011
	B.	- .020**	- .031**	- .009	- .011	- .029**	-	-	- .014*	- .026**
	C.	- .014	- .018	- .011	.000	- .028	-	-	+ .005	- .034*
	D.	- .019	- .024	- .014	+ .004	- .034*	-	-	- .012	- .026
Potassium Chloride 2.	A.	- .009	- .019	+ .001	- .013	- .005	- .002	- .016	-	-
	B.	- .001	- .007	+ .005	+ .003	- .005	+ .005	- .007	-	-
	C.	- .006	- .018	+ .006	+ .001	- .013	+ .014	- .026	-	-
	D.	- .001	- .018	+ .016	- .014	+ .012	+ .006	- .008	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
A.	.260	.038	.019	.013	- .006	+ .011	- .009	+ .010	+ .004	- .007
B.	.227	.013	.007	.005	- .002	+ .011*	- .009	+ .006	- .004	- .006
C.	.229	.028	.014	.010	- .013	+ .003	- .015	+ .012	- .007	- .019
D.	.218	.031	.015	.011	- .007	+ .005	- .015	+ .017	+ .013	- .007

GRASS.

DIFFERENTIAL RESPONSES % P.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	A.	+ .002	-	-	- .010	+ .014	- .006	+ .010	- .002	+ .006
	B.	+ .007	-	-	+ .007	+ .007	+ .006	+ .008	+ .005	+ .010
	C.	+ .005	-	-	+ .020*	- .010	+ .024*	- .014	+ .019	- .009
	D.	+ .021	-	-	+ .032	+ .010	.000	+ .042*	+ .030	+ .012
Ammonium Sulphate 3.	A.	.000	- .012	+ .012	-	-	- .008	+ .008	+ .001	- .001
	B.	+ .005	+ .005	+ .005	-	-	- .018	+ .029	+ .012	- .001
	C.	- .049**	- .034**	- .064**	-	-	- .030**	- .068**	- .042**	- .055**
	D.	- .039**	- .028	- .050*	-	-	.000	- .078**	- .041*	- .037
Superphosphate 3.	A.	+ .022*	+ .014	+ .030*	+ .026	+ .018	-	-	+ .005	+ .039**
	B.	+ .023	+ .022	+ .024	+ .027	+ .019	-	-	+ .015	+ .031
	C.	+ .004	.000	+ .009	+ .022*	- .014	-	-	+ .010	- .002
	D.	- .019	- .040	+ .022	+ .020	- .058*	-	-	+ .005	- .043*
Potassium Chloride 2.	A.	- .010	- .014	- .016	- .011	- .009	- .027	+ .007	-	-
	B.	- .016	- .018	- .014	- .009	- .023	- .024	- .008	-	-
	C.	- .005	+ .009	- .019	- .020*	+ .010	.000	- .010	-	-
	D.	- .012	- .003	- .021	- .014	- .010	+ .012	- .036	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
A.	.280	.027	.013	.010	+ .012	+ .008	- .004	+ .004	- .001	+ .017
B.	,256	.034	.017	.013	.000	+ .002	- .005	+ .002	- .006	+ .008
C.	.219	.019	.009	.007	- .015	+ .005	- .018	- .014	+ .015	- .006
D.	.264	.037	.019	.013	- .011	+ .021	- .039*	- .009	+ .002	- .024

CLOVER. DIFFERENTIAL RESPONSES % P.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	A.	− .016	−	−	+ .013	− .045*	− .018	− .014	− .009	− .023
	B.	− .010	−	−	− .021	+ .001	− .003	− .017	− .006	− .014
	C.	− .006	−	−	+ .007	− .019	− .004	− .008	+ .001	− .013
	D.	− .014*	−	−	− .016	− .012	− .006	− .022*	− .022*	− .006
Ammonium Sulphate 3.	A.	+ .027*	+ .056**	− .002	−	−	+ .036*	+ .018	− .008	+ .062**
	B.	+ .032*	+ .021	+ .043*	−	−	+ .058**	+ .007	+ .011	+ .054**
	C.	− .025*	− .012	− .038**	−	−	+ .005	− .055**	− .034*	− .016
	D.	− .027**	− .029**	− .025**	−	−	− .004	− .039**	− .019*	− .035**
Superphosphate 3,	A.	+ .038*	+ .036*	+ .040*	+ .047**	+ .029	−	−	+ .041*	+ .035*
	B.	+ .017	+ .024	+ .010	+ .042*	− .009	−	−	+ .007	+ .027
	C.	.000	+ .002	− .002	+ .030*	− .030*	−	−	− .003	+ .003
	D.	− .016*	− .008	− .024*	+ .007	− .039**	−	−	− .019*	− .013
Potassium Chloride 2.	A.	− .016	− .009	− .023	− .051**	+ .019	− .013	− .019	−	−
	B.	− .015	− .010	− .019	− .036*	+ .007	− .024	− .005	−	−
	C.	.000	+ .007	− .007	− .009	+ .007	− .003	+ .003	−	−
	D.	+ .007	− .001	+ .015	+ .015	− .001	+ .004	+ .010	−	−

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	PS	NP	KS	NK	PK
A.	.320	.029	.015	.011	− .029*	+ .002	− .009	− .007	+ .035**	− .003
B.	.222	.033	.016	.011	− .011	− .007	− .026*	− .004	+ .022	+ .010
C.	.137	.024	.012	.009	− .013	− .002	− .031*	− .007	+ .009	+ .003
D.	.163	.016	.008	.006	+ .002	− .008	− .023**	+ .008	− .008	+ .003

GRASS. EXPERIMENT 2.

		Dry M. (cwt)		Dry M.%.		Na %			K %.			Ca %			Mg %			P %		
		B	C	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1	P	10.5	7.6	22.5	23.6	.135	.135	.060	1.95	1.20	1.85	.480	.365	.540	.090	.088	.116	.245	.190	.190
2	K	13.2	8.1	22.7	24.1	.075	.045	.025	1.90	1.40	1.70	.415	.330	.415	.114	.084	.102	.245	.150	.230
3	S	12.5	8.3	22.1	23.7	.220	.150	.077	1.80	1.20	1.50	.350	.300	.415	.076	.070	.092	.250	.180	.225
4	N P K	22.5	8.3	19.8	23.8	.300	.210	.077	2.70	1.75	2.05	.430	.400	.380	.120	.098	.096	.315	.230	.230
5	N K S	22.0	7.7	19.7	23.6	.430	.395	.050	2.70	1.70	1.60	.445	.315	.365	.104	.070	.088	.260	.140	.170
6	N P S	19.7	7.7	19.5	22.8	.575	.450	.115	1.90	1.40	1.40	.380	.300	.365	.128	.088	.118	.275	.220	.180
7	P K S	14.0	7.9	21.9	23.0	.200	.135	.040	1.95	1.25	1.55	.400	.260	.340	.090	.056	.102	.195	.110	.180
8	N	17.7	8.2	19.9	23.5	.520	.400	.140	1.60	1.00	1.30	.430	.300	.365	.124	.096	.130	.265	.175	.195
9	P S	13.6	8.3	22.3	24.1	.275	.165	.110	1.65	1.25	1.50	.415	.330	.365	.066	.070	.106	.245	.170	.170
10	N K	22.3	8.3	19.1	23.2	.160	.175	.040	2.70	1.70	1.80	.430	.365	.300	.094	.080	.100	.255	.140	.135
11	K S	13.3	8.4	22.4	24.1	.165	.105	.045	1.90	1.40	1.60	.380	.315	.400	.084	.062	.110	.215	.150	.190
12	P K	13.5	8.4	22.6	24.3	.090	.040	.017	2.25	1.65	1.90	.415	.315	.460	.080	.062	.130	.250	.140	.180
13	N P K S	22.7	8.4	18.9	24.2	.425	.400	.065	2.90	1.90	1.75	.415	.365	.365	.120	.098	.106	.290	.210	.175
14	-	11.2	6.7	22.7	23.6	.125	.090	.060	1.80	1.25	1.70	.365	.300	.400	.066	.080	.102	.215	.130	.150
15	N S	21.2	8.5	19.2	23.8	.675	.535	.135	2.00	1.30	1.45	.380	.345	.330	.100	.080	.096	.230	.150	.160
16	N P	20.0	7.1	19.6	23.9	.365	.205	.115	1.65	1.40	1.50	.500	.400	.460	.138	.088	.124	.340	.230	.220
17	N P K	21.5	7.2	19.6	23.2	.325	.150	.015	3.15	2.30	1.75	.500	.400	.415	.110	.110	.096	.295	.240	.185
18	S	10.9	8.5	21.5	23.5	.205	.180	.065	2.55	1.45	1.95	.415	.280	.445	.090	.080	.096	.295	.140	.195
19	P	11.2	6.3	22.6	23.4	.140	.095	.040	1.65	1.10	1.90	.365	.315	.500	.080	.060	.110	.235	.150	.190
20	N K S	21.0	7.9	19.0	22.9	.315	.320	.075	2.55	2.00	1.70	.400	.340	.340	.100	.080	.096	.240	.180	.165
21	N	17.5	8.2	19.7	22.8	.285	.245	.090	2.10	1.40	1.85	.365	.330	.400	.090	.076	.110	.280	.150	.150
22	N P S	21.5	7.2	18.9	23.7	.550	.365	.077	2.60	1.90	2.00	.480	.400	.400	.110	.102	.088	.350	.235	.190
23	K	13.9	8.5	22.1	24.1	.075	.040	.017	2.05	1.50	2.10	.400	.280	.445	.080	.068	.102	.235	.165	.150
24	P K S	13.7	7.8	21.9	24.2	.180	.082	.040	2.30	1.50	1.80	.400	.260	.400	.074	.058	.096	.295	.145	.150
25	N K	24.0	7.8	18.9	23.9	.140	.130	.025	3.40	2.10	2.15	.415	.330	.430	.100	.080	.102	.310	.180	.190
26	P S	13.9	8.9	22.7	23.7	.205	.085	.045	2.35	1.65	2.10	.430	.280	.400	.068	.060	.108	.280	.145	.225
27	-	10.9	7.5	22.5	22.7	.105	.070	.035	1.90	1.15	1.90	.415	.260	.460	.064	.066	.124	.220	.150	.180
28	N P	19.5	8.0	19.6	23.9	.650	.455	.215	1.40	1.10	1.10	.445	.315	.415	.122	.092	.114	.330	.150	.180
29	P K	12.8	7.9	21.7	23.6	.090	.060	.030	2.20	1.75	2.25	.415	.330	.445	.090	.096	.118	.260	.180	.180
30	K S	13.7	7.9	22.5	23.5	.205	.090	.077	2.50	1.70	2.00	.385	.300	.415	.074	.066	.096	.265	.150	.140
31	N P K S	24.1	8.7	19.7	23.4	.320	.365	.095	3.20	2.80	2.10	.400	.340	.365	.080	.052	.070	.370	.195	.200
32	N S	21.1	7.9	19.5	23.9	.750	.575	.210	2.00	1.35	1.45	.460	.340	.430	.100	.092	.106	.375	.210	.220

GRASS. EXPERIMENT 2.

DIFFERENTIAL RESPONSES Dry Matter Yields (cwt)

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	1st CUT.B.	+ 1.39	-	-	+ 1.42	+ 1.36	+ 0.97	+ 1.81	+ 2.33*	+ 0.45
	2nd CUT.C.	+ 0.46*	-	-	+ 0.63*	+ 0.29	+ 0.40	+ 0.52*	+ 0.70*	+ 0.22
Ammonium Sulphate 3.	1st CUT.B.	+ 7.84***	+ 7.87***	+ 7.81***	-	-	+ 8.26***	+ 7.42***	+ 6.96***	+ 8.72***
	2nd CUT.C.	+ 0.09	+ 0.26	- 0.08	-	-	+ 0.31	- 0.13	+ 0.07	+ 0.11
Superphosphate 3.	1st CUT.B.	+ 0.49	+ 0.07	+ 0.91	+ 0.07	+ 0.91	-	-	+ 0.51	+ 0.47
	2nd CUT.C.	- 0.26	- 0.32	- 0.20	- 0.04	- 0.48	-	-	- 0.33	- 0.19
Potassium Chloride 2.	1st CUT.B.	+ 2.18*	+ 3.12*	+ 1.24	+ 1.30	+ 3.06*	+ 2.20	+ 2.16	-	-
	2nd CUT.C.	+ 0.37*	+ 0.61*	+ 0.13	+ 0.35	+ 0.39	+ 0.30	+ 0.44	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
Ist Cut. B.	16.91	2.21	1.11	0.79	- 0.03	+ 0.42	+ 0.42	- 0.94	+ 0.88	- 0.02
2nd Cut. C.	7.98	0.47	0.24	0.17	- 0.17	+ 0.06	- 0.22	- 0.24	+ 0.02	+ 0.07

GRASS. EXPERIMENT 2.

DIFFERENTIAL RESPONSES % Na.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	A.	+ .132**	-	-	+ .103*	+ .162**	+ .185**	+ .078	+ .141**	+ .123**
	B.	+ .116**	-	-	+ .052	+ .180**	+ .145**	+ .087*	+ .101**	+ .131**
	C.	+ .020	-	-	+ .013	+ .027	+ .038	+ .002	+ .022	+ .018
Ammonium Sulphate 3.	A.	+ .268**	+.239**	+.298**	-	-	+ .262**	+ .275**	+ .371**	+ .167**
	B.	+ .239**	+ .174**	+ .302**	-	-	+ .252**	+ .226**	+ .282**	+ .193**
	C.	+ .035*	+ .028	+ .043*	-	-	+ .046*	+ .024	+ .063**	+ .007
Superphosphate 3.	A.	+ .023	+ .075	- .029	+ .017	+ .029	-	-	+ .001	+ .045
	B.	- .009	+ .019	- .038	+ .003	- .022	-	-	- .036	+ .018
	C.	- .001	+ .017	- .019	+ .010	- .012	-	-	- .005	+ .003
Potassium Chloride 2.	A.	- .143**	- .134**	- .152**	- .041	- .244**	- .165**	- .121**	-	-
	B.	- .091**	- .105**	- .077**	- .047	- .136**	- .118**	- .064*	-	-
	C.	- .054**	- .052*	- .056*	- .026	- .082**	- .058**	- .050*	-	-

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	PS	NP	KS	NK	PK
A.	.290	.075	.038	.027	+ .030	- .053	+ .006	- .009	- .101**	+ .022
B.	.217	.051	.026	.018	+ .063**	- .029	- .013	+ .015	- .045**	+ .027
C.	.073	.038	.019	.013	+ .007	- .018	- .011	- .002	- .028	+ .004

GRASS. EXPERIMENT 2.

DIFFERENTIAL RESPONSES % K.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	A.	+ .12	–	–	+ .16	+ .08	+ .07	+ .17	+ .35	– .11
	B.	.00	–	–	+ .05	– .05	+ .08	– .08	+ .24	– .24
	C.	– .08	–	–	– .16	.00	– .15	– .01	+ .04	– .20
Ammonium Sulphate 3.	A.	+ .33	+ .37	+ .29	–	–	+ .33	+ .33	– .05	+ .71**
	B.	+ .17	+ .22	+ .12	–	–	+ .19	+ .15	+ .08	+ .26
	C.	– .15	– .23*	– .07	–	–	– .15	– .16	– .30*	+ .00
Superphosphate 3.	A.	– .01	– .06	+ .04	– .01	– .01	–	–	– .08	+ .05
	B.	+ .02	+ .10	– .06	+ .04	.00	–	–	+ .11	– .07
	C.	+ .05	– .02	+ .12	+ .05	+ .05	–	–	+ .03	+ .05
Potassium Chloride 2.	A.	+ .56**	+ .79**	+ .33	+ .18	+ .94**	+ .49*	+ .63*	–	–
	B.	+ .33*	+ .57**	+ .09	+ .24	+ .42*	+ .42*	+ .24	–	–
	C.	+ .21*	+ .33**	+ .09	+ .66	+ .36**	+ .19	+ .23*	–	–

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
A.	2.23	.46	.23	.16	– .04	+ .05	.00	– .23	+ .38*	+ .07
B.	1.55	.35	.17	.12	–. 05	– .08	– .02	– .24	+ .09	– .09
C.	1.76	.21	.11	.08	+ .08	+ .07	.00	– .12	+ .15	+ .02

GRASS. EXPERIMENT 2.

DIFFERENTIAL RESPONSES % Ca.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	A.	− .016	−	−	− .012	− .020	− .003	− .029	− .003	− .029
	B.	− .017	−	−	− .022	− .012	+ .005	− .039	− .002	− .032
	C.	− .043*	−	−	− .061*	− .025	− .009	− .077**	− .049	− .036
Ammonium Sulphate 3 ?	A.	+ .027	+ .031	+ .023	−	−	+ .025	+ .027	+ .026	+ .028
	B.	+ .048*	+ .043	+ .053*	−	−	+ .038	+ .058*	+ .038	+ .058*
	C.	− .044*	− .062*	− .026	−	−	− .054*	− .034	− .044	− .044
Superphosphate 3½	A.	+ .026	+ .039	+ .013	+ .024	+ .022	−	−	+ .039	+ .013
	B.	+ .022	+ .044	.000	+ .012	+ .032	−	−	+ .031	+ .013
	C.	+ .017	+ .051*	− .017	+ .007	+ .027	+	−	+ .025	+ .009
Potassium Chloride 2.	A.	− .002	+ .007	− .011	− .003	− .001	+ .011	− .015	−	−
	B.	+ .005	+ .020	− .010	− .005	+ .015	+ .014	− .004	−	−
	C.	− .026	− .032	− .020	− .026	− .026	− .018	− .034	−	−

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	INTERACTIONS PS	INTERACTIONS NP	INTERACTIONS KS	INTERACTIONS NK	INTERACTIONS PK
A.	.416	.043	.022	.016	− .004	− .013	+ .002	− .009	+ .001	− .013
B.	.325	.043	.022	.016	+ .005	− .022	+ .010	− .015	+ .010	− .009
C.	.405	.047	.024	.017	+ .018	− .034	+ .010	+ .006	.000	− .008

DIFFERENTIAL RESPONSES % Mg.

CWT./ACRE		MEAN RESPONSE	SODIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
			ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt 4.	A.	- .006	-	-	- .005	- .007	.000	- .012	- .004	- .008
	B.	- .009	-	-	- .010	- .008	- .004	- .014	.000	- .018*
	C.	- .013**	-	-	- .013*	- .013*	- .012*	- .014*	- .015*	- .011
Ammonium Sulphate 3.	A.	+ .028**	+ .029**	+ .027**	-	-	+ .020**	+ .036**	+ .039**	+ .017*
	B.	+ .015*	+ .014	+ .016*	-	-	+ .010	+ .020*	+ .017*	+ .013
	C.	- .004	- .004	- .004	-	-	+ .001	- .009	+ .004	- .012*
Superphosphate 3.	A.	+ .007	+ .013*	+ .001	- .001	+ .015*	-	-	+ .012	+ .002
	B.	+ .002	+ .007	- .003	- .003	+ .007	-	-	.000	+ .004
	C.	+ .003	+ .004	+ .002	+ .008	- .002	-	-	+ .004	+ .002
Potassium Chloride 2.	A.	.000	+ .002	- .002	+ .011	- .001	+ .005	- .005	-	-
	B.	- .004	+ .005	- .013	- .002	- .006	- .006	+ .002	-	-
	C.	- .008*	- .010	- .006	.000	- .016**	- .007	- .009	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS					
		SINGLE PLOT	DIFFRENTL. RESPONSE	MEAN RESPONSE	NS	PS	NP	KS	NK	PK
A.	.095	.011	.006	.004	- .001	- .006	+ .008	- .002	- .011*	- .005
B.	.078	.015	.007	.005	+ .001	- .005	+ .005	- .009	- .002	+ .002
C.	.105	.011	.006	.004	.000	- .001	- .005	+ .002	- .008*	- .001

DIFFERENTIAL RESPONSES % P.

CWT./ACRE		MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt 4.	A.	+ .008	-	-	+ .016	.000	+ .013	+ .003	+ .021	- .005
	B.	- .001	-	-	- .008	+ .006	+ .008	- .010	+ .016	- .018
	C.	.000	-	-	+ .003	- .003	+ .011	- .011	+ .014	- .014
Ammonium Sulphate 3.	A.	+ .046**	+ .054*	+ .038	-	-	+ .028	+ .064**	+ .051*	+ .041
	B.	+ .037**	+ .030*	+ .044**	-	-	+ .014	+ .060**	+ .033*	+ .041*
	C.	+ .001	+ .040	- .002	-	-	- .008	+ .010	- .004	+ .006
Superphosphate 3.	A.	+ .026	+ .031	+ .021	+ .008	+ .044	-	-	+ .021	+ .031
	B.	+ .025*	+ .034*	+ .016	+ .002	+ .048**	-	-	+ .021	+ .029
	C.	+ .011	+ .022	.000	+ .002	+ .020	-	-	+ .008	+ .014
Potassium Chloride 2.	A.	- .008	+ .005	- .021	- .003	- .013	- .013	- .003	-	-
	B.	- .004	+ .013	- .021	- .008	.000	- .003	- .005	-	-
	C.	+ .011	+ .025	- .003	+ .006	+ .016	+ .008	+ .014	-	-

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± DIFFRENTL. RESPONSE	STANDARD ERRORS ± MEAN RESPONSE	INTERACTIONS NS	INTERACTIONS PS	INTERACTIONS NP	INTERACTIONS KS	INTERACTIONS NK	INTERACTIONS PK
A.	.272	.041	.021	.015	- .008	- .005	+ .018	- .013	- .005	+ .005
B.	.171	.028	.014	.010	+ .007	- .009	+ .023*	- .017	+ .004	- .001
C.	.183	.026	.013	.009	- .003	- .011	+ .009	- .014	+ .005	+ .003

		Grass. D.M. (cwt)				Clover. D.M. (cwt)				Total. D.M. (cwt)				Grass. % DM				Clover. % DM			
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
1	-	13.9	3.0	4.0	2.5	5.3	6.2	5.6	1.2	19.2	9.2	9.6	3.7	21.4	23.3	16.6	17.2	12.3	18.8	13.7	16.6
2	N K	28.1	13.6	16.7	7.6	3.2	2.0	1.4	0.4	31.3	15.6	18.1	8.0	18.6	21.5	14.4	15.2	10.2	16.2	10.4	14.3
3	M P	18.2	4.6	5.6	3.0	5.6	6.9	7.5	1.3	23.8	11.5	13.1	4.3	19.4	24.4	16.3	17.6	11.6	17.8	13.2	15.4
4	S M K	14.1	4.8	5.5	3.1	4.0	8.3	7.4	1.2	18.1	13.1	12.9	4.3	19.9	23.1	15.6	16.4	11.4	17.3	13.8	15.3
5	S N P	33.1	14.0	15.3	7.4	3.8	1.8	1.0	0.2	36.9	15.8	16.3	7.6	19.0	20.2	13.1	14.4	11.2	15.0	12.2	15.4
6	S M N	33.8	13.4	16.0	8.1	2.3	2.0	1.2	0.3	36.1	15.4	17.2	8.4	17.7	19.8	14.0	16.6	10.0	15.8	11.4	16.6
7	S P K	16.4	4.8	3.9	3.8	5.0	6.8	6.0	1.9	21.4	11.6	9.9	5.7	19.5	23.9	15.3	18.0	11.3	18.6	12.8	17.0
8	M N P K	30.0	13.1	16.9	6.7	4.6	3.2	1.8	0.6	34.6	16.3	18.7	7.3	19.1	21.3	14.5	15.6	11.8	16.2	11.1	14.6
9	P	18.7	5.4	3.5	3.2	6.6	6.7	5.8	1.2	25.3	12.1	9.3	4.4	19.9	24.7	16.3	17.4	12.3	18.3	14.2	16.2
10	S M N P	32.4	12.4	19.1	7.7	2.9	1.9	0.8	0.3	35.3	14.3	19.9	8.0	17.8	21.3	14.6	15.2	11.1	16.7	10.6	17.4
11	M	21.3	3.6	2.4	3.4	6.6	7.4	6.2	1.6	27.9	11.0	8.6	5.0	20.1	25.6	16.0	17.2	12.0	18.4	13.1	15.8
12	M N K	40.2	13.3	20.3	9.2	3.2	1.6	1.1	0.2	43.4	14.9	21.4	9.4	18.2	20.2	14.9	15.2	11.1	14.5	11.2	14.6
13	N P K	37.5	12.4	15.2	9.0	4.0	2.0	1.7	0.3	41.5	14.4	16.9	9.3	17.7	20.7	15.4	15.8	10.4	16.3	12.0	14.3
14	S N	35.9	12.7	16.0	7.2	3.4	1.1	0.7	0.2	39.3	13.8	16.7	7.4	17.2	19.5	14.1	15.4	11.0	16.1	11.1	14.3
15	S K	20.2	3.7	4.0	2.8	4.4	4.5	5.8	1.7	24.6	8.2	9.8	4.5	19.2	24.2	16.2	17.0	11.2	18.6	12.8	15.4
16	S M P K	22.3	2.8	3.9	2.8	5.1	4.4	6.6	1.5	27.4	7.2	10.5	4.3	19.4	23.4	15.6	16.6	11.8	19.0	13.4	15.3
17	M N	30.4	12.7	13.7	6.1	4.0	1.7	1.3	0.2	34.4	14.4	15.0	6.3	21.4	18.0	12.6	15.4	12.9	13.8	11.1	14.3
18	S N K	32.0	13.3	15.2	7.7	4.1	1.4	0.8	0.2	36.1	14.7	16.0	7.9	17.3	16.4	11.5	15.7	10.4	12.6	9.5	17.0
19	N P	37.0	13.8	16.0	5.9	3.4	2.0	0.7	0.2	40.4	15.8	16.7	6.1	19.0	17.9	12.5	15.3	11.0	14.0	11.0	14.6
20	S	18.0	4.4	3.3	3.2	4.7	7.0	5.3	1.0	22.7	11.4	8.6	4.2	20.6	19.4	12.7	16.6	12.7	14.9	12.1	15.0
21	S M P	20.4	3.5	5.4	2.4	4.7	6.2	4.5	0.8	25.1	9.7	9.9	3.2	20.4	20.6	13.8	17.0	11.9	15.8	12.0	15.8
22	M K	21.9	4.0	4.4	4.1	5.4	6.9	5.3	1.2	27.3	10.9	9.7	5.3	21.0	19.5	13.4	17.6	12.8	15.6	12.1	14.9
23	S M N P K	35.1	15.4	16.1	7.2	3.9	1.0	0.5	0.3	39.0	16.4	16.6	7.5	19.0	16.8	11.4	15.4	11.5	12.3	10.0	14.7
24	P K	26.4	4.0	5.9	3.9	5.0	6.7	5.9	1.1	31.4	10.7	11.8	5.0	20.7	17.9	14.5	16.1	11.4	14.8	11.7	14.9
25	N	43.9	15.6	16.2	6.5	1.7	0.7	0.8	0.2	45.6	16.3	17.0	6.7	18.8	16.9	11.9	15.3	10.6	10.9	9.8	16.7
26	S M N K	32.1	12.8	14.6	6.6	2.7	2.8	1.2	0.3	34.8	15.6	15.8	6.9	18.8	16.0	11.3	15.3	11.9	12.9	9.9	15.9
27	S P	23.3	3.7	4.4	3.5	5.4	6.2	5.9	1.3	28.7	9.9	10.3	4.8	20.8	22.0	14.4	18.2	12.8	15.6	12.8	15.7
28	S M	24.4	3.7	5.5	3.3	4.8	6.0	6.1	1.1	29.2	9.7	11.6	4.4	20.9	18.8	13.7	17.2	11.8	14.9	11.9	15.3
30	M P K	20.9	4.5	6.5	4.4	6.2	4.7	5.0	1.7	27.1	9.2	11.5	6.1	20.5	19.8	14.4	17.4	11.5	14.5	11.0	16.0
29	K	24.4	2.6	6.2	2.7	7.3	4.4	5.6	1.6	31.7	7.0	11.8	4.3	20.2	19.3	13.7	16.8	12.3	14.9	12.3	17.0
31	M N P	41.9	10.3	17.1	7.2	2.5	1.6	0.5	0.1	44.4	11.9	17.6	7.3	18.7	17.2	12.4	16.1	12.0	14.5	11.0	16.0
32	S N P K	42.7	11.0	19.8	7.1	2.2	0.9	0.7	0.2	44.9	11.9	20.5	7.3	18.6	15.0	12.5	16.1	10.8	13.0	9.5	16.6

Entries 29 and 30 are in reverse order.

Grass Composition.

	Na %				K %				Ca %				Mg %				P %			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
1 -	.077	.095	.130	.230	1.50	2.20	2.75	2.40	.500	.770	.630	.785	.114	.194	.200	.186	.185	.170	.305	.295
2 N K	.077	.135	.360	.700	1.65	2.70	2.30	1.80	.540	.850	.735	.785	.096	.164	.206	.212	.190	.175	.240	.260
3 M P	.095	.070	.130	.205	1.45	2.05	2.75	2.25	.460	.560	.720	.640	.078	.164	.206	.182	.205	.185	.350	.310
4 S M K	.045	.115	.105	.225	1.60	2.25	3.50	2.60	.430	.630	.575	.640	.090	.144	.166	.156	.145	.190	.305	.270
5 S N P	.140	.400	.725	.990	1.45	1.90	1.85	1.35	.460	.680	.680	.785	.076	.160	.200	.218	.175	.195	.245	.225
6 S M N	.310	.450	.675	.600	1.35	1.85	1.85	1.50	.500	.540	.560	.680	.086	.148	.170	.184	.165	.205	.195	.210
7 S P K	.045	.080	.140	.195	1.80	2.10	3.00	2.65	.430	.540	.640	.720	.082	.120	.156	.140	.190	.205	.260	.295
8 M N P K	.070	.185	.280	.460	1.70	2.20	2.40	2.15	.480	.580	.560	.700	.086	.156	.156	.200	.165	.175	.220	.220
9 P	.085	.140	.140	.260	1.40	1.75	2.75	1.90	.540	.500	.660	.620	.090	.152	.212	.172	.175	.220	.245	.270
10 S M N P	.205	.395	.800	.700	1.60	1.80	1.60	1.65	.430	.595	.620	.720	.076	.152	.190	.180	.175	.210	.195	.220
11 M	.050	.080	.085	.150	1.60	2.15	2.65	2.55	.460	.540	.640	.660	.096	.144	.160	.156	.160	.205	.265	.240
12 M N K	.077	.125	.150	.320	1.90	2.60	2.85	2.75	.430	.540	.560	.800	.076	.120	.136	.176	.145	.190	.175	.165
13 N P K	.125	.120	.320	.500	1.85	2.35	2.70	2.20	.480	.595	.620	.850	.082	.134	.106	.184	.155	.185	.165	.200
14 S N	.225	.600	.600	.800	1.65	1.80	1.96	1.65	.480	.680	.720	.785	.078	.152	.190	.190	.135	.175	.175	.190
15 S K	.110	.100	.130	.130	1.50	2.15	2.90	2.95	.460	.720	.620	.660	.068	.126	.158	.132	.130	.195	.220	.250
16 S M P K	.135	.115	.125	.160	1.70	2.15	3.15	2.65	.460	.750	.735	.750	.086	.134	.162	.164	.210	.185	.350	.370
17 M N	.135	.365	.600	.900	1.60	1.50	1.55	1.10	.480	.700	.820	.950	.104	.202	.240	.230	.190	.165	.210	.225
18 S N K	.285	.460	.750	.675	1.95	1.80	2.05	1.80	.500	.700	.820	.750	.100	.190	.210	.190	.225	.180	.220	.215
19 N P	.175	.370	.775	.330	1.45	1.50	1.40	1.50	.520	.680	.960	.750	.114	.202	.234	.218	.215	.185	.220	.230
20 S	.175	.180	.330	.375	1.50	2.05	2.50	2.20	.430	.700	.805	.680	.100	.186	.182	.156	.215	.185	.350	.305
21 S M P	.155	.155	.240	.140	1.70	2.30	2.50	2.15	.445	.700	.775	.720	.078	.152	.194	.162	.190	.215	.330	.250
22 M K	.055	.080	.140	.100	1.75	1.85	2.75	2.60	.430	.640	.640	.750	.100	.148	.182	.166	.210	.185	.305	.270
23 S M N P K	.175	.300	.650	.750	1.70	2.05	2.20	1.80	.380	.640	.680	.720	.096	.152	.182	.192	.180	.190	.215	.195
24 P K	.045	.070	.090	.350	1.75	1.95	3.40	2.50	.330	.680	.660	.700	.076	.134	.160	.146	.190	.215	.260	.215
25 N	.280	.505	.970	.990	1.45	1.45	1.60	1.35	.430	.640	.660	.785	.090	.164	.202	.196	.185	.165	.200	.190
26 S M N K	.195	.330	.675	.520	1.70	1.75	2.25	2.20	.445	.595	.700	.720	.096	.148	.210	.168	.155	.210	.195	.200
27 S P	.210	.135	.245	.550	1.60	1.70	2.20	2.15	.415	.620	.735	.680	.096	.138	.160	.168	.145	.225	.275	.215
28 S M	.200	.105	.285	.375	1.60	1.95	2.55	2.15	.400	.540	.680	.680	.090	.152	.136	.136	.140	.210	.205	.210
29 K	.045	.030	.080	.355	1.85	2.10	2.70	2.65	.340	.630	.700	.750	.072	.138	.152	.140	.125	.200	.265	.240
30 M P K	.070	.050	.090	.205	1.80	1.85	2.95	2.75	.400	.480	.805	.720	.104	.104	.178	.126	.180	.195	.220	.215
31 M N P	.280	.330	.510	.800	1.35	1.50	1.80	1.25	.430	.540	.630	.865	.104	.180	.192	.246	.130	.205	.200	.195
32 S N P K	.245	.505	.550	.235	1.85	1.95	2.60	1.65	.500	.750	.640	.820	.096	.168	.178	.190	.225	.180	.300	.260

Clover Composition.

	Na %				K %				Ca %				Mg %				P %			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
1 –	.165	.210	.135	.180	1.70	1.50	1.70	1.50	2.42	1.78	1.81	2.09	.250	.256	.276	.212	.175	.175	.220	.240
2 N K	.200	.205	.200	.200	2.05	1.70	1.60	1.35	2.20	1.68	1.78	2.12	.238	.244	.254	.210	.145	.150	.220	.260
3 M P	.185	.200	.195	.200	1.35	1.50	1.75	1.40	2.46	1.85	1.98	1.54	.286	.270	.270	.214	.140	.195	.240	.220
4 S M K	.295	.200	.100	.160	2.15	2.15	2.60	2.15	2.20	1.68	1.89	1.78	.238	.240	.240	.206	.175	.175	.200	.190
5 S N P	.450	.405	.510	.485	1.80	1.70	1.45	1.05	1.94	1.46	1.89	2.16	.220	.236	.240	.214	.195	.190	.190	.210
6 S M N	.520	.430	.380	.375	1.80	1.55	1.60	1.30	2.02	1.62	1.94	2.16	.208	.232	.268	.210	.130	.180	.155	.200
7 S P K	.195	.180	.120	.150	2.40	1.90	2.35	2.05	2.28	1.68	1.81	1.81	.200	.210	.236	.180	.150	.205	.185	.245
8 M N P K	.175	.240	.140	.160	2.05	1.70	1.85	1.70	2.06	1.68	1.72	1.75	.218	.216	.250	.206	.155	.195	.145	.245
9 P	.175	.260	.175	.215	1.20	1.30	1.55	1.10	2.20	1.72	1.85	1.81	.220	.210	.290	.200	.190	.205	.170	.200
10 S M N P	.425	.410	.400	.325	1.85	1.45	1.25	1.60	1.94	1.62	1.75	1.68	.210	.232	.270	.216	.190	.165	.115	.220
11 M	.155	.180	.115	.175	1.80	1.65	1.80	1.60	2.09	1.62	1.68	1.75	.230	.216	.236	.210	.160	.190	.195	.200
12 M N K	.160	.155	.100	.135	2.60	2.60	2.30	2.10	2.12	1.81	1.62	1.58	.200	.206	.226	.206	.115	.210	.155	.230
13 N P K	.135	.195	.140	.205	2.20	1.90	2.05	1.95	1.98	1.62	1.75	1.62	.194	.200	.220	.190	.130	.165	.175	.235
14 S N	.405	.365	.340	.445	1.70	1.60	1.40	1.40	1.81	1.72	1.62	1.68	.208	.240	.266	.210	.120	.195	.100	.200
15 S K	.230	.195	.195	.120	2.50	1.85	2.05	2.00	1.94	1.54	1.58	1.68	.208	.186	.260	.170	.190	.180	.185	.230
16 S M P K	.195	.175	.125	.140	2.35	2.00	2.30	2.00	2.32	1.65	1.72	1.85	.246	.200	.232	.188	.205	.175	.175	.295
17 M N	.135	.280	.225	.300	1.25	1.25	1.35	1.00	2.12	1.54	2.32	2.09	.250	.232	.340	.210	.100	.200	.235	.215
18 S N K	.445	.365	.310	.320	2.05	1.55	2.05	1.45	1.78	1.75	2.02	1.65	.202	.244	.294	.214	.155	.190	.300	.280
19 N P	.285	.280	.250	.220	1.60	1.05	1.40	1.50	2.06	1.89	2.20	1.89	.208	.280	.272	.220	.165	.180	.290	.210
20 S	.405	.425	.270	.310	1.35	1.25	1.70	1.35	2.09	1.74	1.98	1.89	.240	.228	.264	.220	.175	.195	.230	.240
21 S M P	.480	.355	.315	.405	1.30	1.35	1.75	1.25	1.85	1.68	2.06	1.78	.270	.216	.288	.216	.140	.165	.245	.215
22 M K	.185	.220	.155	.205	1.60	1.50	2.05	1.70	2.09	1.85	1.96	2.06	.240	.232	.254	.216	.190	.165	.196	.220
23 S M N P K	.355	.335	.430	.310	1.70	1.70	1.90	1.60	2.09	1.78	2.16	1.89	.194	.232	.288	.216	.195	.200	.180	.205
24 P K	.115	.195	.135	.135	2.05	1.85	2.35	1.85	1.98	1.66	1.94	1.62	.188	.216	.220	.194	.190	.220	.215	.250
25 N	.250	.305	.355	.455	1.85	1.40	1.55	1.05	1.94	1.68	1.78	1.72	.200	.266	.290	.212	.175	.175	.130	.160
26 S M N K	.250	.270	.240	.240	1.80	1.75	2.10	1.65	1.89	1.68	1.89	1.78	.210	.232	.276	.212	.145	.215	.195	.230
27 S P	.425	.355	.245	.300	1.40	1.35	1.50	1.25	1.98	1.75	1.78	1.89	.220	.210	.246	.214	.140	.210	.165	.185
28 S M	.405	.270	.290	.290	1.70	1.65	1.75	1.50	1.75	1.72	1.75	1.81	.216	.224	.236	.210	.165	.170	.170	.205
29 K	.125	.150	.100	.140	2.05	1.90	2.05	1.70	2.16	1.85	1.75	1.75	.212	.232	.210	.204	.175	.185	.195	.230
30 M P K	.115	.140	.140	.140	2.05	2.10	2.20	2.00	1.81	1.72	1.81	1.81	.244	.212	.236	.210	.170	.205	.165	.240
31 M N P	.235	.165	.245	.195	1.70	1.35	1.80	1.20	1.75	1.77	1.75	1.81	.212	.276	.280	.210	.160	.205	.170	.170
32 S N P K	.455	.365	.320	.300	2.20	1.75	2.35	1.40	1.75	1.76	1.75	1.94	.194	.210	.260	.210	.180	.190	.300	.270

GRASS. EXPERIMENT 3. Differential Responses. Total Dry Matter Yield. (cwt)

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	A.	- 1.86	-	-	- 1.48	- 2.24	- 2.09	- 1.65	- 2.31	- 1.41	- 0.96	- 2.76
		B.	- 0.16	-	-	- 0.47	+ 0.15	- 0.10	- 0.22	+ 0.33	- 0.65	- 0.27	- 0.05
		C.	- 0.27	-	-	- 0.39	- 0.15	- 0.24	- 0.30	- 0.33	- 0.21	+ 0.45	- 0.99
		D.	- 0.13	-	-	+ 0.24	- 0.50	- 0.34	+ 0.08	- 0.09	- 0.17	+ 0.53	- 0.79*
Magnesium Sulphate	2.	A.	- 0.82	- 0.44	- 1.20	-	-	+ 0.11	- 1.75	+ 0.08	- 1.72	- 0.24	- 1.40
		B.	+ 0.19	- 0.12	+ 0.50	-	-	+ 0.43	- 0.05	+ 1.06	- 0.68	- 0.81	+ 1.19
		C.	+ 0.67	+ 0.55	+ 0.79	-	-	+ 0.84	+ 0.50	+ 0.58	+ 0.76	+ 1.05	+ 0.29
		D.	+ 0.07	+ 0.44	- 0.30	-	-	+ 0.04	+ 0.10	+ 0.41	- 0.27	+ 0.25	- 0.11
Ammonium Sulphate	3 + 3 + 3 + 3.	A.	+12.94**	+12.73**	+13.15**	+13.87**	+12.01**	-	-	+12.53**	+13.35**	+13.80**	+12.08**
		B.	+ 4.69**	+ 4.75**	+ 4.63**	+ 4.74**	+ 4.64**	-	-	+ 5.02**	+ 4.36**	+ 4.15**	+ 5.23**
		C.	+ 6.96**	+ 6.99**	+ 6.93**	+ 7.13**	+ 6.79**	-	-	+ 6.82**	+ 7.12**	+ 6.93**	+ 7.01**
		D.	+ 3.00**	+ 2.79**	+ 3.21**	+ 2.97**	+ 3.03**	-	-	+ 3.02**	+ 2.98**	+ 2.98**	+ 3.02**
Superphosphate	3.	A.	+ 1.59	+ 0.97	+ 2.23	+ 2.50	+ 0.70	+ 1.19	+ 2.01	-	-	+ 0.70	+ 2.50
		B.	- 0.15	+ 0.34	- 0.64	+ 0.72	- 1.02	+ 0.16	- 0.48	-	-	- 0.02	- 0.28
		C.	+ 0.58	+ 0.52	+ 0.64	+ 0.49	+ 0.67	+ 0.44	+ 0.72	-	-	+ 1.09	+ 0.07
		D.	+ 0.09	+ 0.13	+ 0.05	+ 0.43	- 0.25	+ 0.11	+ 0.03	-	-	- 0.05	+ 0.23
Potassium Chloride	2.	A.	+ 0.02	+ 0.92	- 0.88	+ 0.60	- 0.56	+ 0.88	- 0.86	- 0.88	+ 0.92	-	-
		B.	- 0.28	- 0.39	- 0.17	- 1.28	+ 0.72	- 0.82	+ 0.26	- 0.15	- 0.41	-	-
		C.	+ 0.90	+ 1.62	+ 0.18	+ 1.28	+ 0.52	+ 0.86	+ 0.94	+ 1.41	+ 0.39	-	-
		D.	+ 0.71*	+ 1.37**	+ 0.05	+ 0.89*	+ 0.53	+ 0.69	+ 0.73*	+ 0.56	+ 0.86*	-	-

	MEAN	STANDARD ERRORS ±		
		SINGLE PLOT	Diffrntl. Response	Mean Response
A.	32.15	3.42	1.71	1.21
B.	12.50	1.50	0.75	0.53
C.	14.04	1.84	0.92	0.65
D.	6.09	0.71	0.36	0.25

INTERACTIONS	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	- 0.38	+ 0.21	- 0.93	+ 0.63	- 0.91	+ 0.41	- 0.89	- 0.58	- 0.87	+ 0.91
B.	+ 0.31	- 0.06	- 0.05	- 0.48	- 0.87	- 0.33	+ 0.11	+ 1.00	+ 0.54	- 0.13
C.	+ 0.12	- 0.03	- 0.17	+ 0.06	+ 0.09	+ 0.14	+ 0.72	- 0.38	+ 0.04	- 0.51
D.	- 0.37	+ 0.21	+ 0.03	- 0.04	- 0.34	- 0.02	- 0.66*	- 0.18	+ 0.02	+ 0.14

Differential Responses. GRASS. Dry Matter. (cwt.)

CWT./ACRE			MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	MAGNESIUM ABS.	MAGNESIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt	4.	A.	- 1.16	-	-	- 1.04	- 1.28	- 0.83	- 1.49	- 1.70	- 0.62	- 0.50	- 1.82
		B.	- 0.01	-	-	- 0.35	+ 0.33	- 0.04	+ 0.02	+ 0.05	- 0.07	- 0.15	+ 0.13
		C.	- 0.16	-	-	- 0.22	- 0.10	- 0.32	.00	- 0.47	+ 0.15	+ 0.82	- 1.14
		D.	- 0.09	-	-	+ 0.18	- 0.36	- 0.29	+ 0.01	- 0.01	- 0.17	+ 0.63	- 0.81*
Magnesium Sulphate	2.	A.	- 0.76	- 0.64	- 0.88	-	-	+ 0.27	- 1.79	+ 0.22	- 1.74	- 0.13	- 1.39
		B.	- 0.19	- 0.53	+ 0.15	-	-	- 0.04	- 0.34	- 0.10	- 0.28	- 1.05	+ 0.67
		C.	+ 0.46	+ 0.40	+ 0.52	-	-	+ 0.50	+ 0.42	+ 0.10	+ 0.82	+ 0.76	+ 0.16
		D.	+ 0.08	+ 0.35	- 0.19	-	-	+ 0.11	+ 0.05	+ 0.46	- 0.30	+ 0.22	- 0.06
Ammonium Sulphate	3 + 3 + 3 + 3	A.	+15.08**	+15.41**	+14.75**	+16.11**	+14.05**	-	-	+14.77**	+15.39**	+16.27**	+14.89**
		B.	+ 9.17**	+ 9.14**	+ 9.20**	+ 9.32**	+ 9.02**	-	-	+ 9.70**	+ 8.64**	+ 9.13**	+ 9.21**
		C.	+11.86**	+11.70**	+12.02**	+11.90**	+11.82**	-	-	+11.67**	+12.05**	+11.91**	+11.81**
		D.	+ 4.08**	+ 3.88**	+ 4.28**	+ 4.11**	+ 4.05**	-	-	+ 4.10**	+ 4.06**	+ 3.96**	+ 4.20**
Superphosphate	3.	A.	+ 1.36	+ 0.82	+ 1.90	+ 2.34	+ 0.38	+ 1.05	+ 1.67	-	-	+ 0.43	+ 2.29
		B.	- 0.09	- 0.03	- 0.15	.00	- 0.18	+ 0.44	- 0.62	-	-	- 0.17	- 0.01
		C.	+ 0.66	+ 0.35	+ 0.97	+ 0.30	+ 1.02	+ 0.47	+ 0.85	-	-	+ 1.16	+ 0.16
		D.	+ 0.07	+ 0.15	- 0.01	+ 0.45	- 0.31	+ 0.09	+ 0.05	-	-	.000	+ 0.14
Potassium Chloride	2.	A.	- 0.14	+ 0.52	- 0.80	+ 0.49	- 0.77	+ 1.05	- 1.33	- 1.07	+ 0.79	-	-
		B.	- 0.04	- 0.18	+ 0.10	- 0.90	+ 0.82	- 0.08	.00	- 0.12	+ 0.04	-	-
		C.	+ 0.73	+ 1.71	- 0.25	+ 1.03	+ 0.43	+ 0.78	+ 0.68	+ 1.23	+ 0.23	-	-
		D.	+ 0.51*	+ 1.23*	- 0.21	+ 0.65	+ 0.37	+ 0.39	+ 0.63	+ 0.43	+ 0.58	-	-

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± Diffrntl. Response	STANDARD ERRORS ± Mean Response	INTERACTIONS SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	27.84	3.77	1.89	1.34	- 0.12	- 0.33	- 1.03	+ 0.54	- 0.98	+ 0.31	- 0.66	- 0.63	- 1.19	+ 0.93
B.	8.53	1.28	0.64	0.45	+ 0.34	+ 0.03	- 0.15	- 0.06	- 0.09	- 0.53	+ 0.14	+ 0.86	+ 0.04	+ 0.08
C.	10.58	1.78	0.89	0.63	+ 0.06	+ 0.16	- 0.04	+ 0.31	+ 0.36	+ 0.19	- 0.98	- 0.30	+ 0.09	- 0.50
D.	5.49	0.72	0.36	0.25	- 0.27	+ 0.20	- 0.03	- 0.08	- 0.38	- 0.02	- 0.72*	- 0.14	+ 0.12	+ 0.07

GRASS. EXPERIMENT 3.

Differential Responses. CLOVER. Dry Matter. (cwt)

CWT./ACRE			MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	MAGNESIUM ABS.	MAGNESIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt	4.	A.	- 0.70	-	-	- 0.44	- 0.96	- 1.26*	- 0.16	- 0.61	- 0.79	- 0.46	- 0.94
		B.	- 0.15	-	-	- 0.12	- 0.18	- 0.06	- 0.24	+ 0.28	- 0.58	- 0.12	- 0.18
		C.	- 0.11	-	-	- 0.17	- 0.05	+ 0.08	- 0.30	+ 0.15	- 0.37	- 0.37	+ 0.15
		D.	- 0.04	-	-	+ 0.06	- 0.14	- 0.05	- 0.03	- 0.08	.00	- 0.10	+ 0.02
Magnesium Sulphate	2.	A.	- 0.06	+ 0.20	- 0.32	-	-	- 0.16	+ 0.04	- 0.14	+ 0.02	⊖ 0.11	- 0.01
		B.	+ 0.38	+ 0.41	+ 0.35	-	-	+ 0.47	+ 0.29	+ 1.16*	- 0.40	+ 0.24	+ 0.52
		C.	+ 0.21	+ 0.15	+ 0.27	-	-	+ 0.34	+ 0.08	+ 0.48	- 0.06	+ 0.29	+ 0.13
		D.	- 0.01	+ 0.09	- 0.11	-	-	- 0.07	+ 0.05	- 0.05	+ 0.03	+ 0.03	- 0.05
Ammonium Sulphate	3 + 3 + 3 + 3	A.	- 2.14**	- 2.68**	- 1.60**	-.2.24**	- 2.04**	-	-	- 2.24**	- 2.04**	- 2.47**	- 1.81**
		B.	- 4.48**	- 4.39**	- 4.57**	- 4.58**	- 4.38**	-	-	- 4.68**	- 4.28**	- 4.98**	- 3.98**
		C.	- 4.89**	- 4.70**	- 5.08**	- 4.76**	- 5.02**	-	-	- 4.85**	- 4.93**	- 4.98**	- 4.80**
		D.	- 1.08**	- 1.09**	- 1.07**	- 1.14**	- 1.02**	-	-	- 1.08**	- 1.08**	- 0.98**	- 1.18**
Superphosphate	3.	A.	+ 0.24	+ 0.15	+ 0.33	+ 0.16	+ 0.32	+ 0.14	+ 0.34	-	-	+ 0.27	+ 0.21
		B.	- 0.06	+ 0.37	- 0.49	+ 0.72	- 0.84*	- 0.26	+ 0.14	-	-	+ 0.15	- 0.27
		C.	- 0.06	+ 0.20	- 0.32	+ 0.21	- 0.33	- 0 .02	- 0.10	-	-	- 0.07	- 0.05
		D.	+ 0.02	- 0.02	+ 0.06	- 0.02	+ 0.06	+ 0.02	+ 0.02	-	-	- 0.05	+ 0.09
Potassium Chloride	2.	A.	+ 0.16	+ 0.40	- 0.08	+ 0.11	+ 0.21	- 0.17	+ 0.47	+ 0.19	+ 0.13	-	-
		B.	- 0.24	- 0.21	- 0.27	- 0.38	- 0.10	- 0.74**	+ 0.26	- 0.03	- 0.45	-	-
		C.	+ 0.18	- 0.08	+ 0.04	+ 0.26	+ 0.10	+ 0.09	+ 0.27	+ 0.17	+ 0.19	-	-
		D.	+ 0.20*	+ 0.14	+ 0.26*	+ 0.24*	+ 0.16	+ 0.30**	+ 0.10	+ 0.13	+ 0.27**	-	-

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± Diffrntl. Response	STANDARD ERRORS ± Mean Response	INTERACTIONS SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	4.31	0.96	0.48	0.34	- 0.26	+ 0.54	+ 0.10	+ 0.09	+ 0.08	+ 0.10	- 0.24	+ 0.05	+ 0.33	- 0.03
B.	3.97	0.80	0.40	0.28	- 0.03	- 0.09	+ 0.10	- 0.43	- 0.78*	+ 0.20	- 0.03	+ 0.14	+ 0.50	- 0.21
C.	3.46	0.62	0.31	0.22	+ 0.06	- 0.19	- 0.13	- 0.26	- 0.27	- 0.04	+ 0.26	- 0.08	+ 0.09	+ 0.01
D.	0.80	0.20	0.10	0.07	- 0.10	+ 0.01	+ 0.06	+ 0.04	+ 0.04	0.00	+ 0.06	- 0.04	- 0.10	+ 0.07

GRASS. EXPERIMENT 3. Differential Responses. GRASS. % Na.

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4	A.	+.070**	-	-	+ .066*	+ .074*	+ .069*	+ .071*	+ .093**	+ .047	+ .056*	+ .084**
		B.	+ .105**	-	-	+ .125**	+ .085**	+ .046	+ .164**	+ .116**	+ .094**	+ .058*	+ .152**
		C.	+ .136**	-	-	+ .076	+ .196**	+ .089	+ .183**	+ .129*	+ .143**	+ .070	+ .202**
		D.	+ .035	-	-	+ .029	+ .041	+ .036	+ .034	- .006	+ .076	+ .083	- .013
Magnesium Sulphate	2.	A.	- .006	- .010	- .002	-	-	+ .001	- .013	- .026	+ .014	- .020	+ .008
		B.	- .042*	- .022	- .062*	-	-	- .007	- .077*	- .057	- .027	- .059*	- .025
		C.	- .050	- .110*	+ .010	-	-	- .011	- .089	- .080	- .020	- .074	- .026
		D.	- .068*	- .067	- .069	-	-	- .113*	- .023	- .135**	- .001	- .079	- .057
Ammonium Sulphate	3 + 3 + 3 + 3	A.	+ .087**	+ .086**	+ .088**	+ .094**	+ .080**	-	-	+ .103**	+ .071*	+ .087**	+ .087**
		B.	+ .248**	+ .189**	+ .307**	+ .283**	+ .213**	-	-	+ .273**	+ .223**	+ .306**	+ .190**
		C.	+ .432**	+ .385**	+ .479**	+ .471**	+ .393**	-	-	+ .437**	+ .428**	+ .509**	+ .355**
		D.	+ .392**	+ .393**	+ .391**	+ .347**	+ .437**	-	-	+ .446**	+ .338**	+ .510**	+ .274**
Superphosphate	3.	A.	- .005	+ .018	- .028	- .025	+ .015	+ .011	- .021	-	-	- .013	+ .003
		B.	- .021	- .010	- .032	- .036	- .006	+ .004	- .046	-	-	- .048	+ .006
		C.	- .016	- .023	- .009	- .046	+ .014	- .011	- .021	-	-	- .014	- .018
		D.	- .039	- .080	+ .002	- .106*	+ .028	+ .015	- .093*	-	-	- .056	- .022
Potassium Chloride	2.	A.	- .062**	- .076**	- .048	- .076**	- .048	- .062*	- .062*	- .070**	- .054*	-	-
		B.	- .097**	- .144**	- .050	- .114**	- .080*	- .039	- .155**	- .124**	- .070**	-	-
		C.	- .163**	- .229**	- .097	- .187**	- .139*	- .086	- .240**	- .161**	- .165**	-	-
		D.	- .158**	- .110*	- .206**	- .167**	- .149**	- .040	- .276**	- .175**	- .141**	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS									
		SINGLE PLOT	Diffrntl. Response	Mean Response	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	.144	.049	.025	.018	+ .004	+ .001	- .007	- .023	+ .020	- .016	+ .014	+ .014	.000	+ .008
B.	.224	.054	.027	.019	- .020	+ .059**	- .035	- .011	+ .015	- .025	+ .047*	+ .017	- .058**	+ .027
C.	.371	.096	.048	.034	+ .060	+ .047	- .039	+ .007	+ .030	- .005	+ .066	+ .024	- .077*	- .002
D.	.446	.082	.041	.029	+ .006	- .001	+ .045	+ .041	+ .067*	- .054	- .048	+ .009	- .118**	+ .017

CWT./ACRE			MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	MAGNESIUM ABS.	MAGNESIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt	4.	A.	+ .196**	-	-	+ .195**	+ .197**	+ .176**	+ .216**	+ .197**	+ .197**	+ .241**	+ .151**
		B.	+ .108**	-	-	+ .107**	+ .109**	+ .076**	+ .140**	+ .102**	+ .114**	+ .142**	+ .074**
		C.	+ .112**	-	-	+ .103**	+ .121**	+ .064*	+ .160**	+ .093**	+ .131**	+ .132**	+ .092**
		D.	+ .088**	-	-	+ .095**	+ .081**	+ .060*	+ .116**	+ .058*	+ .118**	+ .126**	+ .052*
Magnesium Sulphate	2.	A.	- .012	- .013	- .011	-	-	+ .022	- .046	- .015	- .009	- .003	- .021
		B.	- .027	- .028	- .026	-	-	- .029	- .025	- .027	- .027	- .014	- .040
		C.	- .013	- .022	- .004	-	-	+ .007	- .033	- .038	+ .012	- .015	- .011
		D.	- .027	- .020	- .034	-	-	+ .020	- .074*	- .037	- .017	- .043	- .011
Ammonium Sulphate	3 + 3 + 3 + 3	A.	+ .065*	+ .045	+ .085*	+ .099*	+ .031	-	-	+ .051	+ .079*	+ .039	+ .091*
		B.	+ .066**	+ .034	+ .098**	+ .064**	+ .068**	-	-	+ .065**	+ .067**	+ .048*	+ .084**
		C.	+ .111**	+ .063*	+ .159**	+ .131**	+ .091**	-	-	+ .099**	+ .123**	+ .120**	+ .102**
		D.	+ .088**	+ .060*	+ .116**	+ .135**	+ .041	-	-	+ .111**	+ .065*	+ .091**	+ .085**
Superphosphate	3.	A.	+ .004	+ .005	+ .003	+ .001	+ .007	- .010	+ .018	-	-	+ .027	- .019
		B.	+ .002	- .004	+ .008	+ .002	+ .002	+ .001	+ .003	-	-	- .004	+ .008
		C.	+ .024	+ .005	+ .043	- .001	+ .049	+ .012	+ .036	-	-	+ .029	+ .019
		D.	- .010	- .040	+ .020	- .020	- .000	+ .013	- .033	-	-	- .023	+ .003
Potassium Chloride	2.	A.	- .029	+ .016	- .074*	- .020	- .038	- .055	- .003	- .006	- .052	-	-
		B.	- .082**	- .048*	- .116**	- .069**	- .095**	- .100**	- .064**	- .088**	- .076**	-	-
		C.	- .094**	- .074*	- .114**	- .096**	- .092**	- .085**	- .103**	- .089**	- .099**	-	-
		D.	- .114**	- .078**	- .150**	- .130**	- .098**	- .111**	- .117**	- .127**	- .101**	-	-

	MEAN	STANDARD ERRORS ± SINGLE PLOT	Diffrntl. Response	Mean Response	INTERACTIONS SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	.273	.068	.034	.024	+ .001	+ .020	- .034	- .001	+ .003	+ .014	- .045	- .009	+ .026	- .023
B.	.265	.042	.021	.015	+ .001	+ .032*	+ .002	+ .006	.000	+ .001	- .034*	- .013	+ .018	+ .006
C.	.231	.055	.028	.021	+ .009	+ .048*	- .020	+ .019	+ .025	+ .012	- .020	+ .002	- .009	- .005
D.	.248	.051	.025	.018	- .007	+ .028	- .047*	+ .030	+ .010	- .023	- .036	+ .016	- .003	+ .013

GRASS. EXPERIMENT 3. Differential Responses. GRASS. % K.

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	A.	+ .01	−	−	+ .05	− .03	− .02	+ .04	− .06	+ .08	+ .08	− .06
		B.	+ .02	−	−	− .01	+ .05	+ .09	− .05	− .06	+ .10	+ .15	− .11
		C.	− .04	−	−	− .07	− .01	− .05	− .03	+ .05	− .13	− .03	− .05
		D.	− .04	−	−	+ .01	− .09	− .01	− .07	− .02	− .06	− .14	+ .06
Magnesium Sulphate	2.	A.	− .01	+ .03	− .05	−	−	+ .03	− .05	− .06	+ .04	+ .03	− .05
		B.	+ .05	+ .02	+ .08	−	−	+ .07	+ .03	+ .02	+ .08	+ .09	+ .01
		C.	− .04	− .07	− .01	−	−	− .01	− .07	+ .07	− .15	− .05	− .03
		D.	+ .09	+ .14	+ .04	−	−	+ .04	+ .14	+ .08	+ .10	+ .02	+ .16
Ammonium Sulphate	3 + 3 + 3 + 3	A.	+ .06	+ .03	+ .09	+ .10	+ .02	−	−	+ .10	+ .02	.00	+ .12
		B.	− .15*	− .08	− .22*	− .13	− .17*	−	−	− .22*	−. 08	− .36**	+ .06
		C.	− .75**	− .76**	− .74**	− .72**	− .78**	−	−	− .74**	− .76**	− .88**	− .62**
		D.	− .71**	− .68**	− .74**	− .76**	− .66**	−	−	− .74**	− .68**	− .80**	− .62**
Superphosphate	3.	A.	− .13	− .20	− .06	− .18	− .08	− .09	− .17	−	−	− .16	− .10
		B.	− .03	− .11	+ .05	− .06	.00	− .10	+ .04	−	−	− .05	− .01
		C.	+ .04	+ .13	− .05	+ .15	− .07	+ .05	+ .03	−	−	− .07	+ .15
		D.	− .11	− .09	− .13	− .12	− .10	− .14	− .08	−	−	− .09	− .13
Potassium Chloride	2.	A.	+ .24**	+ .31**	+ .17*	+ .28**	+ .20*	+ .18*	+ .30**	+ .21*	+ .27**	−	−
		B.	+ .24**	+ .37**	+ .11	+ .28**	+ .20*	+ .03	+ .45**	+ .22*	+ .26**	−	−
		C.	+ .59**	+ .60**	+ .58**	+ .58**	+ .60**	+ .46**	+ .72**	+ .48**	+ .70**	−	−
		D.	+ .53**	+ .43**	+ .63**	+ .46**	+ .60**	+ .44**	+ .62**	+ .55**	+ .51**	−	−

	MEAN	STANDARD ERRORS ±			INTERACTIONS									
		SINGLE PLOT	Diffrntl. Response	Mean Response	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	1.63	0.16	0.08	0.06	− .04	+ .03	− .04	+ .07	+ .05	− .04	− .07	− .04	+ .06	+ .03
B.	1.96	0.16	0.08	0.06	+ .03	− .07	− .02	+ .08	+ .03	+ .07	− .13*	− .04	+ .21**	+ .02
C.	2.43	0.28	0.14	0.10	+ .03	+ .01	− .03	− .09	− .11	− .01	− .01	+ .01	+ .13	+ .11
D.	2.09	0.24	0.12	0.08	− .05	− .03	+ .05	− .02	+ .01	+ .03	+ .10	+ .07	+ .09	− .02

GRASS. EXPERIMENT 3. Differential Responses. CLOVER. % K.

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	A.	+ .06	-	-	+ .09	+ .03	+ .17	- .05	+ .02	+ .10	+ .06	+ .06
		B.	+ .02	-	-	+ .05	- .01	+ .03	+ .01	- .01	+ .05	- .03	+ .01
		C.	+ .05	-	-	+ .08	+ .02	+ .07	+ .03	+ .11	- .01	- .06	+ .16
		D.	+ .01	-	-	- .01	+ .03	+ .09	- .07	+ .10	- .08	+ .04	- .02
Magnesium Sulphate	2.	A.	- .07	- .04	- .10	-	-	- .05	- .09	- .07	- .07	+ .01	- .15
		B.	+ .11	+ .14	+ .08	-	-	+ .13	+ .09	+ .17	+ .05	+ .08	+ .14
		C.	+ .08	+ .11	+ .05	-	-	+ .12	+ .04	+ .18	- .02	+ .10	+ .06
		D.	+ .11	+ .09	+ .13	-	-	+ .10	+ .12	+ .15	+ .07	+ .08	+ .14
Ammonium Sulphate	3 + 3 + 3 + 3.	A.	+ .08	+ .19	- .03	+ .10	+ .06	-	-	+ .03	+ .13	+ .22	- .06
		B.	- .05	- .04	- .06	- .07	- .03	-	-	.00	- .10	- .02	- .08
		C.	- .22**	- .20	- .24*	- .18	- .26*	-	-	- .22**	- .22*	- .22*	- .22*
		D.	- .20*	- .12	- .28*	- .21*	- .19	-	-	- .28*	- .12	- .11	- .29*
Superphosphate	3,	A.	- .05	- .09	- .01	- .05	- .05	- .10	00	-	-	- .12	+ .02
		B.	- .05	- .08	- .02	+ .01	- .11	.00	- .10	-	-	- .09	- .01
		C.	+ .01	+ .07	- .05	+ .11	- .09	+ .01	+ .01	-	-	- .05	+ .07
		D.	.00	+ .09	- .09	+ .04	- .04	- .08	+ .08	-	-	- .04	+ .04
Potassium Chloride	2.	A.	+ .53**	+ .53**	+ .53**	+ .61**	+ .45**	+ .67**	+ .39**	+ .46**	+ .60**	-	-
		B.	+ .44**	+ .54**	+ .34**	+ .41**	+ .47**	+ .47**	+ .41**	+ .40**	+ .48**	-	-
		C.	+ .55**	+ .45**	+ .65**	+ .57**	+ .53**	+ .55**	+ .55**	+ .49**	+ .61**	-	-
		D.	+ .47**	+ .50**	+ .44**	+ .44**	+ .50**	+ .56**	+ .38**	+ .43**	+ .51**	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS									
		SINGLE PLOT	Diffrntl. Response	Mean Response	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	1.85	.22	.11	.07	- .03	- .11	- .02	+ .04	.00	+ .05	.00	- .08	- .14	+ .07
B.	1.65	.22	.11	.07	- .03	- .01	- .02	+ .03	- . 06	- .05	-.10	+ .03	- .03	+ .04
C.	1.86	.21	.10	.07	- .03	- .02	- .04	- .06	- .10	.00	+ .11	- .02	.00	+ .06
D.	1.55	.20	.10	.07	+ .02	- .08	+ .01	- .09	- .04	+ .08	- .03	+ .03	- .09	+ .04

GRASS. EXPERIMENT 3. Differential Responses. GRASS. % Ca.

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	A.	- .005	-	-	.000	- .010	+ .002	- .012	+ .005	- .015	- .032	+ .022
		B.	+ .041	-	-	+ .006	+ .076*	+ .063	+ .019	- .025	+ .107**	+ .016	+ .066*
		C.	- .001	-	-	+ .004	- .006	+ .014	- .016	+ .012	- .014	- .018	+ .016
		D.	- .038	-	-	- .018	- .058	- .013	- .063	- .084*	+ .008	- .041	- .035
Magnesium Sulphate	2.	A.	- .018	- .013	- .023	-	-	+ .006	- .042	- .013	- .023	- .021	- .015
		B.	- .066**	- .101**	- .031	-	-	- .046	- .086**	- .126**	- .006	- .075*	- .057
		C.	- .036	- .031	- .041	-	-	+ .015	- .087*	- .064	- .008	- .050	- .022
		D.	- .012	+ .008	- .032	-	-	- .004	- .020	- .013	+ .011	+ .006	- .030
Ammonium Sulphate	3 + 3 + 3 + 3.	A.	+ .035*	+ .042*	+ .028	+ .059*	+ .011	-	-	+ .045*	+ .025	+ .010	+ .060*
		B.	+ .031	+ .053	+ .009	+ .051	+ .011	-	-	+ .009	+ .053	+ .015	+ .047
		C.	- .003	+ .012	- .018	+ .048	- .054	-	-	+ .036	- .042	+ .007	- .013
		D.	+ .082**	+ .107**	+ .057	+ .090**	+ .074*	-	-	+ .081*	+ .083*	+ .107**	+ .057
Superphosphate	3.	A.	- .006	+ .004	- .016	- .001	- .011	+ .004	- .016	-	-	+ .002	- .014
		B.	- .020	- .086**	+ .046	- .080*	+ .040	- .042	+ .002	-	-	- .029	- .011
		C.	+ .016	+ .029	+ .003	- .012	+ .044	+ .055	- .023	-	-	+ .033	- .001
		D.	- .006	- .052	+ .040	- .007	- .005	- .007	- .005	-	-	- .028	+ .016
Potassium Chloride	2.	A.	- .022	- .049*	+ .005	- .025	- .019	- .047*	+ .003	- .014	- .030	-	-
		B.	+ .033	+ .008	+ .058	+ .024	+ .042	+ .017	+ .049	+ .024	+ .042	-	-
		C.	- .038	- .055	- .021	- .052	- .024	- .028	- .048	- .021	- .055	-	-
		D.	+ .003	.000	+ .006	+ .021	- .015	+ .028	- .022	- .019	+ .025	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS									
		SINGLE PLOT	Diffrntl. Response	Mean Response	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	.450	.044	.022	.016	- .005	- .007	- .024	- .010	- .005	- .010	+ .027	+ .003	+ .025	- .008
B.	.628	.056	.028	.020	+ .035	- .022	- .020	+ .066**	+ .060**	+ .022	+ .025	+ .009	+ .016	+ .009
C.	.687	.080	.040	.028	- .005	- .015	- .051	- .013	+ .028	- .039	+ .017	+ .014	- .010	- .017
D.	.738	.061	.030	.021	- .020	- .025	- .008	+ .046*	+ .001	+ .001	+ .003	- .018	- .025	+ .022

GRASS. EXPERIMENT 3. Differential Responses. CLOVER. % Ca.

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	A.	- .12	-	-	- .18	- .06	- .10	- .14	- .21	- .03	- .27	+ .03
		B.	- .06	-	-	- .05	- .07	- .08	- .04	- .05	- .07	- .07	- .05
		C.	- .01	-	-	- .06	+ .04	- .03	+ .01	+ .01	- .01	- .08	+ .06
		D.	+ .03	-	-	+ .01	+ .05	+ .01	+ .05	- .09	+ .15	+ .05	+ .01
Magnesium Sulphate	2.	A.	.00	- .06	+ .06	-	-	- .06	+ .06	- .01	+ .01	- .06	+ .06
		B.	.00	+ .01	- .01	-	-	+ .01	- .01	- .03	+ .03	- .04	+ .04
		C.	+ .05	.00	+ .10	-	-	+ .05	+ .05	+ .10	.00	+ .04	+ .06
		D.	- .01	- .03	+ .01	-	-	- .02	.00	+ .06	- .08	- .06	+ .04
Ammonium Sulphate	3 + 3 + 3 + 3.	A.	- .14	- .12	- .16	- .20	- .08	-	-	- .11	- .17	- .16	- .12
		B.	- .03	- .05	- .01	- .02	- .04	-	-	- .04	- .02	- .07	+ .01
		C.	- .02	- .04	.00	- .02	- .02	-	-	+ .01	- .05	- .01	- .03
		D.	+ .04	+ .02	+ .04	+ .03	+ .05	-	-	.00	+ .08	+ .08	.00
Superphosphate	3.	A.	- .02	- .11	+ .07	- .03	- .01	+ .01	- .05	-	-	- .01	- .03
		B.	.00	+ .01	- .01	- .03	+ .03	- .01	+ .01	-	-	+ .04	- .04
		C.	+ .04	+ .04	+ .04	+ .09	- .01	+ .07	+ .01	-	-	+ .05	+ .03
		D.	- .05	- .17	+ .07	+ .02	- .12	- .09	- .01	-	-	- .08	- .02
Potassium Chloride	2.	A.	+ .01	- .14	+ .16	- .05	+ .07	- .01	+ .03	+ .02	.00	-	-
		B.	+ .01	.00	+ .02	- .03	+ .05	- .03	+ .05	+ .05	- .03	-	-
		C.	- .06	- .13	+ .01	- .07	- .05	- .05	- .07	- .05	- .07	-	-
		D.	- .07	- .05	- .09	- .12	- .02	- .03	- .11	- .10	- .04	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS									
		SINGLE PLOT	Diffrntl. Response	Mean Response	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	2 .03	.20	.10	.07	+ .06	- .02	+ .06	+ .09	+ .01	- .03	+ .15	+ .06	+ .02	- .01
B.	1.70	.11	.06	.04	- .01	+ .02	- .01	- .01	+ .03	+ .01	+ .01	+ .04	+ .04	- .04
C.	1.85	.09	.05	.03	+ .05	+ .02	.00	.00	- .05	- .03	+ .07	+ .01	- .01	- .01
D.	1.83	.18	.09	.06	+ .02	+ .02	+ .01	+ .12	- .07	+ .04	- .02	+ .05	- .04	+ .03

GRASS. EXPERIMENT 3. Differential Responses. GRASS. % Mg.

CWT./ACRE			MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	MAGNESIUM ABS.	MAGNESIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt	4.	A.	- .006	-	-	- .005	- .007	- .005	- .007	- .005	- .007	- .014	+ .002
		B.	- .005	-	-	- .005	- .005	- .003	- .007	- .004	- .006	- .014	+ .004
		C.	- .005	-	-	- .005	- .005	- .017	+ .007	- .007	- .003	- .028*	+ .018
		D.	- .013*	-	-	- .009	- .017*	- .008	- .018*	- .018*	- .008	- .024**	- .002
Magnesium Sulphate	2.	A.	+ .001	+ .002	.000	-	-	+ .003	- .001	+ .003	- .001	- .006	+ .008
		B.	- .008	- .008	- .008	-	-	- .006	- .010	- .014	- .002	- .007	- .009
		C.	- .003	- .003	- .003	-	-	.000	- .006	- .013	+ .007	+ .006	- .012
		D.	- .001	+ .003	- .005	-	-	+ .001	- .003	- .004	+ .002	- .004	+ .002
Ammonium Sulphate	3 + 3 + 3 + 3.	A.	+ .002	+ .003	+ .001	+ .004	.000	-	-	- .001	+ .005	- .002	+ .006
		B.	+ .016*	+ .018	+ .014	+ .018	+ .014	-	-	+ .007	+ .025*	+ .009	+ .023*
		C.	+ .015*	+ .003	+ .027**	+ .018	+ .012	-	-	+ .029**	+ .001	+ .021*	+ .009
		D.	+ .043**	+ .048**	+ .038**	+ .045**	+ .041**	-	-	+ .040**	+ .046**	+ .043**	+ .043**
Superphosphate	3.	A.	- .002	- .001	- .003	.000	- .004	- .005	+ .001	-	-	- .006	+ .002
		B.	- .007	- .006	- .008	- .013	- .001	- .016	+ .002	-	-	- .006	- .008
		C.	- .002	- .004	.000	- .012	+ .008	+ .012	- .016	-	-	+ .014	- .018
		D.	+ .007	+ .002	+ .012	+ .004	+ .010	+ .004	+ .010	-	-	+ .014	.000
Potassium Chloride	2.	A.	- .004	- .012	+ .004	- .011	+ .003	- .008	.000	- .008	.000	-	-
		B.	- .023**	- .032**	- .014	- .022*	- .024*	- .030**	- .016	- .022*	- .024*	-	-
		C.	- .023**	- .046**	.000	+ .014	- .032**	- .017	- .029**	- .007	- .039**	-	-
		D.	- .019**	- .030**	- .008	- .022**	- .016*	- .019*	- .019*	- .012	- .026**	-	-

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± Diffrntl. Response	STANDARD ERRORS ± Mean Response	INTERACTIONS SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	.090	.012	.006	.004	- .001	- .001	- .002	- .001	- .002	+ .003	+ .008	+ .007	+ .004	+ .004
B.	.154	.018	.009	.006	.000	- .002	- .002	- .001	+ .006	+ .009	+ .009	- .001	+ .007	- .001
C.	.180	.018	.009	.006	.000	+ .012	- .003	+ .002	+ .010	- .014	+ .023**	- .009	- .006	- .016*
D.	.177	.015	.008	.005	- .004	- .005	- .002	+ .005	+ .003	+ .003	+ .011*	+ .003	.000	- .007

GRASS. EXPERIMENT 3. Differential Responses. CLOVER. % Mg.

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	A.	- .007	-	-	- .003	- .011	- .004	- .010	- .012	- .002	- .008	- .006
		B.	- .012*	-	-	- .017*	- .007	- .016*	- .008	- .007	- .017*	- .024**	.000
		C.	+ .003	-	-	+ .005	+ .001	+ .002	+ .004	+ .003	+ .003	- .022*	+ .028**
		D.	- .001	-	-	- .001	- .001	- .007*	+ .005	- .003	+ .001	+ .003	- .005
Magnesium Sulphate	2.	A.	+ .017**	+ .021*	+ .013	-	-	+ .029**	+ .005	+ .004	+ .030**	+ .015	+ .019*
		B.	.000	- .005	+ .005	-	-	+ .008	- .008	- .010	+ .010	- .004	+ .004
		C.	+ .006	+ .008	+ .004	-	-	- .002	+ .014	- .005	+ .017	+ .006	+ .006
		D.	+ .005*	+ .005	+ .005	-	-	+ .010*	.000	+ .003	+ .007*	- .001	+ .011*
Ammonium Sulphate	3 + 3 + 3 + 3	A.	- .021**	- .018*	- .024**	- .009	- .033**	-	-	- .014	- .028**	- .027**	- .015
		B.	+ .014**	+ .010	+ .018**	+ .022**	+ .006	-	-	+ .010	+ .018**	+ .021**	+ .007
		C.	+ .019*	+ .018	+ .020	+ .011	+ .027**	-	-	+ .030**	+ .008	+ .015	+ .023*
		D.	+ .006*	.000	+ .012*	+ .011*	+ .001	-	-	+ .004	+ .008*	.000	+ .012*
Superphosphate	3.	A.	- .002	- .007	+ .003	- .015	+ .011	+ .005	- .009	-	-	+ .005	- .009
		B.	- .005	.000	- .010	- .015*	+ .005	- .009	- .001	-	-	+ .005	- .015*
		C.	- .006	- .006	- .006	- .017	+ .005	+ .005	- .017	-	-	+ .003	- .009
		D.	- .002	- .004	.000	- .004	.000	- .004	.000	-	-	+ .001	- .005
Potassium Chloride	2.	A.	- .014*	- .015	- .013	- .016	- .012	- .020*	- .008	- .007	- .021*	-	-
		B.	- .019**	- .031**	- .007	- .023**	- .015*	- .012	- .026**	- .009	- .029**	-	-
		C.	- .024**	- .049**	+ .001	- .024*	- .024*	- .028**	- .020*	- .021*	- .027**	-	-
		D.	- .010**	- .006	- .016**	- .016**	- .004	- .016**	- .004	- .007*	- .013**	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS									
		SINGLE PLOT	Diffrntl. Response	Mean Response	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	.221	.016	.008	.006	- .004	- .003	- .012*	+ .005	+ .013*	- .007	+ .001	+ .002	+ .006	- .007
B.	.229	.013	.006	.004	+ .005	+ .004	- .008	- .005	+ .010*	+ .004	+ .012*	+ .004	- .007	- .010*
C.	.259	.018	.009	.007	- .002	+ .001	+ .008	.000	+ .011	- .011	+ .025**	.000	+ .004	- .003
D.	.207	.007	.004	.002	.000	+ .006*	- .005*	+ .002	+ .002	+ .002	- .004	+ .006*	+ .006*	- .003

CWT./ACRE			MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	MAGNESIUM ABS.	MAGNESIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt	4.	A.	.000	–	–	+ .003	– .003	– .008	+ .008	– .010	+ .010	– .013	+ .013
		B.	+ .008	–	–	+ .003	+ .013	+ .004	+ .012	+ .012	+ .004	+ .015	+ .001
		C.	+ .012	–	–	+ .018	+ .006	+ .010	+ .014	– .012	+ .036*	– .003	+ .027
		D.	+ .009	–	–	+ .007	+ .011	+ .014	+ .004	– .004	+ .022	– .016	+ .034
Magnesium Sulphate	2.	A.	– .007	– .004	– .010	–	–	+ .011	– .025	– .010	– .004	– .009	– .005
		B.	+ .003	– .002	+ .008	–	–	– .007	+ .013	+ .014	– .008	+ .010	– .004
		C.	– .001	+ .005	– .007	–	–	+ .018	– .020	– .015	+ .013	+ .030	– .032
		D.	– .006	– .008	– .004	–	–	+ .005	– .017	– .020	+ .008	– .008	– .004
Ammonium Sulphate	3 + 3 + 3 + 3.	A.	.000	– .008	+ .008	+ .018	– .018	–	–	+ .009	– .009	– .007	+ .007
		B.	– .012	– .016	– .008	– .022*	– .002	–	–	– .009	– .015	– .014	– .010
		C.	– .071**	– .073**	– .069**	– .052**	– .090**	–	–	– .076**	– .066**	– .085**	– .057**
		D.	– .051**	– .046**	– .056**	– .040**	– .062**	–	–	– .053**	– .049**	– .051**	– .051**
Superphosphate	3.	A.	+ .013	+ .003	+ .023	+ .010	+ .016	+ .022	+ .004	–	–	+ .005	+ .021
		B.	+ .010	+ .014	+ .006	+ .021	– .001	+ .013	+ .007	–	–	+ .020	.000
		C.	+ .014	– .010	+ .038*	.000	+ .028	+ .009	+ .019	–	–	+ .020	+ .008
		D.	+ .009	– .004	+ .022	– .005	+ .023	+ .007	+ .011	–	–	+ .006	+ .012
Potassium Chloride	2.	A.	+ .002	– .011	+ .015	.000	+ .004	– .005	+ .009	– .006	+ .010	–	–
		B.	– .005	+ .002	– .012	+ .002	– .012	– .007	– .003	+ .005	– .015	–	–
		C.	– .003	– .018	+ .012	+ .028	– .034	– .017	+ .011	+ .003	– .009	–	–
		D.	+ .004	– .021	+ .029	+ .002	+ .006	+ .004	+ .004	+ .001	+ .007	–	–

	MEAN	STANDARD ERRORS ± SINGLE PLOT	Diffrntl. Response	Mean Response	INTERACTIONS SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	.175	.028	.014	.010	– .003	+ .008	– .018	+ .010	+ .003	– .009	+ .013	+ .002	+ .007	+ .008
B.	.193	.020	.010	.007	+ .005	+ .004	+ .010	– .004	– .011	– .003	– .007	– .007	+ .002	– .010
C.	.246	.034	.017	.012	– .006	+ .002	– .019	+ .024	+ .014	+ .005	+ .015	+ .031*	+ .014	– .006
D.	.238	.038	.019	.013	+ .002	– .005	– .011	+ .013	+ .014	+ .002	+ .025	+ .002	.000	+ .003

GRASS. EXPERIMENT 3.

Differential Responses. CLOVER. % P.

CWT./ACRE			MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	MAGNESIUM ABS.	MAGNESIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt	4.	A.	– .020**	–	–	– .033**	– .007	– .030**	– .010	– .021*	– .019*	– .026**	– .014
		B.	.000	–	–	+ .014	– .014	– .007	+ .007	– .006	+ .006	– .007	+ .007
		C.	– .025*	–	–	– .018	– .032*	– .028*	– .022	– .025	– .025	– .061**	+ .008
		D.	+ .006	–	–	+ .009	+ .003	+ .001	+ .011	+ .003	+ .009	+ .004	+ .008
Magnesium Sulphate	2.	A.	– .005	– .018*	+ .008	–	–	– .006	– .004	– .018*	+ .008	– .019*	+ .009
		B.	.000	+ .014	– .014	–	–	– .007	+ .007	+ .008	– .008	– .007	+ .007
		C.	– .021*	– .014	– .028*	–	–	+ .002	– .044**	– .010	– .032*	+ .004	– .046**
		D.	– .009	– .006	– .012	–	–	– .004	– .014	– .019	+ .001	.000	– .018
Ammonium Sulphate	3 + 3 + 3 + 3.	A.	– .018**	– .028**	– .008	– .019*	– .017*	–	–	– .041**	+ .005	– .007	– .029**
		B.	– .001	– .008	+ .006	– .019	+ .017	–	–	+ .010	– .012	– .002	.000
		C.	– .006	– .009	– .003	+ .017	– .029*	–	–	– .013	+ .001	– .031*	+ .019
		D.	– .004	– .009	+ .001	+ .001	– .009	–	–	+ .003	– .011	– .015	+ .007
Superphosphate	3.	A.	+ .013*	+ .012	+ .014	.000	+ .026**	– .010	+ .036**	–	–	+ .015	+ .011
		B.	+ .009	+ .003	+ .015	+ .017	+ .001	+ .020	– .002	–	–	+ .005	+ .013
		C.	+ .003	+ .003	+ .003	+ .014	– .008	– .004	+ .010	–	–	+ .019	– .013
		D.	+ .005	+ .002	+ .008	– .005	+ .015	+ .012	– .002	–	–	– .004	+ .014
Potassium Chloride	2.	A.	+ .009	+ .003	+ .015	– .005	+ .023**	+ .020*	+ .002	+ .011	+ .007	–	–
		B.	– .003	– .010	+ .004	– .010	+ .004	– .004	– .002	– .007	+ .001	–	–
		C.	+ .010	– .023	+ .043**	+ .035**	+ .015	– .015	+ .035**	+ .026	– .006	–	–
		D.	+ .035**	+ .033*	+ .037*	+ .044**	+ .026	+ .024	+ .046**	+ .026	+ .044**	–	–

	MEAN	STANDARD ERRORS ± SINGLE PLOT	Diffrntl. Response	Mean Response	INTERACTIONS SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	.162	.015	.008	.005	+ .013*	+ .010	+ .001	+ .001	+ .013*	+ .023**	+ .006	+ .014*	– .011*	– .002
B.	.188	.020	.010	.007	– .014	+ .007	+ .018*	+ .006	– .008	– .011	+ .007	+ .007	+ .001	+ .004
C.	.194	.026	.013	.009	– .007	+ .003	– .023*	.000	– .011	+ .007	+ .033**	– .025*	+ .025*	– .016
D.	.223	.028	.014	.010	– .003	+ .005	– .005	+ .003	+ .010	– .007	+ .002	– .009	+ .011	+ .009

GRASS. EXPERIMENT 4.

		DRY MATTER YIELDS cwt.			DRY MATTER %.		
		A	B	C	A	B	C
1	S M K	6.2	5.2	7.0	27.7	26.1	26.5
2	N K	21.5	16.4	14.0	25.7	25.0	24.5
3	M P	3.5	4.8	5.1	27.7	26.3	26.7
4	S P K	3.9	6.2	6.2	28.2	27.0	27.0
5	M N P K	20.0	17.8	15.0	26.0	25.1	24.9
6	-	3.6	2.3	3.3	28.7	26.8	26.7
7	S N P	21.5	16.8	11.0	26.0	24.9	25.1
8	S M N	19.5	14.0	10.0	26.1	23.9	24.0
9	M N K	22.6	16.8	14.0	27.0	24.1	24.5
10	P	3.4	4.2	4.4	28.3	27.2	27.0
11	M	3.1	3.9	4.2	29.1	27.5	27.2
12	S K	3.9	6.7	6.2	28.1	27.0	27.1
13	S M N P	18.7	14.8	10.2	24.2	22.0	23.1
14	S M P K	5.6	5.2	6.9	27.7	26.8	26.5
15	S N	17.3	15.6	9.9	24.5	22.0	23.3
16	N P K	17.2	17.2	13.0	26.4	24.2	24.5
17	S	4.7	3.7	3.8	28.1	26.8	26.2
18	M K	7.0	4.2	7.0	27.7	27.0	26.5
19	S M P	5.0	5.1	5.6	27.8	27.0	26.8
20	M N	22.4	10.4	8.5	26.5	24.1	24.2
21	S N K	16.8	15.4	13.4	26.0	25.1	25.0
22	P K	5.4	6.8	7.0	28.7	27.7	27.1
23	S M N P K	25.4	16.4	14.5	25.5	24.0	24.5
24	N P	18.7	14.0	8.0	26.2	25.2	25.0
25	M P K	4.5	6.7	6.8	27.5	26.6	26.5
26	S P	2.9	4.9	4.9	28.3	27.7	27.0
27	K	4.0	5.2	7.2	26.5	25.0	25.1
28	S M	4.0	9.0	5.3	28.0	27.2	27.0
29	S N P K	22.2	17.0	13.5	26.1	22.5	24.0
30	M N P	16.3	12.2	9.5	25.9	23.0	23.1
31	N	21.2	10.8	8.9	26.1	24.0	22.0
32	S M N K	15.6	17.6	13.5	25.8	24.5	23.5

GRASS. EXPERIMENT 4.

DRY MATTER COMPOSITION.

		Na %			K %			Ca %			Mg %			P %		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1	S M K	.080	.050	.075	1.40	1.15	1.20	.365	.430	.625	.125	.108	.112	.165	.165	.150
2	N K	.070	.150	.175	1.50	1.25	1.25	.440	.575	.635	.106	.160	.176	.185	.185	.140
3	M P	.100	.055	.075	1.10	0.85	0.65	.440	.550	.640	.096	.126	.184	.180	.195	.165
4	S P K	.085	.035	.040	1.25	1.00	1.10	.365	.400	.660	.070	.096	.080	.185	.185	.170
5	M N P K	.085	.300	.250	1.40	1.30	1.35	.385	.600	.605	.086	.148	.124	.150	.170	.165
6	-	.110	.045	.060	1.05	0.80	0.75	.385	.430	.595	.092	.096	.098	.175	.135	.170
7	S N P	.400	.405	.625	0.70	0.80	0.90	.415	.600	.675	.092	.140	.166	.175	.185	.150
8	S M N	.420	.445	.630	0.80	0.85	0.90	.345	.520	.620	.088	.170	.196	.140	.190	.165
9	M N K	.075	.230	.225	1.40	1.35	1.30	.315	.540	.590	.092	.162	.216	.155	.160	.160
10	P	.120	.060	.065	1.05	0.90	0.75	.330	.400	.660	.076	.100	.106	.170	.205	.185
11	M	.110	.040	.055	1.10	1.00	0.95	.385	.400	.580	.070	.108	.082	.125	.135	.140
12	S K	.110	.055	.060	1.15	1.05	1.05	.260	.330	.610	.062	.090	.096	.170	.195	.140
13	S M N P	.535	.475	.675	0.75	0.70	0.70	.315	.460	.625	.092	.164	.156	.175	.190	.210
14	S M P K	.125	.055	.085	1.20	1.10	1.10	.280	.400	.610	.062	.082	.120	.140	.215	.185
15	S N	.387	.410	.725	0.85	0.90	0.95	.330	.430	.635	.076	.140	.152	.135	.145	.150
16	N P K	.095	.205	.250	1.35	1.25	1.35	.385	.520	.600	.070	.114	.110	.160	.210	.175
17	S	.175	.060	.125	1.10	1.00	1.10	.365	.500	.645	.126	.090	.102	.135	.150	.145
18	M K	.055	.025	.030	1.35	1.20	1.30	.385	.445	.630	.130	.116	.112	.150	.160	.140
19	S M P	.165	.095	.125	1.00	0.95	0.95	.400	.400	.625	.126	.110	.110	.155	.165	.185
20	M N	.285	.335	.410	0.75	0.90	0.60	.385	.540	.610	.126	.162	.236	.120	.145	.160
21	S N K	.180	.210	.195	1.30	1.40	1.25	.385	.460	.545	.076	.098	.086	.165	.190	.175
22	P K	.045	.055	.055	1.15	1.20	1.10	.365	.445	.585	.086	.102	.096	.170	.205	.165
23	S M N P K	.185	.200	.225	1.35	1.70	1.40	.365	.500	.595	.104	.128	.116	.185	.190	.170
24	N P	.365	.387	.735	0.60	0.75	0.60	.400	.575	.665	.096	.162	.206	.175	.165	.150
25	M P K	.045	.040	.075	1.25	1.30	1.20	.365	.460	.675	.096	.116	.150	.140	.165	.175
26	S P	.165	.070	.125	0.95	1.00	1.10	.345	.340	.635	.062	.082	.096	.175	.190	.160
27	K	.040	.035	.035	1.25	1.05	1.30	.345	.415	.620	.078	.098	.102	.140	.155	.150
28	S M	.200	.090	.135	0.90	0.95	0.80	.260	.280	.650	.082	.076	.136	.165	.175	.170
29	S N P K	.180	.330	.275	1.30	1.20	1.15	.330	.365	.615	.090	.098	.106	.180	.195	.180
30	M N P	.320	.375	.630	0.60	0.65	0.75	.400	.400	.620	.088	.122	.192	.170	.210	.165
32	S M N K	.170	.225	.250	1.40	1.35	1.20	.365	.500	.610	.090	.116	.126	.190	.175	.130
31	N	.310	.290	.585	0.70	0.80	0.75	.365	.445	.525	.090	.132	.184	.140	.165	.170

GRASS. EXPERIMENT 4.

Differential Responses. Dry Matter Yields (cwt)

CWT./ACRE			MEAN RESPONSE	SODIUM ABS.	SODIUM PRES.	MAGNESIUM ABS.	MAGNESIUM PRES.	NITROGEN ABS.	NITROGEN PRES.	PHOSPHORUS ABS.	PHOSPHORUS PRES.	POTASSIUM ABS.	POTASSIUM PRES.
Salt	4.	A.	- 0.08	-	-	- 0.25	+ 0.07	+ 0.21	- 0.37	- 2.19	+ 2.03	+ 0.17	- 0.33
		B.	+ 1.24*	-	-	+ 1.17	+ 1.31*	+ 0.98	+ 1.50*	+ 2.14**	+ 0.34	+ 2.66**	- 0.18
		C.	+ 0.38	-	-	+ 0.39	+ 0.37	+ 0.12	+ 0.64*	+ 0.25	+ 0.[illegible]1	+ 1.10**	- 0.36
Magnesium Sulphate	2.	A.	+ 0.70	+ 0.55	+ 0.85	-	-	+ 0.89	+ 0.51	+ 0.93	+ 0.47	- 0.10	+ 1.50
		B.	+ 0.06	- 0.01	+ 0.13	-	-	+ 0.52	- 0.40	+ 0.57	- 0.45	+ 0.24	- 0.12
		C.	+ 0.52*	+ 0.53	+ 0.51	-	-	+ 0.61*	+ 0.43	+ 0.34	+ 0.70*	+ 0.52	+ 0.52
Ammonium Sulphate	3 + 3 + 3	A.	+15.39**	+15.68**	+15.10**	+ 15.58**	+15.20**	-	-	+15.05**	+15.73**	+15.68**	+15.10**
		B.	+ 9.95**	+ 9.69**	+10.21**	+10.41**	+ 9.49**	-	-	+ 9.61**	+10.29**	+ 8.78**	+11.12**
		C.	+ 6.00**	+ 5.74**	+ 6.26**	+ 6.09**	+ 5.91**	-	-	+ 6.03**	+ 5.97**	+ 4.92**	+ 7.08**
Superphosphate	3.	A.	+ 0.05	- 2.06	+ 2.16	+ 0.28	- 0.18	- 0.29	+ 0.39	-	-	- 0.73	+ 0.78
		B.	+ 0.81	+ 1.71*	- 0.09	+ 1.32	+ 0.30	+ 0.47	+ 1.15	-	-	+ 0.89	+ 0.73
		C.	+ 0.34	+ 0.21	+ 0.47	+ 0.16	+ 0.52	+ 0.37	+ 0.31	-	-	+ 0.50	+ 0.08
Potassium Chloride	2.	A.	+ 1.00	+ 1.25	+ 0.75	+ 0.20	+ 1.80	+ 1.29	+ 1.71	+ 0.22	+ 1.78	-	-
		B.	+ 2.08**	+ 3.50**	+ 0.66	+ 2.26**	+ 1.90**	+ 0.91	+ 3.25**	+ 2.16**	+ 2.00**	-	-
		C.	+ 3.28**	+ 4.00**	+ 2.56**	+ 3.28**	+ 3.28**	+ 2.20**	+ 4.36**	+ 3.54**	+ 3.02**	-	-

	MEAN	STANDARD ERRORS ± SINGLE PLOT	STANDARD ERRORS ± Diffrntl. Response	STANDARD ERRORS ± Mean Response	INTERACTIONS SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	12.11	2.06	1.03	0.73	+ 0.15	- 0.29	- 0.19	+ 2.11	- 0.23	+ 0.34	- 0.25	+ 0.80	- 0.29	+ 0.78
B.	10.23	1.26	0.63	0.45	+ 0.07	+ 0.26	- 0.46	- 0.90	- 0.51	+ 0.34	- 1.42**	- 0.18	+ 1.17*	- 0.08
C.	8.68	0.56	0.28	0.20	- 0.01	+ o.26	- 0.09	+ 0.13	+ 0.18	- 0.03	- 0.72**	0.00	+ 1.08**	- 0.26

GRASS. EXPERIMENT 4. Differential Responses. % Na.

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	A.	+ .083**	-	-	+ .066**	+ .100**	+ .060**	+ .106**	+ .083**	+ .083**	+ .091**	+ .075**
		B.	+ .027	-	-	+ .019	+ .034	+ .019	+ .034	+ .031	+ .023	+ .039	+ .015
		C.	+ .041*	-	-	+ .026	+ .056*	+ .040	+ .042	+ .077**	+ .005	+ .069**	+ .013
Magnesium Sulphate	2.	A.	+ .007	- .010	+ .024	-	-	+ .003	+ .011	+ .001	+ .013	+ .013	+ .001
		B.	+ .009	+ .001	+ .017	-	-	+ .004	+ .014	+ .012	+ .006	+ .012	+ .006
		C.	- .011	- .026	+ .004	-	-	+ .011	- .033	- .018	- .004	- .040	+ .018
Ammonium Sulphate	3 + 3 + 3	A.	+ .146**	+ .123**	+ .169**	+ .142**	+ .150**	-	-	+ .137**	+ .165**	+ .235**	+ .067**
		B.	+ .257**	+ .249**	+ .265**	+ .252**	+ .262**	-	-	+ .237**	+ .277**	+ .326**	+ .188**
		C.	+ .352**	+ .351**	+ .353**	+ .374**	+ .330**	-	-	+ .327**	+ .379**	+ .531**	+ .173**
Superphosphate	3.	A.	+ .015	+ .015	+ .015	+ .009	+ .021	- .004	+ .034*	-	-	+ .022	+ .008
		B.	+ .028	+ .032	+ .024	+ .031	+ .027	+ .008	+ .048	-	-	+ .028	+ .036
		C.	+ .034	+ .050*	- .002	+ .027	+ .041	+ .009	+ .059*	-	-	+ .041	+ .027
Potassium Chloride	2.	A.	- .159**	- .151**	- .167**	- .153**	- .165**	- .070**	- .248**	- .152**	- .165**	-	-
		B.	- .090**	- .078**	- .102**	- .087**	- .093**	- .021	- .159**	- .098**	- .082**	-	-
		C.	- .217**	- .189**	- .245**	- .248**	- .188**	- .038	- .396**	- .210**	- .224**	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS									
		SINGLE PLOT	Diffrntl. Response	Mean Response	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	.181	.026	.013	.009	+ .017	+ .023*	+ .004	.000	+ .006	+ .019	- .008	- .006	- .089**	- .007
B.	.182	.048	.024	.017	+ .008	+ .008	+ .005	- .004	- .003	+ .020	- .012	- .003	- .069**	+ .008
C.	.252	.046	.023	.016	+ .015	+ .001	- .022	- .036*	+ .007	+ .025	- .028	+ .029	- .179**	- .007

GRASS. EXPERIMENT 4. Differential Responses % K.

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	A.	- .01	-	-	.00	- .02	- .04	+ .02	- .02	.00	+ .02	- .04
		B.	+ .03	-	-	+ .04	+ .02	- .02	+ .08	+ .03	+ .03	+ .06	.00
		C.	+ .06	-	-	+ .09	+ .03	+ .05	+ .07	+ .03	+ .09	+ .20**	- .08
Magnesium Sulphate	2.	A.	+ .03	+ .04	+ .02	-	-	+ .04	+ .02	+ .02	+ .04	.00	+ .06
		B.	+ .06	+ .07	+ .05	-	-	+ .04	+ .08	+ .06	+ .06	- .01	+ .13*
		C.	- .01	+ .02	- .04	-	-	- .02	.00	- .03	+ .01	- .08	+ .06
Ammonium Sulphate	3 + 3 + 3.	A.	- .09**	- .12**	- .06	- .08*	- .10*	-	-	- .07*	- .11**	- .31**	+ .13**
		B.	+ .04	- .01	+ .09	+ .02	+ .06	-	-	+ .08	.00	- .14**	+ .22**
		C.	.00	- .01	+ .01	- .01	+ .01	-	-	- .04	+ .04	- .11	+ .11
Superphosphate	3.	A.	- .06*	- .07	- .05	- .07	- .05	- .04	- .08	-	-	- .06	- .06
		B.	- .02	- .02	- .02	- .02	- .02	+ .02	- .06	-	-	+ .01	- .05
		C.	- .03	- .06	.00	- .05	- .01	- .07	+ .01	-	-	- .05	- .01
Potassium Chloride	2.	A.	+ .44**	+ .47**	+ .41**	+ .41**	+ .47**	+ .22**	+ .66**	+ .44**	+ .44**	-	-
		B.	+ .38**	+ .41**	+ .35**	+ .31**	+ .45**	+ .20**	+ .56**	+ .33**	+ .43**	-	-
		C.	+ .41**	+ .56**	+ .27**	+ .34**	+ .48**	+ .30**	+ .52**	+ .39**	+ .43**	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS									
		SINGLE PLOT	Diffrntl. Response	Mean Response	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	1.09	.07	.04	.03	- .01	+ .03	- .01	+ .01	+ .01	- .02	- .03	+ .03	+ .22**	.00
B.	1.05	.09	.05	.03	- .01	+ .05	+ .02	.00	.00	- .04	- .03	+ .07*	+ .18**	+ .05
C.	1.03	.13	.07	.05	- .03	+ .01	+ .01	+ .03	+ .02	+ .04	- .14**	+ .07	+ .11*	+ .02

GRASS. EXPERIMENT 4. Differential Responses. % Ca.

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	A.	– .037**	–	–	– .028	– .046**	– .045**	– .029	– .042*	– .032*	– .040*	– .034*
		B.	– .052*	–	–	– .048	– .056*	– .059*	– .045	– .043	– .061*	– .027	– .079**
		C.	+ .009	–	–	+ .017	+ .001	+ .009	+ .009	+ .019	– .001	+ .027	– .009
Magnesium Sulphate	2.	A.	– .003	+ .006	– .012	–	–	+ .015	– .021	– .008	+ .002	.000	– .006
		B.	+ .012	+ .016	+ .008	–	–	+ .013	+ .011	+ .008	+ .016	– .022	+ .044
		C.	.000	+ .008	– .008	–	–	+ .009	– .009	+ .013	– .013	– .008	+ .008
Ammonium Sulphate	3 + 3 + 3	A.	+ .018	+ .010	+ .026	+ .036*	.000	–	–	+ .023	+ .013	+ .006	+ .030
		B.	+ .088**	+ .081**	+ .095**	+ .089**	+ .087**	–	–	+ .098**	+ .078**	+ .084**	+ .092**
		C.	– .017	– .017	– .017	– .008	– .026	–	–	– .023	– .011	– .007	– .027
Superphosphate	3.	A.	+ .013	+ .008	+ .018	+ .008	+ .018	+ .018	+ .008	–	–	+ .028	– .002
		B.	+ .011	+ .020	+ .002	+ .007	+ .015	+ .021	+ .001	–	–	+ .023	– .001
		C.	+ .023	+ .033	+ .013	+ .036	+ .010	+ .017	+ .029	–	–	+ .036	+ .010
Potassium Chloride	2.	A.	– .010	– .013	– .007	– .007	– .013	– .022	+ .002	+ .005	– .025	–	–
		B.	+ .007	+ .033	– .018	– .027	+ .041	+ .003	+ .011	+ .019	– .005	–	–
		C.	– .012	+ .006	– .030	– .020	– .004	– .002	– .022	+ .001	– .025	–	–

	MEAN	STANDARD ERRORS ±			INTERACTIONS									
		SINGLE PLOT	Diffrntl. Response	Mean Response	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	.361	.031	.015	.011	– .009	+ .008	– .018	+ .005	+ .005	– .005	+ .003	– .003	+ .012	– .015
B.	.458	.052	.026	.018	– .004	+ .047	– .001	– .009	+ .004	– .010	– .025	+ .034	+ .004	– .012
C.	.620	.034	.017	.012	– .008	.000	– .009	– .010	– .013	+ .006	– .018	+ .008	– .010	– .013

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	A.	- .003	-	-	- .005	- .001	- .001	- .005	- .007	+ .001	+ .002	- .008
		B.	- .015*	-	-	- .016*	- .014	- .016*	- .014	- .019*	- .011	+ .008	- .038**
		C.	- .026*	-	-	- .024	- .028	- .010	- .042**	- .025	- .027	- .022	- .030*
Magnesium Sulphate	2.	A.	+ .013*	+ .011	+ .015	-	-	+ .017	+ .009	+ .012	+ .014	+ .007	+ .019*
		B.	+ .014*	+ .013	+ .015*	-	-	+ .011	+ .017*	+ .015*	+ .013	+ .012	+ .016*
		C.	+ .025*	+ .041*	+ .009	-	-	+ .029	+ .021	+ .026	+ .024	+ .022	+ .029
Ammonium Sulphate	3 + 3 + 3	A.	+ .001	+ .003	- .001	+ .005	- .003	-	-	- .003	+ .005	+ .002	.000
		B.	+ .038**	+ .037**	+ .039**	+ .035**	+ .041**	-	-	+ .044**	+ .032**	+ .050**	+ .026**
		C.	+ .048**	+ .064**	+ .032*	+ .052**	+ .044**	-	-	+ .067**	+ .029	+ .072**	+ .024
Superphosphate	3.	A.	- .007	- .011	- .003	- .008	- .006	- .011	- .003	-	-	- .002	- .012
		B.	- .002	- .006	+ .002	- .001	- .003	+ .004	- .008	-	-	+ .004	- .008
		C.	- .006	- .005	- .007	- .004	- .008	+ .013	- .025	-	-	+ .004	- .016
Potassium Chloride	2.	A.	- .003	+ .002	- .008	- .009	+ .003	- .002	- .004	+ .002	- .008	-	-
		B.	- .009	+ .014	- .032**	- .011	- .007	+ .003	- .021**	- .003	- .015*	-	-
		C.	- .030*	- .026	- .034*	- .033*	- .027	- .006	- .054**	- .020	- .040*	-	-

	MEAN	STANDARD ERRORS ±			INTERACTIONS									
		SINGLE PLOT	Diffrntl. Response	Mean Response	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	.091	.017	.008	.006	+ .002	- .002	- .004	+ .004	+ .001	+ .004	- .005	+ .006	- .001	- .005
B.	.119	.014	.007	.005	+ .001	+ .001	+ .003	+ .004	- .001	- .006	- .023**	+ .002	- .012*	- .006
C.	.135	.028	.014	.010	- .002	- .016	- .004	- .001	- .002	- .019	- .004	+ .003	- .024*	- .010

GRASS. EXPERIMENT 4. Differential Responses. % P.

CWT./ACRE			MEAN RESPONSE	SODIUM		MAGNESIUM		NITROGEN		PHOSPHORUS		POTASSIUM	
				ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.	ABS.	PRES.
Salt	4.	A.	+ .007	–	–	– .002	+ .016	+ .003	+ .011	+ .009	+ .005	.000	+ .014
		B.	+ .008	–	–	+ .001	+ .015	+ .010	+ .006	+ .018	– .002	+ .004	+ .012
		C.	+ .004	–	–	– .004	+ .012	+ .002	+ .006	.000	+ .008	+ .004	+ .004
Magnesium Sulphate	2.	A.	– .007	– .016	+ .002	–	–	– .010	– .004	– .005	– .009	– .006	– .008
		B.	– .003	– .010	+ .004	–	–	– .005	– .001	– .001	– .005	+ .009	– .015
		C.	+ .004	– .004	+ .012	–	–	+ .003	+ .005	– .003	+ .011	+ .010	– .002
Ammonium Sulphate	3 + 3 + 3.	A.	+ .005	+ .001	+ .009	+ .002	+ .008	–	–	+ .001	+ .009	– .006	+ .017*
		B.	+ .005	+ .007	+ .003	+ .003	+ .007	–	–	+ .011	– .001	+ .006	+ .004
		C.	+ .001	– .001	+ .003	.000	+ .002	–	–	+ .005	– .003	.000	+ .002
Superphosphate	3.	A.	+ .013*	+ .015*	+ .011	+ .015*	+ .011	+ .009	+ .017*	–	–	+ .030**	– .004
		B.	+ .026**	+ .036**	+ .016	+ .028**	+ .024*	+ .032**	+ .020*	–	–	+ .033**	+ .019
		C.	+ .019**	+ .015	+ .023*	+ .012	+ .026**	+ .023*	+ .015	–	–	+ .013	+ .025**
Potassium Chloride	2.	A.	+ .006	– .001	+ .013	+ .007	+ .005	– .005	+ .017	+ .023*	– .011	–	–
		B.	+ .011	+ .007	+ .015	+ .023*	– .001	+ .012	+ .010	+ .018	+ .004	–	–
		C.	– .004	– .004	– .004	+ .002	– .010	– .005	– .003	– .010	+ .002	–	–

	MEAN	STANDARD ERRORS ±			INTERACTIONS									
		SINGLE PLOT	Diffrntl. Response	Mean Response	SM	SN	MN	SP	MP	NP	SK	MK	NK	PK
A.	.160	.014	.007	.005	+ .009	+ .004	+ .003	– .002	– .002	+ .004	+ .007	– .001	+ .011*	– .017**
B.	.177	.019	.009	.007	+ .007	– .002	+ .002	– .010	– .002	– .006	+ .004	– .012	– .001	– .007
C.	.163	.017	.008	.006	+ .008	+ .002	+ .001	+ .004	+ .007	– .004	.000	– .006	+ .001	+ .006