POTASSIUM RELATIONSHIPS IN SELECTED EUTROPHIC HUTTON SOILS OF IRRIGATION AREAS

by

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ABSTRACT

The relationship between red leaf disease and soil fertility status was studied in the glasshouse. For red leaf disease affected plants grown on Mangano soils, no effective fertilizer treatment could be found. However, yield could be predicted more accurately by soil parameters other than the traditional ammonium acetate extractable potassium or exchangeable potassium. These parameters were the ratio (Ca+Mg)/K in the soil and exchangeable potassium percentage.

These initial findings were tested in fifteen field trials on Mangano soils with variable clay contents and exchangeable potassium contents at Vaalharts.

A large matrix of data resulted from the field investigation. However, only statistical procedures relating soil and leaf-K parameters to yield and leaf-K were investigated.

The data were statistically analised by means of analysis of variance, correlation and multiple regression on an IBM 900 computer. For each soil and leaf potassium parameter relationships were established with yield and leaf-K content for individual trials, pooled data and grouped data.

Attention is drawn to the fact that ammonium acetate extractable potassium and exchangeable potassium are not reliable predictors of cotton yield for this soil/crop relationship. These two parameters should rather be considered together with the ratio (Ca + Mg)/K in the soil,exchangeable potassium percentage and leaf-K content when cotton yield is to be predicted on Mangano soils at Vaalharts.

The initial results from one pot experiment and fifteen field trials were largely substantiated by two additional pot experiments.In order to find an explanation for the lack of response to applied potassium, potassium fixation and K fractionation were also investigated. All the soils tested fixed appreciable quantities of K. Total K amounted to approximately one percent.

Recommendations are made to clarify the complex nature of potassium reactions in the soil/crop relationship.

CHAPTER 1

INTRODUCTION

The soils of the Vaalharts irrigation scheme are predominantly of aeolian origin and are therefore of a sandy nature. Sand grains are well rounded and sorted and approximately 75 percent of the sand fraction passes a 0,2 mm sieve (Van der Merwe, 1973, Van Rooyen, 1971 and Du Preez, 1979).

Soils of this nature have a natural tendency to compact under cultivation and irrigation (Bennie, 1979). Various investigations linked the soils' poor physical conditions and generally low potassium contents with growth disorders of inter alia cotton (Gossypium hirsutum). Early fertilizer trials at Vaalharts (Wessels & Pretorius, 1953) indicated that potassium fertilizer was either detrimental to or had no effect on crop yields of cereals, potatoes and lucerne. Laker (1970), however, pointed out that these soils generally have a low potassium supplying power. This is in keeping with their mineralogical composition, viz. a very high percentage of quartz and mostly less than 10 percent clay contents.

These considerations led to the conclusion that Vaalharts soils are in danger of rapid depletion of potassium reserves. Crops with poor or weakened root systems may be expected to show the first signs of potassium deficiencies. Cotton roots apparently have a very weak power to penetrate compacted layers. This phenomenon has often been observed in soil pits dug in soils with plough soles.

After the early fertilizer trials (Wessels & Pretorius, 1953), a considerable period elapsed before further soil fertility investigations were resumed in 1971 (Eloff, 1971 and Dietrichsen, 1973). These experiments, however, were confined to phosphorus and zinc.

The widespread occurrence of red leaf disease in cotton on these soils was attributed to a combined effect of soil compaction and an insufficient uptake of potassium (Van der Merwe, Britz & De Wet, 1969). Likewise,certain growth disorders of sultanas were attributed to soil compaction and potassium deficiency (Laker, 1970).

The report by Van der Merwe, Britz and De Wet (1969) dealt mainly with field observations and some analytical results of randomly taken leaf samples. There still existed a serious deficiency in our knowledge of the causes of red leaf disease, a possible relationship between potassium nutrition and this and other growth disorders as well as a possible link between soil compaction and insufficient potassium uptake.

Soil analysis, which serves a useful purpose in determining the nutrient status of a soil, is also used for predicting crop needs and expected yield. This is done by correlating soil analysis values with yield. In this process many soil and plant parameters are used.

Traditionally the potassium fraction extracted from soils by neutral normal ammonium acetate has been used to predict the relationship between soil potassium, plant growth and yield. Other methods, such as 0,1N HNO_3 extractable potassium (Ramanathan & Krishnamoorthy, 1981) have also been used. The Q/I concept as described by Beckett (1964a,b) and Laker (1970), is too tedious to be used as a routine laboratory method. Furthermore Ram & Prassad (1981) concluded that quantity/intensity parameters of potassium did not show any advantage over the commonly used neutral normal ammonium acetate for predicting plant available potassium in the soil.

In the potassium nutrition of plants there are several factors that should be taken into account :

1. The potassium requirements of the crop grown.
2. The ability of the soil to supply potassium to the growing crop.

The initial findings of Van der Merwe, Brits and De Wet, (1969) led to the present investigation to ascertain whether potassium application under controlled conditions could alleviate red leaf disease in affected cotton plants. In this investigation parameters other than NH_4Ac extractable potassium were tested as possible predictors of cotton yield. Because of the economic importance to find a reliable predictor of cotton yield for the Vaalharts situation, where the potassium supplying power of the soils to cotton is suspect, parameters for both topsoils and subsoils were tested. These included potassium adsorption ratio (P.A.R.), exchangeable potassium percentage (E.P.P.) (Ca+Mg)/K and leaf K content.

The initial findings in the glasshouse supported the suspicion that for the Mangano soils at least, other parameters than NH_4Ac extractable potassium should be considered in the potassium nutrition of cotton grown at Vaalharts.

In order to find an answer to the questions raised in the foregoing, it was decided to conduct a series of experiments with soils on which red leaf disease was known to occur. Firstly soil of the Mangano series from Kakamas was used in a pot experiment at Glen Agricultural Research Institute. In this experiment cotton plants, already affected by red leaf disease, were transplanted in pots containing the original soil on which they contracted the disease. The purpose of this was to find a possible cure by treatment with various nutrient combinations of which potassium was the major constituent under investigation.

The soil and its potassium status were extensively characterized by testing various soil parameters based on extraction of the cations with ammonium acetate. Using the results of the pot experiment, a number of field experiments were designed. These were spread along the entire extent of the Vaalharts irrigation scheme.

Samples from all fifteen field experiments, both topsoil and subsoil, were collected before treatment and after harvesting. Leaf samples and seed cotton yields were available for testing. This vast matrix of experimental data afforded a thorough statistical treatment, which could be used to draw reliable conclusions.

It is obvious that in seeking a more reliable parameter to predict cotton yield at Vaalharts, the widest possible range of soils regarding clay content and NH_4Ac extractable potassium should be included in the study. This was accomplished by selecting fifteen sites of which the soils varied in clay content from 8 - 14% in the surface layer and with a NH_4Ac extractable potassium content of 0,10 - 0,64 me/100g.

The large number of soil and leaf samples were analysed for most of the plant nutrients. Quality parameters for the cotton were also obtained and all the results were subjected to standard statistical analysis.

These results were followed by two further glass house investigations and a series of experiments to characterise the different potassium fractions in these soils, as well as potassium fixation.

CHAPTER 2

REVIEW OF LITERATURE

2.1 SOURCES AND FORMS OF POTASSIUM IN THE SOIL

Excluding the amounts of potassium added to a soil in fertlizers, the potassium contained in soils originates from the decomposition of rocks containing potassium bearing minerals. The primary minerals, generally considered to be sources of potassium are the potash feldspars, muscovite and biotite (Tisdale & Nelson, 1966). The potassium contained in these minerals is not directly available to plants, but only becomes available upon the decomposition of these minerals. Another primary source of soil potassium is the clay minerals, particularly those derived from micas. Potassium contained in clay minerals may be slowly released upon weathering (Russell, 1961).

On the basis of availability the various forms of potassium in soils can be classified into three general groups: 1) unavailable 2) slowly available and 3) readily available. Unavailable potassium includes potassium present in primary minerals as stated earlier. The slowly available potassium represents potassium in fixed positions on exchange materials and readily available potassium includes exchangeable potassium and potassium present in the soil solution. The equilibrium among the various forms of potassium present in a soil is of primary importance in the potassium utilization of plants (Buckman & Brady, 1969).

The equilibrium among the different forms of soil potassium and the availability of potassium to plants is influenced by such factors as pH, nature of cation exchangers in the soil, state of soil weathering, water content of the soil and soil temperature (Thomas & Hipp, 1968).

2.2 CHEMICAL FACTORS AFFECTING POTASSIUM AVAILABILITY

2.2.1 Nature of cation exchangers in soil.

2.2.1.1 Kinds of cation exchangers.

The materials responsible for the adsorption and exchanging of cations in soils include the clay minerals mica, montmorillonite and vermiculite which are composed of an octahedral hydroxide layer sandwiched between two tetrahedral oxide layers, and kaolinite and halloysite, which are composed of one octahedral and one tetrahedral layer. In addition organic matter is an important source of cation exchange capacity in soils.

The negative charge responsible for cation exchange, originates when a higher valence cation is substituted by a lower valence cation e.g. Al^{+3} for Si^{+4}. For a given clay mineral the amount of substitution is fairly constant and therefore the total negative charge is predictable. In micas and vermiculite formed from micas, a large part of the negative charge is balanced by potassium ions which form part of the mineral structure. Due to their position and/or the high affinity these potassium ions have for the clay surfaces, other cations do not exchange places with them readily. Only rigorous, long time exchange (Cook & Rich, 1963a) or precipitation of the replaced potassium (De Mumbrum, 1963) can completely remove it. A small amount of this difficultly exchangeable potassium is continually replaced by other cations.

This source of plant available potassium is found only in the micaceous clay minerals, including muscovite, biotite, illite, hydrobiotite and vermiculite. The clay minerals montmorillonite, kaolinite and halloysite do not contain difficultly exchangeable potassium. The result is that any soil which contains mica or mica products has a reserve supply of potassium which is not normally extracted by a salt solution. The importance of this reserve potassium is a function of the amount, stability and weathering state of the mica or micaceous minerals (Thomas & Hipp, 1968).

The cation exchange capacity of organic material arises from the carboxyl (60%) and phenolic (40%) groups (Broadbent & Bradfort, 1952, Schnitzer & Skinner, 1963). It seems that the carboxyl groups have an acid strength of acetic acid (pK 4-5) (Martin & Reeve, 1958), whereas the phenolic groups are considerably weaker (pK 8). The pK value is most conveniently regarded as the pH at which half of the sites are able to attract metallic cations. Because of the weak acid nature of the charge on organic matter, the effective cation exchange capacity is extremely sensitive to pH.

Weak acid sites, which give rise to cation exchange capacity, also exist in crystalline clays but they are not very important. In poorly crystalline clays (allophanes) the charge on the clay is truly weakly acid and pH dependent. These materials can have effective cation exchange capacities ranging from 100 to zero. Apparently this is due to a shift of aluminium in the lattice from a six co-ordinated to a four co-ordinated state, a kind of pH-induced isomorphous substitution (Thomas & Hipp, 1968).

The cation exchange capacities for some of the cation exchangers found in soils are presented in Table 2.1.

Table 2.1 CATION EXCHANGE CAPACITIES OF MATERIALS OCCURRING IN SOILS.

MATERIAL	C.E.C. meq/100g	LATTICE CHARGE meq/100g
Montmorillonite	100	100
Muscovite	20	250
Biotite	40	250
Vermiculite (Di- or Trioctahedral)	150	200
Kaolinite	5	5
Allophane	0-100	0
Organic matter	50-250	0

The total lattice charge is also given. "The difference between these two figures is a measure of the potassium which is not exchangeable by normal methods" (Thomas & Hipp, 1968).

2.2.1.2 Effect of site of charge and density of charge on potassium adsorption.

In the formation of clay minerals, substitution of one cation for another may occur in either the silicon - oxygen tetrahedral layer or the magnesium hydroxide octahedral layer. If the former is the case the location of the excess of negative charge will be closer to the point where the exchangeable cations are gathered. Coulomb's law states that the strength of electrostatic charge varies as the reciprocal of the squared distance between the charge and the ion. In tetrahedrally substituted clays, the distance between the charge and the cation is about half of that for octahedrally substituted clays. Therefore, the strength should be four times as great with tetrahedrally substituted clays.

Fink & Thomas (1964) showed that the observed differences in cation affinity between a clay substituted entirely in the octahedral layer (hectorite) and one substituted in both layers (Wyoming montmorillonite) are quite large. Clays substituted entirely in the tetrahedral layer have even higher affinities for cations. This has been shown by Barber & Marshall (1951) with beidellite.

When clay types are compared, the confounded nature of the location and amount of charge makes it extremely difficult to draw absolute conclusions about the effects of each. For example, micas are entirely substituted in the tetrahedral layer but they also have a larger amount of substitution than other clays. In the weathering of biotite the ferrous iron is oxidized to ferric iron and/or internal protonation occurs and the negative charge on the clay is reduced, usually from 250 m.e.q./100g to 200 m.e.q/100g or less (Jackson, 1964). Apparently weathering does not reduce the charge of muscovite as much (Cook & Rich, 1963b), but the negative sites tend to become neutralized with hydroxy aluminium ions. From the fast weathering rate of biotite as compared to muscovite (De Mumbrum, 1963, Mortland, Lawton & Uehave, 1958) it may be concluded that density of charge, strongly favours potassium retention by clays.

Tabikh, Barshad & Overstreet (1960) working with mineral specimens showed that this is also true in the case of montmorillonitic clays. According to Thomas & Hipp (1968), Knibbe (1968) proved this for montmorillonitic soil clays and showed that soil montmorillonites have a much higher affinity for potassium (compared to calcium) than does Wyoming bentonite. Knibbe (according to Thomas & Hipp, 1968) also found that the charge density was 50% higher in the soil clays than in the mineral specimen. "It can be concluded that for crystalline clays, the presence of a charge originating in the tetrahedral layer favours specific potassium adsorption" (Thomas & Hipp, 1968). It seems that the adsorption of potassium is also favoured by a high density of negative charge, presumably because the high charge favours a collapse of the clay lattice around the potassium ions, and because the high substitution results in the formation of voids in the clay surface so that potassium is likely to be trapped (Radoslovich & Norrish, 1962).

In the case of kaolinite and halloysite, it was observed by Andrew, Jackson & Wada (1960) that potassium salts can move in between layers of these clays, although this occurs much more easily in halloysite than in kaolinite. As far as can be observed the interlayer potassium in these cases is not held by negative charge and can easily be replaced by water (Thomas, 1960).

The affinity of organic matter for potassium is low compared to its affinity for calcium and magnesium. Field results with soils high in organic matter confirm the view that potassium is barely retained by the negative sites in organic matter (Mehlich, 1946).

2.2.2 Relationship between exchangeable and soil solution potassium and its significance.

The distribution of potassium between negatively charged sites on materials in the soil and the soil solution is a function of (i) the kinds and amounts of complementary cations, (ii) the anion concentration and (iii) the properties of the exchange materials in the soil.

Calcium is the major cation both in the soil solution and on exchange sites of exchange materials in the soil for most cultivated soils and therefore calcium - potassium equilibria in soils have been studied most often.

It was suggested by Schofield (1947) that the ratio of the activities of two cations like calcium and potassium was defined by the relation $K = [\,K\,]/\sqrt{[Ca]}$. When the amounts of cations in solution were negligible compared to those adsorbed by the soil, the above ratio was reported to be reasonably independent of dilution (Taylor, 1958).

It has been suggested by Woodruff (1955) that the relationship $[\,K\,]/\sqrt{[Ca]}$ could be used as an index of potassium availability in soils. A limited number of results by Woodruff & McIntosh (1960) and Ramamoorty & Paliwal (1965) suggested that the ratio law reflected the differences in affinities for potassium which were found in soils. Barber & Marshall (1951), Mehlich (1946) and Spencer (1954) all pointed out that the relative amount of potassium available for plant uptake from the soil solution was dependent on the type of cation exchanger in the soil.

Beckett (1964a,b) and Tinker (1964a,b) have suggested that the ratio $[\,K\,]/\sqrt{[Ca + Mg]}$ is related to the change in exchangeable potassium to obtain a more complete picture of the quantity (exchangaeble K) on the intensity $[\,K\,]/\sqrt{[Ca + Mg]}$. This is known as the quantity/intensity or Q/I relationship. The ratio Δ K exch./ $[\,K\,]/\sqrt{[Ca + Mg]}$ was found to be rather constant for a given soil regardless of potassium removed by plants, provided that the level of non - exchangeable potassium was not significantly changed (Beckett & Nafady, 1967).

Beckett (1964b) showed that for a group of English soils, with varying clay mineralogy, the Q/I relationship increased rather regularly with increased clay content. Apparently no relationship between clay mineralogy and Q/I was evident (Beckett, Craig, Nafady & Watson, 1966). Soils from Natal and Nigeria (35% and

65% clay) had much lower values of Q/I.

Contrary to the above Moss (1967) found that the Q/I relation was rather well related to the clay mineralogy of West Indian soils. Young micaceous soils showed the least changes in solution potassium, montmorillonitic soils were intermediate and kaolinitic soils were the least buffered against changes in solution potassium. "This last group of soils is probably similar to the soils of Nigeria and Natal ...." (Thomas & Hipp, 1968).

High Q/I values suggested that the availability of potassium will remain about the same over a long period of time. A low Q/I value indicates that frequent fertilization will be necessary. In either case the ratio $[K]/\sqrt{[Ca + Mg]}$ remains important because it is a measure of the relative activity of potassium in solution.

Nelson, Kunze & Godfrey (1960) found that for certain montmorillonitic soils of Texas the supply of exchangeable potassium (Q) is nearly inexhaustible and that Q/I is very high but the value of $[K]/\sqrt{[Ca + Mg]}$ (I) is too low to support optimum plant growth. Because the value of Q/I is so large, a great deal of potassium must be added to the soil to bring about any significant change.

On the other hand sandy soils, especially those in which organic matter contributes largely to the cation exchange capacity, have the opposite problem. Q/I is so low that the amount of potassium in the soil solution at a given time is virtually meaningless. Heavy rains or rapid plant growth can seriously deplete available potassium in a matter of days.

It appears that the relation between exchangeable potassium and the soil solution potassium is a good measure of the availability of the more labile potassium in soils to plants. However, Barber (1962) pointed out that diffusion is a large factor in potassium up- take by plants. On the other hand the total potassium that can diffuse through the soil solution is directly related to the proportion which is present in the soil solution at any given time. For that reason the "intensity" of potassium is of great importance in plant nutrition.

Mangano soils of the Free State region are known for their poor potassium nutrition (Laker 1970). In a very valuable investigation concerning cationic equilibria in soils Laker (1970) found that Beckett (1964a,b) erred in some of his conclusions. "The most significant errors were : (i) AR^k was used as the activity ratio of the soil solution, something for which only AR^k qualifies according to Beckett's (1964a,b) own definitions, and (ii) $-\Delta K$ was described as the exchangeable potassium content of the soil".

Laker (1970) however, concluded that the Q/I concept was a very valuable technique for determining the potassium supplying power of soils, "provided that it is used and developed correctly".

2.2.3 Salinity and alkalinity.

Sodium seems to play an important part in soil - plant relationships, especially in arid and semi-arid regions. This is not because of its nutritional effects but because of the effect of sodium on availability of other cations in the soil (Lunt, 1966).

"Sodium does not seem to be an essential element for any crop, even for salt marsh plants, yet certain crops undoubtedly grow better in the presence of available sodium supplies than in their absence, the sodium in these cases appearing to carry out some of the functions that potassium usually fulfills" (Russell, 1961).

In a water culture experiment Joham & Amin (1965) clearly illustrated this substitution effect mentioned by Russell (1961). The addition of sodium to potassium deficient treatments increased the boll weight of cotton equal to that of potassium supplied plants. It seems therefore, that when potassium is present in short supply, sodium can interfere with the uptake of available potassium. Heiman (1958) found that a large K/Na ratio in the soil was correlated to a large K/Na ratio in the leaves and _vice versa_.

2.3 CLAY MINERALOGY, STATE OF SOIL WEATHERING AND RELEASE OF POTASSIUM FROM THE NON-EXCHANGEABLE FORM.

In the potassium nutrition of plants for a single season or in some cases for several years, the equilibrium between exchangeable and soil solution potassium is of great importance. Over long periods of time the equilibrium between non-exchangeable and exchangeable potassium is even of greater importance for continued plant growth. The reactions between non-exchangeable and exchangeable potassium in soils probably received more attention than any other facet of potassium chemistry. "The results, taken as a whole, are utterly confusing" (Thomas & Hipp, 1968). This is probably due to the fact that most of the work was done on soils in which the clay mineralogy was inadequately characterised.

When knowledge of clay mineral characteristics is combined with equilibrium data, a fairly clear picture of potassium behaviour emerges. Extrapolation of these data to similar soils gives reasonable explanations for changes in soil potassium during plant growth.

Work on biotite and vermiculite by Mortland & Ellis (1959) and Mortland et al (1958) suggest that in virtually unweathered soils which contain large amounts of trioctahedral mica and its derivatives, release of soil potassium from non-exchangeable forms occurs almost as rapidly as potassium is taken up by plants.

When less trioctahedral and/or dioctahedral mica and montmorillonite are present in the soil, the release is appreciable, especially under intensive cropping, but the rate of release is inadequate to maintain the levels of exchangeable potassium for optimum plant growth over long periods of time.

There is some suggestion that a trioctahedral mica parent material and a soil with a low intensity of weathering favours release of sufficient potassium for crop needs. A dioctahedral mica parent material and/or a moderate state of weathering allow enough potassium release so that potassium fertilization requirements are significantly reduced (Milford & Jackson, 1966).

However, a low mica parent material and/or intensive weathering produce soils in which potassium requirements for plants must be met by applications of potassium fertilizers for the most part.

2.4 REPLACEABILITY OF POTASSIUM BY OTHER CATIONS.

The value obtained when exchangeable potassium is replaced by ammonium is only valid for a given set of circumstances.

This value is useful because it has been found to correlate well with potassium uptake by plants in a wide range of soils. However, this value does not always represent the amount of potassium exchanged under field conditions. From the literature, it seems that ammonium exchanges more potassium than most other cations from soils containing dioctahedral micaceous clays. In soils containing hydrobiotite and trioctahedral vermiculite, ammonium appears to replace potassium less efficiently than most other cations (Thomas & Hipp, 1968).

Jackson (1964) has shown that muscovite weathers to become an expanding clay from the edges inward. This mode of weathering produces many wedge-shaped zones in which potassium is tightly held and into which only potassium sized cations such as ammonium, hydronium and silver can enter. Mervin & Peach (1950), Rich (1964) and Rich & Black (1964) showed that cations such as calcium and magnesium cannot replace any of the potassium held in such positions. It has also been pointed out that in some soils, a very large proportion of the potassium exchangeable to ammonium is held in wedge - shaped voids so that virtually no potassium is released by any naturally occurring soil cations, except ammonium and hydronium. Murdoch & Rich (1965) showed that in a limed soil high in muscovite, containing very little hydronium and no ammonium, a severe deficiency of potassium occurred in oats.

Contrary to the weathering of muscovite, potassium is weathered out of biotite a whole layer at a time producing hydrobiotite (Rhoades & Coleman, 1967). When most of the potassium has gone, vermiculite forms. Due to nearly all the potassium being replaced by calcium and magnesium there are fewer wedgeshaped zones and most of the potassium exists in fully expanded layers. When ammonium is added to such a clay it tends to clamp down the edges (Barshad, 1948), trapping the cations present between the layers. Almost exactly the opposite occurs in muscovite clays.

Potassium exchange in trioctahedral mica derivatives is brought about by cations which keep the lattice expanded. Therefore, in these clays calcium and magnesium are superior replacers of potassium.

2.5 EFFECTS OF SOIL REACTION ON POTASSIUM AVAILABILITY.

2.5.1 Effect of pH on potassium fixation.

Volk (1934) observed a marked increase in potassium fixation in soils where the pH was increased to about 9 or 10 with sodium carbonate. Martin, Overstreet & Hoagland (1946) found that up to pH 2,5 there was essentially no fixation and that between pH 2,5 and 5,5 the amount of potassium fixation increased very rapidly. Above pH 5,5 the amount of potassium fixation increased more slowly. Increase in potassium fixation between pH 5,5 and 7,0 is probably due to a decrease in the number of hydroxy aluminium polymer cations which can effectively block collapse of the clay (Rich, 1960). At very low pH, the lack of fixation is probably due to large numbers of hydronium ions and their ability to replace potassium effectively (Rich, 1964).

2.5.2 Effect of pH on potassium availability.

Much controversy surrounds the effect of calcium on potassium in soil solution. It seems likely that the addition of calcium to a soil will replace potassium, but in practice, it has been found that liming a soil reduces the amount of potassium in the soil solution (Peach & Bradfield, 1943). When a soluble calcium salt is added to a soil, all the cations in the soil are replaced to some extent, consequently potassium in the soil solution will increase. However, when an acid soil is limed the exchangeable aluminium is precipitated by the hydroxide ions formed. In addition the hydroxyaluminium cations are progressively "hydroxylated" by the lime until they have no charge. It seems therefore that the addition of calcium carbonate removes the trivalent ions from competing with potassium and it frees blocked sites and potassium can compete with calcium for these sites. The combination of these effects apparently increases the potassium held by the clay and decreases the amount of potassium in the soil solution (Thomas & Hipp, 1968).

It has also been found that potassium leaching is a much less serious problem in limed soils than in acid soils (Baver, 1943; Thomas & Coleman, 1959).

"In a practical way it will always be found that liming a very acid soil to a pH of 6, will increase potassium uptake by plants. Liming a soil having a pH of 6 to a pH of 7,5 generally will decrease the potassium uptake by plants" (Thomas & Hipp, 1968).

2.6 PHYSICAL FACTORS AFFECTING POTASSIUM AVAILABILITY

2.6.1 Water content of the soil.

2.6.1.1 Effect of water content on the ratio of cations in the soil solution.

Because modern laboratory methods have made analysis of small samples of low concentration possible, the effect of soil solution on plant nutrition has received much attention. This resulted in increased interest in the proper ratios and concentrations of cations in solution for optimum plant growth.

As far as potassium is concerned the ratio $[\ K\ ] / \sqrt{[Ca + Mg]}$ has received particular attention. When a soil is wetted the concentration of ions in the soil solution decreases because of a dilution effect, but a net adsorption of divalent cations and exchange of monovalent cations occur because the above ratio tends to remain constant. This is a well known dilution effect (Wiklander, 1964). As the soil moisture is reduced the concentration of calcium, magnesium and potassium increases, but the concentration of calcium and magnesium increases faster than does the concentration of potassium. This results in a decreasing value of $[\ K\ ]/\sqrt{[Ca + Mg]}$ with increasing soil moisture tension. The increase of soil moisture tension and resulting decrease in $[\ K\ ]/\sqrt{[Ca + Mg]}$ was directly related to the $[\ K\ ]/\sqrt{[Ca + Mg]}$ ratio in plants in a study by Moss (1963).

2.6.1.2 The effect of water on potassium diffusion coefficients.

There may be enough potassium present in a soil, but there is no assurance that plant roots will be able to utilize it. It was calculated by Barber (1962) that potassium in solution was inadequate to account for the amount of potassium present in growing plants. He suggested that the rate of diffusion in the soil was a limiting factor in potassium uptake by plants. Because of the short life of potassium - 42, most investigations on diffusion of potassium have been conducted using rubidium - 86. Fried, Hawkes & Mackie (1959) have indicated that rubidium is a good indicator of potassium behaviour in certain instances.

Place & Barber (1964) showed that the rate of rubidium - 86 diffusion could be increased by increasing soil moisture and that increased diffusion resulted in increased rubidium uptake by plants. An r^2 value of 0,987 was obtained between self diffusion and plant uptake. Working in a glassbead system Klute & Letey (1958) showed that diffusion coefficients of rubidium - 86 decreased considerably as moisture content decreased.

It is evident that increased soil moisture content results in increased diffusion as well as increased uptake of potassium. It is not very clear, however, whether the increased uptake is caused by increased diffusion rate.

2.6.1.3 Release and fixation of exchangeable potassium as affected by water.

Brown (1953) demonstrated the influence of soil moisture on the exchange of potassium in several soils. This work was carried out in the range field capacity to wilting point. He found that as soil moisture was increased, more potassium was exchanged from the soil to hydrogen saturated resin but that the effect of moisture varied with different soils.

Scott & Smith (1957) found that the exchangeable potassium in the surface and subsoil of Iowa soils was doubled upon drying and that potassium uptake by plants was always less on continually moist soil than from a soil that had been dried. However, Leubs, Stanford & Scott (1956) showed that under field conditions the change in exchangeable potassium due to changes in soil moisture was limited to the surface inch of soil. Van der Paauw (1962) has suggested that exchangeable potassium levels fluctuate depending on rainfall distribution, and that wet periods result in a decrease in exchangeable potassium. Attoe (1946) showed that the increase in exchangeable potassium levels upon drying varied from 4 - 90% over moist soil. Ganje & Page (1970) found that soils containing vermiculite and hydrobiotite have an average wet fixation capacity of 4,9 me/100g. Because the normal application rate for these soils was 560kg actual K per hectare 15cm, no response to K fertilization was obtained where K deficiencies occurred in plants grown on these soils. An average application of 4250kg K per hectare is required to satisfy the fixing capacity of these soils to a depth of 15cm.

Under humid conditions less potassium was extracted by Scott & Hanway (1960) from Marshall subsoil samples than at low humidity. Attoe (1946) showed that more of the applied potassium was fixed as moisture content decreased.

2.6.1.4 Influence of soil moisture on potassium nutrition of plants.

The ultimate goal of studies involving soil potassium is the precise prediction of potassium uptake by plants. Because plants and soils are so variable and the factors governing potassium uptake are so inter - dependent, there seems to be disagreement on the influence of soil moisture on potassium uptake. The general trend, however, is an increase in potassium uptake by plants as soil moisture increases.

2.7 OXYGEN CONTENT OF THE SOIL

The relationship between the availability of potassium to plants and soil aeration seems to be one which involves the ability of the plant to utilize potassium under certain levels of soil oxygen. A great deal of work has been done to relate the uptake of soil potassium to the rate of oxygen diffusion in soils. Methods of measuring oxygen diffusion by the platinum electrode method have been well developed.

The general trend indicates that as aeration is decreased the uptake of potassium is decreased (Thomas & Hipp, 1968).

A decrease in soil oxygen supply in the field is associated with an increase in carbon dioxide concentration of the soil atmosphere.

Harris & van Bavel (1957) studied tobacco plants in sand culture with the root zone subjected to variations in O_2 and CO_2. Decreasing oxygen and increasing carbon - dioxide resulted in decreased potassium uptake by tobacco plants, but no serious potassium decrease occurred until the O_2 level was below 10%. Letey, Stolzy, Blank & Lunt (1961) found that potassium uptake by cotton was little influenced after the surrounding air reached 7% O_2.

Soil compaction has an obvious influence on aeration and Phillips & Kirkham (1962) have shown that tractor traffic can reduce total potassium in maize leaves at indigenous levels of potassium as well as with added fertilizer. Lawton (1945) increased the potassium content of maize growing on high moisture soils merely by forcing air through the soil.

2.8 TEMPERATURE EFFECTS

2.8.1 The effect of temperature on potassium equilibrium shifts.

An increase in temperature increases the rate of chemical reactions. If applied to soil conditions it would be expected that if temperature rises the rate of cation exchange would increase, which in turn would increase the amount of potassium absorbed by plant roots, providing the reactions of potassium in the soil are a major factor in potassium absorption by plants.

Woodruff's (1955) equation $F = RT \ln [K]/\sqrt{[Ca]}$ infers temperature dependence of the $[K]/\sqrt{[Ca]}$ ratio in the soil solution as long as F remains constant for a given soil.

The rate of release of non-exchangeable potassium has been found to be temperature dependent by Haagsma & Millar (1963). They found that release of non - exchangeable potassium to a cation exchange resin increased with increasing temperature.

2.8.2 The effect of temperature on plant uptake of potassium.

In considerations regarding potassium availability and soil temperature, a factor that must not be overlooked is the increased metabolic activity of plant roots as a result of increased soil temperature.

Martin & Wilcox (1963) studied the influence of temperature on two varieties of tomatoes and found that percent potassium in the plants increased markedly when the soil temperature was increased from 13,3°C to 21°C with low rates of phosphorus, but the temperature effects on potassium content were not as great when high rates of phosphorus were used. Nielson _et al_ (1960) found that potassium uptake by oats in temperature controlled soils was increased with increases in the soil temperature from 5°C to 19,4°C.

It appears that potassium uptake by plants increases up to some optimum temperature, specific for a given plant. At higher temperatures some internal damage to the plant's absorption mechanism occurs (Thomas & Hipp, 1968).

2.9 SOIL STRENGTH AND COMPACTION

The adverse effect of soil strength and compaction on root development has been clearly illustrated by several workers. Because potassium uptake is a function of root development it is clear that soil strength and compaction will affect potassium uptake.

"Soils resist the local deformation caused by roots, and as there is a definite upper limit to the pressure which can be excerted by roots of a given species, growth may be prevented if the strength of the soil is sufficiently large. Moreover, there is a continuous decrease in root elongation as mechanical resistance rises to the level required to prevent further growth" (Barley, 1963).

Murty (1964) investigated the influence of compaction on nutrient uptake by plants. The potassium content of the plants increased with increasing compaction when potassium was present in adequate supply. When potassium was present in short supply the potassium content of the plants decreased with increasing compaction.

Bennie (1979) showed that potassium uptake by cotton was adversely affected by soil compaction.

Perrigaud (1966) found an increase of 10 - 15% N in plants with increasing compaction and a decrease of 15 - 37% in potassium which was accompanied by an increase in calcium in the roots.

It is evident that soil compaction and soil strength together with soil temperature, aeration and moisture should be considered when potassium uptake by plants is evaluated.

CHAPTER 3

POT EXPERIMENT

During an investigation by Van der Merwe, Brits and De Wet (1969) it was pointed out that potassium deficiency occurred in cotton plants affected by red leaf ("Rooidood") disease. It was also pointed out that potassium deficiency in combination with other elements was a major factor in causing the disease. It was decided to investigate these initial findings under controlled conditions in the glass house.

The purpose of this experiment was to treat red leaf affected cotton plants with various fertilizer combinations to evaluate possible alleviation of the symptoms by any one combination. It was therefore decided to select cotton plants affected with red leaf disease and to transport these plants with the soil, in which they contracted the disease originally, to Glen.

3.1 PROCEDURE

A site near Kakamas was selected for this purpose. The soil was from an old lucerne field and represented the Mangano series of the Hutton form. As is the practice in the Kakamas area this field had not received any fertilizer.

In March 1971 red leaf affected plants were dug out and replanted in Mitscherlich pots with the least disturbance of roots and soil. The pots were wetted with canal water and transported to Glen.

After cutting back the plants the following treatments were applied:

1. Control (no fertilization)
2. N, P, Zn
3. N, P, K, Zn
4. N, P, Mg, Zn
5. Spoorspray*,N, P
6. Spoorspray, N, P, K
7. Spoorspray, N, P, Na (as $NaNO_3$)
8. Spoorspray
9. N, P, K

The abovementioned treatments were applied at the following levels:-

a) N as 159 kg/ha urea
b) P as 424 kg/ha superphosphate
c) Zn as 16 kg/ha zinc sulphate
d) K as 530 kg/ha potassium sulphate
e) Mg as 530 kg/ha magnesium sulphate
f) Na as 530 kg/ha sodium nitrate

g) Spoorspray: Plants were sprayed at weekly intervals at the prescribed dosage

* Spoorspray is a registered proprietary product containing a balanced mixture of micronutrients.

Each treatment was replicated five times with one plant per pot. Insect control was applied rigorously. The soil was kept at field capacity. After the plants were harvested, leaf samples collected and soil samples collected, the plants were cut off and allowed to regrow in order to obtain a second harvest. During October 1971 some of the treatments were altered. Due to excessive amounts of micronutrients in the soil, spraying with Spoorspray was stopped. The application of potassiumsulphate was increased to 3180kg/ha while the superphosphate application was increased to 1272kg/ha.

3.2 RESULTS AND DISCUSSION

3.2.1 Leaf symptoms.

Symptoms similar to those associated with red leaf disease were observed on all the plants and no visual difference between treatments could be ascertained. It was concluded that once cotton plants were affected by red leaf disease no combination of fertilizer treatment could alleviate the symptoms.

3.2.2 Soil analysis.

In Table 3.1 general analytical data, from a composite soil sample, collected before any treatment was applied, are presented. Phosphate, potassium and zinc contents appears to be low. Chemical data for the soils are presented in Table 3.2. Phosphate contents were increased three to five fold by the application of 1272kg/ha superphosphate (Table 3.2).

Table 3.1 Chemical data for soil used in pot experiment.

VARIABLE	VALUE
pH ($CaCl_2$)	7,4
mS/m 25°C	83
S.A.R.	2,69
Ca mg/kg (exchangeable)	2880
Mg mg/kg (exchangeable)	484
K mg/kg (exchangeable)	95
(Ca + Mg)/K me/100g	75,1
E.P.P.	1,73
P mg/kg (Olsen)	4
Zn mg/kg (0,1NHCl)	1,2
C.E.C. me/100g	13,9

Table 3.2 Chemical data for soils after the first and second cycles
(Averages for treatments)

TREATMENTS	pH $CaCl_2$	$\frac{Ca+Mg}{K}$	me/ 100g	E.P.P.		C.E.C		Ca mg/kg		Mg mg/kg.		K mg/kg		P mg/kg		Zn mg/kg		Cu mg/kg	Fe mg/kg
Cycle	11	1	11	1	11	1	11	1	11	1	11	1	11	1	11	1	11	11	11
1. Control	7,9	72,6	95,0	1,5	1,4	16,8	17,9	2425	2970	690	715	99	89	0,9	5,7	2,9	3,9	3,9	7,5
2. N.P. Zn	7,7	59,6	79,0	1,7	1,4	17,1	17,9	2215	2690	615	670	110	94	1,2	18,5	4,5	4,3	3,2	9,9
3. N.P.K. Zn	7,7	71,0	26,0	1,7	4,9	16,1	16,9	2665	2950	730	675	109	310	0,9	19,6	3,5	5,6	3,4	7,7
4. N.P. Mg Zn	7,8	74,0	89,3	1,5	1,4	17,6	16,9	2530	2890	725	735	101	93	0,9	21,9	5,8	4,1	3,4	8,0
5. N.P. Spoorspray	7,7	72,0	88,0	1,5	1,4	16,9	16,9	2390	2760	700	675	99	89	0,9	24,9	32,2	22,1	8,3	10,6
6. N.P.K. Spoorspray	7,8	62,4	24,0	1,9	5,3	16,3	16,9	2480	2880	760	730	120	335	0,9	23,2	24,3	12,9	5,2	9,0
7. N.P. Na Spoorspray	7,8	76,6	94,0	1,5	1,4	16,2	16,9	2480	3130	725	720	96	91	0,9	25,4	29,6	18,4	6,1	6,7
8. Spoorspray	7,9	71,4	92,0	1,6	1,4	16,7	16,4	2430	2880	730	705	103	89	0,9	4,8	30,4	17,3	7,2	9,0
9. N.P.K.	7,8	66,4	22,0	1,8	5,7	15,7	13,3	2430	2770	735	670	110	350	0,9	23,4	5,8	5,7	3,9	8,3

The application of 530kg/ha potassium sulphate apparently had no effect on exchangeable potassium content. The application of 3180kg/ha potassium sulphate, however, increased the exchangeable potassium content considerably (Table 3.2).

Ammonium acetate extractable potassium was not significantly correlated with yield (Table 3.3). However, (Ca+Mg)/K was significantly correlated with yield at both 1 and 5% levels (r=0,701**; Table 3.3). Exchangeable potassium percentage (E.P.P.) was also significantly correlated with yield at the 5% level (r=0,592*; Table 3.3).

Table 3.3 The relationships pertaining to soil and crop data for the second crop.

RELATIONSHIP	CORRELATION COEFFICIENT
NH_4Ac K in soil vs yield	0,488 ^{ns}
(Ca+Mg)/K in soil vs yield	0,7013**
E.P.P. vs yield	0,592 *

Table 3.3 (continued)....

RELATIONSHIP	CORRELATION COEFFICIENT
K uptake vs yield	0,597 *
NH_4Ac K vs K-uptake	0,832 **
E.P.P. vs K-uptake	0,835 **
NH_4Ac K vs (Ca+Mg)/K in leaves	0,928 **
E.P.P. vs (Ca+Mg)/K in leaves	0,933 **
(Ca+Mg)/K leaves vs yield	0,230

3.2.3 Leaf analysis.

Analytical data for the cotton leaves of the two crops are presented in Table 3.4. According to the criteria of Van der Merwe, Brits & De Wet (1969) the potassium content of the leaves of the first crop was low, even for treatments where potassium was included. The large applications of potassium for the second crop, however, increased the potassium content considerably (treatments 3, 6 & 9). Potassium uptake for the second

Table 3.4 Chemical Analysis for leafblades and petioles for the two cycles
(Averages for treatments)

TREATMENT	Ca%		Mg%		K%		Na%		S%		P%		N%		$\frac{K}{Mg}$		$\frac{Ca}{K + Na}$		$\frac{Ca}{Mg}$	
	1	11	1	11	1	11	1	11	1	11	1	11	1	11	1	11	1	11	1	11
1. Control	5,19	7,05	1,98	2,07	0,57	0,54	0,48	0,32	0,43	0,013	0,18	0,14	1,86	1,20	0,29	0,26	4,94	8,20	2,62	3,41
2. N.P. Zn	5,46	5,60	1,89	2,04	0,74	0,34	0,34	0,39	0,40	0,013	0,24	0,52	1,89	1,47	0,39	0,17	5,06	7,67	2,89	2,75
3. N.P.K. Zn	5,00	4,37	1,81	1,06	0,64	1,55	0,37	0,32	0,85	1,41	0,19	0,26	1,68	1,28	0,35	1,46	4,95	2,34	2,76	4,12
4. N.P. Mg Zn	5,64	6,40	2,09	2,56	0,48	0,32	0,36	0,42	0,86	0,91	0,20	0,49	1,68	1,38	0,23	0,13	6,71	8,65	2,70	2,50
5. N.P. Spoorspray	5,33	5,76	2,01	2,59	0,40	0,49	0,48	0,58	1,37	0,013	0,26	0,55	2,20	1,46	0,20	0,19	6,06	5,38	2,65	2,22
6. N.P.K. Spoorspray	5,09	4,19	1,94	1,07	0,86	1,48	0,36	0,23	1,31	1,45	0,25	0,33	2,06	1,51	0,44	1,38	4,17	2,45	2,62	3,92
7. N.P. Na Spoorspray	5,20	5,51	2,04	2,78	0,68	0,34	0,37	0,63	1,28	0,013	0,24	0,42	2,54	1,86	0,33	0,12	4,95	5,68	2,55	1,98
8. Spoorspray	5,18	6,67	1,61	2,27	0,61	0,46	0,36	0,43	1,27	0,52	0,25	0,17	2,13	1,48	0,38	0,20	5,34	7,49	3,22	2,94
9. N.P.K.	5,20	4,31	3,60	1,28	0,52	1,69	0,35	0,33	1,26	1,38	0,20	0,31	1,83	1,40	0,14	1,32	5,98	2,13	1,44	3,37

crop was highly significantly correlated with ammonium acetate extractable potassium in the soil (r=0,832**), as well as with E.P.P. (r=0,835**), (Table 3.3). The correlation coefficient for potassium content versus yield was r=0,597*, significant at the 5% level (Table 3.3).

NH_4Ac potassium was also significantly correlated with (Ca+Mg)/K in leaves (r = 0,928**) while E.P.P. versus (Ca+Mg)/K in the leaves gave a correlation coefficient of (r=0,933**), (Table 3.3).

No significant relationship between (Ca+Mg)/K in the leaves and yield could be found ($r=0,230^{ns}$), (Table 3.3).

3.2.4 Yield.

The yields obtained from the various treatments for the two cycles are summerized in Table 3.5

It is evident that N, P and K fertilizer in some kind of combination at least is required for optimum yield (Table 3.5).

Table 3.5 Yield for two cycles in gram seed cotton per pot.

TREATMENT		CYCLE 1	CYCLE 2
1.	Control	12,50	10,96
2.	N.P. + Zn	29,23	17,88
3.	N.P.K. + Zn	22,76	16,83
4.	N.P. Mg + Zn	27,28	16,97
5.	N.P. + Spoorspray	21,24	11,59
6.	N.P.K. + Spoorspray	21,02	19,80
7.	N.P.Na + Spoorspray	20,36	18,21
8.	Spoorspray	19,35	11,85
9.	N.P.K.	25,75	19,38
L S D (TUKEY 0,5)		12,82	8,41
TREATMENTS		2,4,9 > 1	6,9 > 1 6 > 8,5 9 > 5

3.3 DISCUSSION AND CONCLUSIONS

Soil tests serve a useful purpose as an indication of the nutrient status of the soil. The evaluation of soil test criteria is commonly based on the practical yardstick of crop yield. The ultimate idea being to provide a guide for soil fertility management using experimentally determined relationships between nutrient levels in the soil and plant growth. It is necessary, for advisory purposes, to establish the relationship between soil test values and yield.

Although the purpose of this experiment was to find a relationship between red leaf disease and fertility status of the soil it also served to confirm the suspicion that ammonium acetate extractable potassium alone is not a reliable criterion for predicting yield responses ($r=0,488^{ns}$). On the other hand the ratio (Ca+Mg)/K was highly significantly correlated with yield ($r=0,7013^{**}$). E.P.P. was also significantly correlated with yield ($r=0,592^{*}$).

In view of these results it was decided to test these criteria under field conditions. Subsequently it was decided to lay down fifteen field trials at Vaalharts. The results of these experiments are discussed in the following chapters.

CHAPTER 4

FIELD EXPERIMENTS

4.1 GENERAL

The Vaalharts Irrigation Scheme is the largest irrigation scheme in the Rebuplic of South Africa and covers 35 897 ha.

Vaalharts is situated at 20° 57 southern latitude and 24° 50 eastern longitude at 1175 meters above sea level. Rainfall varies markedly from 250mm to 625mm per annum with an average over the period 1938 to 1967 of 427mm per annum. Precipitation occurs mainly in the form of showers during the summer months. Maximum temperatures above 37°C is the exception but average summer temperatures above 32°C are quite common. Frost occurs as early as April and as late as October. Strong westerly, north-westerly and southerly winds are common during the months August to January.

Soils under irrigation are predominantly of the Hutton form. These red soils are of a sandy nature with a variation of 6 - 15% in clay content. According to sandgrade these soils are subdivided within the limits of 6 - 15% clay content into the Mangano series which is a fine sand and the Zwartfontein series which is a medium sand. It is expected that some of these soils, especially in the vacinity of Ventersdorp lawa outcrops, may have a clay content exceeding 15% which will then fall into the Shorrocks series of the Hutton form.

4.2 EXPERIMENTAL METHODOLOGY

Fifteen co-operative trials, with cotton as test crop, were conducted on various farms at Vaalharts. Various levels of potassium application as well as basic dresings of phosphorus, nitrogen and zinc were included.

4.3 EXPERIMENTAL TECHNIQUE

4.3.1 Experimental design.

A randomised block design with four replications was used.

4.3.2 Treatments.

A basic treatment of 815kg/ha superphosphate, 815kg/ha ammonium sulphate and 6kg/ha zinc fertilizer was applied. The phosphorus application was split into two, half of which was applied at 45cm depth and the other half was broadcast at seedbed preparation. The nitrogen application was also split into two, with half the amount applied at planting and the other half six weeks later.

Potassium applications included the following levels: 0, 265, 530, 795 and 1060 kg KCl/ha. In the following chapters and in the Appendices these application levels are designated as treatment numbers 1, 2, 3, 4 and 5. Irrigation, planting and spraying followed normal farming practices.

4.4 DATA COLLECTED

4.4.1 Soil samples.

Representative topsoil (0-30cm) and subsoil samples (30-60cm) were collected from each experimental site before any treatment was applied. Topsoil and subsoil samples were collected in the same way from each treatment and replicate plot. These were analysed for Na, Ca, Mg, K (water soluble plus exchangeable), P, Zn, Cu, C.E.C., pH, S-value, texture, conductivity and S.A.R. of saturation extract.

4.4.2 Leaf samples.

Leaf samples of each treatment were collected at 130 days after planting and analysed for Na, Ca,Mg, K, P, Zn, Fe, Cu and Mn.

4.4.3 Yield samples.

The yield of each treatment and replication was determined separately.

4.4.4 Quality test samples.

Seed cotton samples were collected from each treatment and was submitted to quality tests, including micronaire values and fibre percentage.

4.4.5 Statistical procedures.

Normal analysis of variance procedures were carried out as well as correlation studies between potassium applied, potassium in the soil, leaf potassium and yield.

4.5 ANALYTICAL PROCEDURES

4.5.1 Soils.

Exchangeable Na, K, Mg and Ca were extracted with 1N

NH_4Ac (pH7) and determined by atomic absorption and flame photometer techniques.

Phosphorus was extracted according to the method of Olsen _et al_ (1954) and determined colorimetrically according to the method of Fogg & Wilkinson (1958). Cu and Zn were extracted according to the 0,1 N HCl method as described by Stanton (1964) and determined by atomic absorption. Manganese was extracted according to the method described by Adams (1965).

pH was determined in a 1:2,5 soil : water suspension with a glass electrode.

S.A.R. and electrical conductivity were determined according to the method described by the United States Salinity Laboratory Staff (1954).

The sodium saturation method as described by the United States Salinity Laboratory Staff (1954) was used to determine C.E.C. Texture was determined by the hydrometer method of Day (1956) as modified by Van der Watt (1966).

4.5.2 Plant material.

Plant material was dryashed at 475°C and the ash was taken up in 1:3 HCl after silica was removed by denydration and precipitation. Ca, Mg, Na, K, Zn, Cu, Fe and Mn in the extracts were determined as described under soils.

4.6 DESCRIPTION OF SOILS

General analytical data and chemical analysis for the fifteen trial sites are presented in Appendices 1-4. These values describe the chemical and physical status of the soils before any treatment was applied.

These soils are all representative of the Hutton form. It is evident that 14 of the profiles were from the Mangano series with a B horizon clay content of 6 - 15% and a fine sand fraction of 76%. One profile viz. 3M11 is representative of the Shorrocks series with a B horizon clay content of 15 - 35% and fine sand fraction of 61,7%.

Clay contents vary from 8% to 16% in the topsoils and from 8% to 22% in the subsoils (Appendices 1 and 2).

Van der Merwe (1973) reported a highly significant correlation coefficient between % clay and % montmorillonite (r=0,746**) for soils from the Mangano series. It is also reported that 56% of the clay fraction of these soils consists of montmorillonite, the balance being vermiculite (Van der Merwe, 1973).

pH(H_2O) values are very near to neutral in both topsoils and subsoils (Appendices 1 and 2). The pH($CaCl_2$) emphasizes the near neutral character and low buffer capacity of these soils.

Exchangeable and water soluble cations are of the magnitude expected for these sandy soils. Botha (1971) reported average values for comparable virgin soils of 2,47 me/100g calcium, and 2,09 me/100g magnesium. It is interesting to note that in some of the topsoils the potassium content is higher than in the subsoils viz. trial 4B4, 4C5, 6L8, 7Q1, 3M11, Osblok, Skaapblok, 24D10 and 5C5 (Appendices 3 and 4).

Only in the case of trial 6L8 does the topsoil contain more clay (10%) than the subsoil (8%). There are three soils with 10% clay in the topsoil viz. 1B2, 6L8 and 6Q1. However, the soil in trial 1B2 has a much higher C.E.C. than the other two soils indicating a difference in clay type present in the soil. Calcium and magnesium constitute the greater part of the exchangeable cations (Appendices 3 and 4). It is known that excessively high concentrations of calcium and magnesium have a limiting influence on the availability of potassium, especially when the latter is in short supply (Ulrich & Ohki, 1966). However, it is not expected that the calcium and magnesium concentrations, compared to potassium will limit potassium uptake. In the case of trial 1B2 initial potassium is very low with a value of 0,10 me/100g and a (Ca+Mg)/K ratio of 94 in the topsoil (Appendix 3).

Phosphate contents of the topsoils are generally of a satisfactory level except in the case of trial 4C5 (0 mg/kg) and trial 7Q1 (2 mg/kg). Adequate phosphate fertilization was however, applied when the trials were subsequently laid down (section 3.2.2). Although quite a number of zero phosphate values were recorded for subsoils (Appendix 4) some extremely high values, viz. trial 1R1, 3K9 and 24D10, were recorded suggesting some form of previous deep placement of phosphates.

Zinc deficiency was reported by Viets, Boawn and Crawford (1954) for various field crops grown in soils with 0,1N HCl extractable zinc contents of 0,80 mg/kg to 1,3 mg/kg. Wear and Sommer (1948) found soils with a 0,1N HCl extractable zinc content of 0,50 to 0,90 mg/kg to be deficient. The zinc contents of the soils (Appendices 3 and 4) suggest and adequate supply, although a standard zinc dressing was included when the trials were laid down (section 3.2.2).

CHAPTER 5

EFFECT OF FERTILIZATION ON SOIL FERTILITY PARAMETERS

5.1 AMMONIUM ACETATE EXTRACTABLE POTASSIUM (WATERSOLUBLE PLUS EXCHANGEABLE)

The soils included in the trials represent a wide range of ammonium acetate extractable potassium, 0,10 me/100g - 0,64 me/100g (Appendix 3).

When the zero treatment is compared with the highest treatment of potassium application (Appendix 5) it is seen that the ammonium acetate extractable potassium contents of the topsoils increased in all the trials except in 5C5 and 7Q1 (Table 5.1). No explanation for this is offered here. The application of potassium fertilizers to these soils are thus generally capable of increasing the ammonium acetate extractable potassium content of the topsoils (Table 5.1). In the case of the subsoils no clear picture emerges. Some trials show an increase in potassium content in the subsoils (Appendix 6), suggesting some downward movement of potassium.

Table 5.1 K_5 - K_1 Values for Various Potassium Parameters (Topsoils)

TRIAL NO.	ΔNH_4AC-K me/100g	ΔWater Soluble K me/100g	ΔExch. K me/100g	$\Delta\frac{Ca+Mg}{K}$	ΔE.P.P.	ΔP.A.R.	ΔLeaf K Content
1B2	+0,13	+0,003	+0,13	-1,9	+3,1	+0,48	+2,76
1R1	+0,15	+0,005	+0,13	-5,1	+3,5	+0,62	-3,09
2A5	+0,10	+0,008	+0,10	-5,1	+1,5	+0,27	+8,63
3K9	+0,03	+0,007	+0,03	-1,1	+2,0	+0,27	+0,65
4B4	+0,15	+0,020	+0,13	-4,3	+3,3	+0,53	+8,42
4C5	+0,19	+0,013	+0,18	-7,6	+4,2	+0,86	+14,11
6L8	+0,17	+0,018	+0,16	-3,3	+3,0	+0,84	+4,17
6Q1	+0,15	+0,003	+0,15	-3,7	+2,7	+0,32	+1,08
7Q1	0	+0,010	0	-0,6	+0,1	+0,01	-2,15
3M11	+0,18	+0,005	+0,17	-6,4	+1,7	+0,15	-0,25
OSBLOK	+0,14	0	+0,03	-1,1	+1,2	+0,14	-1,05
SKAAPBLOK	+0,15	+0,003	+0,15	-10,4	+3,8	+0,40	+8,92
4Q4	+0,12	+0,008	+0,11	-3,8	+3,5	+0,53	-0,10
23D10	+0,10	+0,007	+0,10	-2,6	+2,0	+0,33	+1,24
5C5	0	0	0	-3,1	+0,1	+0,06	+1,82

5.2 WATERSOLUBLE POTASSIUM (me/100g)

Burger (1955) defined water soluble potassium as that amount which occurs in soluble form under field conditions and which is relatively unbound by cation exchange sites. It occurs in the soil solution and is in equilibrium with the exchangeable K.

When the water soluble potassium contents, expressed as me/100g soil are considered, it is evident that very small changes, or no change at all, were brought about by potassium application to the topsoil (Table 5.1, Appendix 7). Likewise the subsoils were unaffected (Table 5.1, Appendix 8).

5.3 EXCHANGEABLE POTASSIUM

Exchangeable potassium was calculated by subtracting water soluble potassium (me/100g) from exchangeable plus water soluble potassium (ammonium acetate extractable potassium) (me/100g).

The values obtained (Appendices 5 and 9, Table 5.1) are of the same magnitude as obtained for ammonium acetate extractable potassium. This suggests that when potassium fertilizers are applied to these soils water soluble potassium is little affected, but that the exchangeable potassium is increased.

Once again trials 7Q1 and 5C5 show no change in exchangeable potassium when the zero treatment is compared to the highest level of application (Table 5.1). It is known that drying, cropping and mineralogy can affect added potassium. The results obtained for subsoils (Appendix 10), showed that applied potassium moves very little if at all during one cropping season.

5.4 RATIO OF Ca + Mg to K

When adding potassium to soils it can be expected that a decrease in the ratio (Ca + Mg)/K would result. Although only small changes were recorded for some soils (Appendix 11, Table 5.1), it is evident that this ratio for the topsoils was markedly reduced, generally.

The subsoils of some trials also showed a decrease in the (Ca + Mg)/K ratio, viz. 1R1 and 4C5. This suggests some downward movement of potassium (Appendix 12).

5.5 EXCHANGEABLE POTASSIUM PERCENTAGE (E.P.P.)

Applied potassium affected the E.P.P. in an opposite manner to the (Ca + Mg)/K ratio, because E.P.P. is inversely related to the latter.

This parameter was markedly increased in all the topsoils except for trials 7Q1 and 5C5 (Table 5.1). No significant changes in E.P.P. of the subsoils were apparent (Appendix 12).

5.6 POTASSIUM ADSORPTION RATIO (P.A.R.)

P.A.R. was calculated for the topsoils only, using the formula $K / \sqrt{[Ca^{++} + Mg^{++}]/2}$ me/l. Inspection of the values for P.A.R. (Appendix 13, Table 5.1), shows an increase in P.A.R. for all trials. The smallest increases were found for trials 7Q1 and 5C5 (Table 5.1).

5.7 PHOSPHATE

The basic application of superphosphate at 815 kg/ha and split into two, half applied at 45cm depth and the other half broadcast at seedbed preparation, did ensure an adequate supply of phosphate in both topsoils and subsoils (Appendices 14 and 15).

The extreme deficiency of phosphorus in the majority of subsoils before application of phosphate fertilizers (Appendix 4), is merely an expression of the fact that virgin Vaalharts soils are very low in native phosphate. It further illustrates the immobility of applied phosphates. Any enrichment of the subsoil can apparently only be achieved by deep application of fertilizer phosphate. The fact that some subsoils originally contained appreciable amounts of available P (Appendix 4) indicates that these soils must have received phosphate by deep placement at some stage previously.

5.8 ZINC

The application of 6kg/ha of zinc fertilizer material increased the zinc content of the topsoils in all but two of the experiments (Appendices 3 and 14). The zinc content of the subsoils was also slightly increased (Appendices 4 and 15).

5.9 ORGANIC MATTER

The sandy soils of Vaalharts are known to be rather low in organic matter, seldom containing more than one per cent. The organic matter contents of the topsoils ranged between 0,3 and 0,76 per cent with an average of approximately 0,5 per cent (Appendix 14). The corresponding values for the subsoils are only slightly lower, viz. 0,18, 0,52 and 0,3 per cent (Appendix 15). These low values together with the low clay contents (Appendix 1), emphasize the poor buffer capacity of these soils.

5.10 COPPER

The copper content of the soils is generally higher than the 1,19 mg/kg reported by Botha (1971) for comparable virgin Hutton soils (Appendices 14 and 15). Since no incidences of copper deficiency had been reported for Vaalharts, no further attention is given to possible effects of this element (Burger, 1983).

5.11 S.A.R. AND ELECTRICAL CONDUCTIVITY

Both S.A.R. and electrical conductivity were unaffected by the application of potassium fertilizer to these soils (Appendices 16 and 17). These parameters are indicative of the low salt contents of these soils.

5.12 pH ($CaCl_2$)

Very little change in pH was observed after applying quite large quantities of fertilizers to these soils (Appendices 16 and 17). Only this parameter is discussed here because the pH ($CaCl_2$) was considered to be less affected by fertilizer applications and crop influence.

CHAPTER 6

EFFECTS OF FERTILIZATION ON LEAF ANALYSIS PARAMETERS

The analytical data for cotton leaves are discussed in this chapter. Some attention is given to related data found in the literature and comparisons are made.

In the interpretation of the results of foliar analysis certain factors should be taken into account:-

i) The organ sampled (leaf, petiole or blade).
ii) Its situation on the plant (summit or oxil of an open flower).
iii) The age of the cotton plant.

Other factors that should also be considered include the variety, the moisture regime and possible interactions with other nutrient elements.

6.1 MICRONUTRIENTS

References to micronutrients in cotton are rare. Chapman (1966), in one of the most comprehensive reviews of diagnostic criteria, did not report on critical manganese values for the cotton plant. De Kock (1976) in summarising the inorganic composition of the cotton plant also did not refer to manganese.

6.1.1 Manganese.

Pellisier (1976) reported values of 40 mg/kg in cotton leaves where no manganese was applied and 50 to 60 mg/kg with manganese application on a Mangano soil. Cardozier (1957) regards manganese excess together with calcium deficiency as the principal cause of crinkle leaf disease in cotton. Malavolta _et al_ (1962) states that manganese deficiency in cotton only occurs when large amounts of liming materials have been added to the soil.

In contrast to these reported values, El - Aggory, Malwardi, El-Razek and Serry (1977) in a sand culture study with two cotton varieties found, that manganese content of the leaves was a maximum at concentration of 60 mg/kg with no difference between varieties. There was no sign of deficiency symptoms.

Bhatt and Nathan (1979) found a peak of 140 mg/kg manganese in field experiments with three cotton varieties.

Manganese contents ranging from 58 mg/kg to 262 mg/kg are reported in Appendices 22 and 23. It may therefore, be concluded that manganese was supplied by these soils in sufficient quantities for normal cotton production.

6.1.2 Iron.

Finck (1982) mentioned that slight iron deficiencies sometimes occur in cotton grown under irrigation, but he did not state critical values. Values of 71 mg/kg were obtained by Pellisier (1976) for untreated cotton plants. A foliar application of Spoorspray raised the iron content of the leaves to 97 mg/kg (Pellisier, 1976).

El - Aggory et al (1977) studied the iron content of two cotton varieties in sand culture and reported an increase in the iron content of leaves from 126 mg/kg at 67 days to 264 mg/kg at harvest.

In Appendices 22 and 23 values for iron vary from 53 to 427 mg/kg of dry matter.

6.1.3 Copper.

It is significant that Bhatt & Nathan (1979) gave leaf copper values of close to 10 mg/kg as a norm. El - Aggory et al (1977), in sand culture studies, found that leaf copper fluctuated without a definite trend between 33 - 94 mg/kg.

From Appendices 22 and 23 it can be seen that without the addition of copper to these soils the leaf copper content varied between 13,01 mg/kg and 45,05 mg/kg.

6.1.4 Zinc.

Increase in zinc content of cotton leaves from 36 - 87 mg/kg with age and no difference between varieties were reported by El - Aggory et al (1977). Bhatt and Nathan (1979) reported values of 40 - 70 mg/kg zinc in 120 - 150 day old cotton leaves. Values of 23 - 39 mg/kg where zinc was applied in a pot experiment were reported by Pellisier (1976). Zinc contents of the cotton leaves from the Vaalharts experiments varied between 18 and 40 mg/kg dry matter. (Appendices 22 and 23).

Regarding the microelement contents of the cotton leaves it may be concluded that the soils of this series of experiments are not unduly low in any of the micronutrients. It is known, however, that deficiency levels of manganese and zinc have been found in cotton grown at Vaalharts. Burger (1983) reported a case of 2 mg/kg of manganese in cotton leaf petioles and 3 mg/kg of zinc in the same sample.

6.2 MACRONUTRIENTS AND SODIUM

The macronutrient contents of the cotton leaves, other than potassium are discussed in this section in light of their interrelationships with potassium and their individual effects on the crop. For the purposes of comparison, also with published data, the contents for nitrogen, phosphorus, sulphur, calcium, magnesium sodium and potassium are presented as percentages (average of four replicates) in Appendix 19.

The complete data for the cations Na , Ca , Mg and K are listed in Appendix 18 (me/100g). Phosphorus, expressed as mg/kg and sulphate as me/100g are presented in Appendix 20. Values for the nitrogen content of the cotton leaves (%N) are listed in Appendix 21.

6.2.1 Nitrogen.

Bonnett <u>et</u> <u>al</u> (1958), working in a sand culture, reported that cotton leaves with 2,14 %N of dry matter showed deficiency symptoms, while 2,79 %N was intermediate in nitrogen content. Fauconnier (1978) stated that 4,0 %N of the dry matter of leaf blades is critical for Tropical Africa. A nitrogen content of 1,5 % was regarded by Bhatt et al (1979) as a critical level for nitrogen deficiency in cotton.

The lowest individual value of 3,74 %N (Appendix 21) in the present study is well above the stated critical values for nitrogen deficiency. It is not expected that any deficiencies of nitrogen occurred.

6.2.2 Phosphorus.

Average phosphorus contents of cotton leaves appear to be in the range of 0,2 - 0,4 % (Burger, 1983; Fauconnier, 1978 and Nelson et al, 1948). Nelson et al (1948) reported that 0,18 %P of dry matter for leaves was low and 0,32 %P was intermediate.

Fauconnier (1978) published a critical value of 0,30 %P for cotton in Tropical Africa. Unfortunately no values where deficiency of phosphorus occurred, could be found.

The values presented in Appendix 19 and 20 range from 0,22 % to 0,41 % and it is accepted that no deficiency occurred even where a very low initial phosphorus content of soil 4C5 was found (Appendix 3).

6.2.3 Sulphur.

Ergle and Eaton (1951) reported deficiency symptoms in 65 day old upper leaves containing 0,003 - 0,01 % sulphur as $SO_4^=$. Fauconnier (1978) stated 0,30 - 0,40 %S as critical for Tropical Africa.

No value below 0,20 % $SO_4^=$ was recorded in any of the present trials (Appendices 19 and 20) and therefore it seems that no deficiency of sulphur occurred. This may be viewed in light of the general application of superphosphate and ammonium sulphate on Vaalharts soils.

6.2.4 Calcium.

Cotton appears to accumulate exceptionally high percentages of calcium in the leaves, especially in the leaf blades. An extreme value of 6,9 % of calcium with a corresponding value of 1,3 % calcium in the petiole was reported by Burger (1983). Mehlich & Reed (1946) reported values of 0,80 - 1,02 %Ca of dry matter as low and 2,2 %Ca as intermediate.

The values presented in Appendices 18 and 19 for this study range from 3 % Ca to 7,6 % Ca and it is accepted that calcium was adequately taken up from all the soils.

6.2.5 Magnesium.

From studies in solution culture Helmy, Joham and Hall (1960) suggested values of 0,28% Mg as deficient, 0,31 % as low and 0,51 % Mg as intermediate. For this study the values in Appendices 18 and 19 are generally higher than those reported by Helmy _et al_ (1960).

It may be accepted that magnesium was present in adequate quantities in the cotton leaves of all the trials.

6.2.6 Sodium.

Values of 0,16 - 0,23 % sodium in cotton leaves were reported as satisfactory or consistent with good crop growth performance, (Chang & Dregne, 1955).

The majority of the results obtained fall into this range (Appendices 18 and 19). However, some rather low levels were found in trial No's 1R1, 3K9 and 7Q1 (Appendix 19). It has been suggested that when potassium is in short supply sodium is taken up by cotton instead (Joham and Amin, 1965). Bearing in mind the findings of Hagin (1982) and Van der Merwe (1972) that a (Ca+Mg)/K ratio of less than 15 implies adequate potassium supply, these rather low values for sodium suggest that potassium uptake was not inhibited by sodium because in these three trials the ratio (Ca+Mg)/K in the soil was less than 15 (Appendix 11).

6.2.7 Potassium.

Potassium content for various plant organs differ quite widely. Cotton leaf blades grown on a Mangano soil were reported to contain 1,7 %K and the corresponding petioles 4,4 %K (Burger, 1983). Whole plant values of between 1,2 and 3,2 %K were recorded by Bennie (1979). Potassium contents of leaf blades regarded as adequate levels for cotton, range between 1,03 and 2,8% (Fauconnier, 1978; McClung, De Freitas, Mikkelsen and Lott, 1961; Mendes, Abramides and Gallo, 1960 and Bazelet, 1981). Deficiency symptoms were noted by Ticknell, Lopez and Ayala (1960) in cotton with a leaf K content of 0,9 %. Bazelet (1981) and Fauconnier, (1978) regarded 1,2 % K of the leaves as the critical value for adequacy in K supply.

It appears that the K content of petioles may serve as a more sensitive indicator of potassium nutrition for cotton plants. It is noteworthy that Stromberg (1960) used 1 %K in the petioles as a critical value.

Comparing leaf K contents of the present experiments with the above criteria, it may be concluded that K levels below the critical values were obtained in three of the fifteen experiments, viz. 2A5, 4C5 and 5C5. Leaf potassium contents of well below 1% were recorded for these experiments, averages of 0,67 %, 0,75 % and 0,72 % respectively for the zero K treatment (Appendix 19).

Referring to Table 5.1, attention is focused on the data for experiments 2A5 and 4C5, both of which show marked increases in leaf potassium upon K application. Furthermore, it must be noted that the NH_4Ac-K of the soil also increased. Conversely the data for experiment 5C5 reflect no increase in soil and very little increase in leaf K. Although this soil had a very low initial K value, applications of up to 1050 kg KCl per ha failed to increase the available K content (Tables 5.1, 6.1 and Appendix 19). This apparent disappearance of applied K may be attributed to a severe degree of fixation into unavailable forms. Van der Merwe (1973) found that certain Mangano soils of Vaalharts contained appreciable quantities of soil vermiculite, a known fixer of potassium.

Another notable phenomenon of these data (Table 5.1 and Appendix 19) is the fact that cotton grown on the

Table 6.1 Initial NH_4Ac Extractable Potassium Soil $K_5 - K_1$, Significance, Leaf $K_5 - K_1$ and Significance for topsoils

	INITIAL NH_4Ac-K	NH_4Ac-K $K_5 - K_1$	SIGNIFICANCE	LEAF $K_5 - K_1$	LEAF SIGNIFICANCE
1B2	0,10	+0,13	B4,5>B1** B4,5>B2*	+2,76	N S
5C5	0,15	0	N S	+1,82	N S
SKAAPBLOK	0,18	+0,15	B5>B1*	+8,92	N S
6L8	0,21	+0,17	B5>B1** B5>B2*	+4,17	N S
4C5	0,21	+0,19	B5>B123** B5>B4*	+14,11	B5>B1**
2A5	0,26	+0,10	B4,5>B1,2*	+8,63	B4>B1,3** B5>B1234*
1R1	0,26	+0,15	B2,3,4,5>B1**	-3,09	N S
4B4	0,28	+0,15	B5>B1*	+8,42	B4>B1** B3>B2*
4Q4	0,28	+0,12	B5>B1B2**	-0,10	N S
OSBLOK	0,31	+0,04	N S	-1,05	N S
24D10	0,38	+0,10	B5>B1B2*	+1,24	N S
6Q1	0,44	+0,15	B5>B1**	+1,08	N S
3K9	0,46	+0,03	N S	+0,65	N S
3M11	0,51	+0,08	B5>B231** B4>B2	-0,25	N S
7Q1	0,64	0	N S	-2,15	N S

Skaapblok showed a large increase in K uptake between treatments K1 and K5 although not statistically significant (Table 6.1). This soil had a low initial soil K of 0,18 me/100g which increased significantly to 0,33 me/100g. This implies that, although NH_4Ac-K can be significantly influenced by potassium application, it does not necessarily imply increased potassium uptake from this soil.

When the data for the experiments are arranged in an ascending order for initial NH_4Ac-extractable potassium of the topsoil, a significant pattern comes to light (Table 6.1). For soil K values up to approximately 0,25 me/100g increases in leaf K values resulted from K applications (K5 - K1), some of which were highly significant (Table 6.1). Between soil K values of approximately 0,3 and 0,5 me/100g, it appears that potassium uptake by cotton was not influenced in a definite direction by potassium fertilization. There might be a detrimental effect on K uptake when soil K is higher than 0,5 me/100g in these soils.

From these results the following recommendations for cotton fertilization may be made : For soil K of less than 0,25 me/100g sufficient K fertilizer must be applied to increase the soil K to at least 0,25 me/100g. Between 0,25 and 0,5 me K/100g only a maintenance application should be given. When the soil K exceeds 0,5 me/100g, K fertilization may be omitted for a season or two.

6.2.8 Ratio of Ca and Mg to K.

In general this parameter was reduced in all the leaf samples except in the case of trial 4B4 and 3M11 (Appendix 24). If this parameter is taken as a measure of potassium uptake by cotton, it would seem that some restriction on potassium uptake in these two soils existed. However, these two experiments do not reflect the possibility of potassium deficiency when compared to the critical value of 1 % K in leaf blades (Section 6.2.7). This confirms the result of the pot experiment where no relationship between this parameter and yield could be found.

It would therefore seem that this ratio is not a true reflection of the critical amounts of potassium in cotton leaves.

CHAPTER 7

STATISTICAL TREATMENT OF THE DATA

7.1 ANALYSIS OF VARIANCE

7.1.1 Leaf Samples.

Analysis of variance was performed for each individual experiment and the results are presented in Table 7.1.

Significant responses for potassium content of the leaves were recorded in only three of the fifteen experiments viz. 2A5, 4B4 and 4C5. In all three experiments the highest application of potassium (treatments 4 and 5) resulted in a significantly higher K content of the leaves than the control and the lower K applications (Table 7.1). It is noteworthy that in the case of experiment 4B4, the level of potassium in the leaves was much higher than in the other two experiments, suggesting that uptake of potassium was much more efficient (Appendix 18).

Table 7.1 Analysis of Variance (Nutrient Contents of Leaves) Individual Experiments.

TRIAL NO.	Mn	Fe	Cu	Zn	Ca	Mg	K	Na	P	$SO_4^=$
4Q4	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
24D10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
3K9	NS	$B_3>B_2$*	NS	NS	NS	NS	NS	NS	NS	NS
1R1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
OSBLOK	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SKAAPBLOK	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2A5	NS	NS	NS	NS	NS	NS	$B_4>B_1B_2$** $B_4>B_1B_2B_3B_4$*			
4B4	NS	NS	NS	NS	NS	NS	$B_4>B_1$** $B_4>B_2$*	NS	NS	NS
5C5	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4C5	$B_2>B_1$*	NS	NS	NS	NS	$B_1>B_4B_5$*	$B_5>B_1$**	$B_1>B_4$*	NS	NS
6Q1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1B2	$B_2>B_1B_4B_5$*	NS	NS	NS	NS	NS	NS	NS	NS	NS
6L8	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
7Q1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
3M11	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Significance for certain other elements are also indicated in some of the experiments, but appears to be unrelated to differential K fertilization. The analysis of variance for these elements was performed as a standard procedure and any significance will not be discussed here because it is not relevant to the present study.

7.1.2 Ammonium acetate extractable potassium.

In the analysis of variance for ammonium acetate extractable potassium in the topsoils, significant differences in soil K content were found between treatments in eleven of the fifteen experiments (Table 7.2a). Again the highest levels of potassium application (treatments 4 and 5) differed significantly from the control and lower applications (Table 7.1).

Considering those four experiments where potassium applications failed to raise the NH_4Ac extractable K to a significantly higher level (Table 7.2a), two extremes are evident. The soil of experiment 5C5 had a very low initial K content of 0,15 me/100g compared with the higher value of 0,64 me/100g for experiment 7Q1 (Table 6.1). In none of these four soils could a significant increase in NH_4Ac extractable K be detected. This may be attributed to an extremely severe case of K fixation

Table 7.2 (a) Analysis of Variance for Various Soil Parameters (Individual Experiments)

NH_4Ac Extractable Potassium - Topsoils.

TRIAL NO.	% CLAY	Na	K	Ca	Mg	S	CEC	E.P.P.	$\frac{Ca + Mg}{K}$
4Q4	8	NS	$B_5>B_1B_2$**	NS	NS	NS	NS	$B_5>B_1B_2$*	$B_2>B_5$** $B_1>B_5$**
24D10	8	NS	$B_5>B_1B_2$*	NS	NS	NS	NS	NS	$B_1>B_5$*
3K9	8	NS	NS	NS	NS	NS	NS	NS	NS
1R1	8	NS	$B_2B_3B_4B_5>B_1$**	NS	NS	NS	NS	NS	$B_1>B_3$** $B_1>B_5B_4$**
OSBLOK	8	NS	NS	NS	NS	NS	NS	NS	NS
SKAAPBLOK	8	NS	$B_5>B_1$*	NS	NS	NS	NS	$B_5>B_1$**	$B_1>B_5$** $B_1>B_4B_3$*
2A5	8	NS	$B_4>B_1B_2$* $B_5>B_1B_2$ *	NS	NS	NS	NS	NS	$B_2>B_4B_5$** $B_1>B_4B_5$**
4B4	8	NS	$B_5>B_1$*	NS	NS	NS	NS	NS	NS
5C5	8	NS	NS	NS	NS	NS	NS	NS	NS
4C5	8	NS	$B_5>B_1B_2B_3$** $B_5>B_4$*	NS	NS	NS	NS	$B_5>B_1B_3$** $B_5>B_2$*	$B_1>B_3B_4B_5$** $B_2>B_5$*
6Q1	10	NS	$B_5>B_1$**	NS	$B_3>B_5$*	NS	NS	$B_5>B_1$** $B_5>B_2$**	NS

Table 7.2 (a) Continued.....

TRIAL NO.	% CLAY	Na	K	Ca	Mg	S	CEC	E.P.P.	$\frac{Ca + Mg}{K}$
1B2	10	$B_4>B_1B_2B_3^{**}$ $B_4>B_5^{*}$	$B_5B_4>B_1^{**}$ $B_5B_4>B_2^{*}$	NS	NS	NS	NS	$B_5B_3>B_1^{*}$	NS
6L8	10	NS	$B_5>B_1^{**}$ $B_5>B_2^{*}$	NS	NS	NS	NS	NS	NS
7Q1	12	NS	NS	NS	NS	NS	$B_1>B_3^{*}$	NS	NS
3M11	16	NS	$B_5>B_{\underline{1}}B_2B_3^{**}$ $B_4>B_2^{*}$	NS	NS	NS	NS	$B_4B_5>B_2^{**}$ $B_4B_5>B_1B_3^{*}$	$B_2>B_5^{*}$

in these particular soils. Furthermore, no significant increases in cotton leaf K could be detected (Table 7.1).

With regard to the subsoils, in two experiments viz. 3K9 and 1R1, significant increases in subsoil NH_4Ac extractable K were evident (Table 7.2b). This indicates some downward movement of applied potassium in these rather sandy soils.

Exchangeable potassium percentage (E.P.P.) in the topsoils was significantly influenced by the application of potassium in five of the experiments (Table 7.2a). Once again only the higher applications of potassium (treatments 3, 4 and 5, Table 7.2a), had a significant influence on E.P.P. In view of the positive correlation between E.P.P. and yield found in the pot experiment (Table 3.4), E.P.P. must be given serious consideration as a parameter for fertilizer recommendations. The E.P.P. of the subsoils was not significantly influenced by the application of potassium fertilizers (Table 7.2b).

7.1.3 Water soluble potassium.

The water soluble K contents of the topsoils was significantly increased in only three of the experiments,

Table 7.2 (b) Analysis of Variance for Various Soil Parameters (Individual Experiments) NH_4Ac Extractable Potassium - Subsoils.

TRIAL NO.	Na	K	Ca	Mg	S	CEC	EPP	$\frac{Ca + Mg}{K}$
4Q4	NS	NS	NS	$B_3>B_2$*	NS	NS	NS	NS
24D10	NS	NS	NS	NS	NS	NS	NS	NS
3K9	NS	$B_3>B_1$*	NS	NS	NS	NS	NS	NS
1R1	NS	$B_5>B_1$*	$B_1B_2>B_5$**	NS	NS	NS	NS	$B_1B_2>B_5$**
OSBLOK	NS	NS	NS	NS	NS	NS	NS	NS
SKAAPBLOK	NS	NS	NS	NS	NS	NS	NS	NS
2A5	NS	NS	NS	$B_5>B_2$*	NS	NS	NS	NS
4B4	NS	NS	NS	NS	NS	NS	NS	NS
5C5	NS	NS	NS	NS	NS	$B_3>B_5$* $B_3>B_2$**	NS	NS
4C5	NS	NS	NS	NS	NS	NS	NS	NS
6Q1	NS	NS	NS	NS	NS	NS	NS	NS
1B2	NS	NS	NS	NS	NS	NS	NS	NS
6L8	NS	NS	NS	NS	NS	NS	NS	NS
7Q1	NS	NS	NS	NS	NS	NS	NS	NS
3M11	NS	NS	NS	NS	NS	NS	NS	NS

viz. 3K9, 4C5 and 3M11. The one percent significance level was attained in only one experiment viz. 3M11 (Table 7.3). It would therefore seem that the application of potassium fertilizers to these soils has very little influence on the water soluble potassium content in the plow layer.

The application of potassium fertilizers to these soils had no significant influence on the water soluble potassium contents of the subsoils (Table 7.3).

7.1.4 Micronaire values and fibre percentage.

No significant influence of applied potassium fertilizers on quality parameters could be found. The values are presented in Appendix 26.

7.1.5 Yield data.

The results for yield obtained for the 10 trials that were harvested are presented in Appendix 25. There were no significant effects of soil and applied K on the cotton yields for the individual experiments.

In light of various results obtained in field experiments on Vaalharts soils, e.g. that K fertilization suppressed yields (Wessels & Pretorius, 1953), and the

Table 7.3 Analysis of Variance (Water-Soluble Potassium) Individual Experiments

	TOPSOILS				SUBSOILS			
TRIAL NO.	Na	K	Ca	Mg	Na	K	Ca	Mg
4Q4	NS	NS	NS	$B_1>B_5$**	NS	NS	NS	NS
24D10	NS	NS	NS	NS	NS	NS	NS	NS
3K9	NS	$B_4>B_1$*	NS	NS	NS	NS	NS	$B_4>B_3$*
1R1	NS	NS	NS	NS	NS	NS	NS	NS
OSBLOK	NS	NS	NS	NS	NS	NS	NS	NS
SKAAPBLOK	NS	NS	NS	NS	NS	NS	NS	NS
2A5	NS	NS	NS	NS	NS	NS	NS	NS
4B4	NS	NS	NS	NS	NS	NS	NS	NS
5C5	NS	NS	NS	NS	NS	NS	NS	NS
4C5	NS	$B_5>B_1B_2B_3$*	NS	NS	NS	NS	$B_5>B_2$*	NS
6Q1	NS	NS	NS	NS	NS	NS	NS	NS
1B2	NS	NS	NS	NS	NS	NS	NS	NS
6L8	$B_1>B_2B_3B_4$*	NS	NS	NS	NS	NS	NS	NS
7Q1	$B_5>B_2$*	NS	$B_2>B_4$*	Ns	NS	NS	NS	NS
3M11	$B_5>B_1B_2B_3B_4$**	$B_5>B_1B_2$* $B_4>B_1B_2$*	NS	NS	NS	NS	NS	NS

fact that in a few experiments with a low initial soil K, increases in cotton leaf K were recorded, it was reasoned that the effects of K on yield could be masked to a certain extent (Table 6.1). Furthermore, five of the soils had very low available K contents, in the range where K deficiencies could be expected. There is also evidence that at least some of these soils are able to fix K in non-exchangeable forms (See page 73).

7.2 CORRELATION COEFFICIENTS FOR INDIVIDUAL TRIALS

In order to check the existance of any possible relationship between soil parameters, leaf K parameters and yield as well as leaf potassium content the following parameters were correlated for the individual trials (Table 7.4).

Table 7.4. Parameters correlated with yield and leaf K content.

E.P.P.	SUBSOILS	EXCH - K	TOPSOILS
E.P.P.	TOPSOILS	P.A.R.	TOPSOILS
Ca + Mg/K	SUBSOILS	NH_4Ac-K	TOPSOILS
Ca + Mg/K	TOPSOILS	Ca + Mg/K	LEAVES
K - LEAVES			

7.2.1 Leaf K.

The correlation coefficients for the nine parameters and leaf K content for the fifteen trials are presented in Table 7.5.

As indicated in Table 7.5 some very good relationships between the parameters and leaf K content were found. It is however, very clear that neither NH_4Ac-K nor Exch-K consistently expressed the best relationship with leaf K content. In the case of 4B4 highly significant relationships between these two parameters and leaf K content were found, but, the best relationship was expressed by E.P.P. topsoils, r=0,70971** (Table 7.5).

It would therefore seem that other parameters than NH_4Ac-K and Exch-K should be taken into account when assessing the potassium nutrition of cotton growing on these soils.

Another fact that is quite clear is the non-existance of any relationship between yield and leaf K content. As was found in the pot experiment,(Ca + Mg)/K in the leaves expressed a very good relationship with leaf K content.

Table 7.5 Relationships Between Various Soil and Leaf Parameters and Leaf - K Content.

TRIAL NO.	E.P.P.(S)*	E.P.P.(T)*	$\frac{Ca + Mg}{K}$(S)*	$\frac{Ca + Mg}{K}$(T)*	EXCH-K	P.A.R.	YIELD	NH Ac-K	$\frac{Ca + Mg}{K}$(Leaf)
1B2	0,70927**	0,44068	-0,68003	-0,26740**	0,26350	0,14398	0,15448	0,26822	-0,63377**
1R1	0,23197	0,29555	-0,26071	0,05192	0,15770	0,26329	-	0,17382	-0,51589*
2A5	0,34541	0,34395	-0,15318	-0,36531	0,35768	0,42002	-	0,36420	-0,35094
3K9	0,36878	0,12523	-0,38857	-0,30532	0,38300	0,35330	-	0,38188	-0,66196**
4B4	0,57135*	0,70971**	-0,44901	-0,58061*	0,69495**	0,65409	-0,46900	0,68500**	-0,04219
4C5	0,32206	0,61460**	0,03610	-0,80345**	0,84537**	0,71395**	-0,16810	0,84125**	-0,94136**
6L8	0,12947	0,23603	-0,07649	-0,22225	0,27132	0,41110	0,26974	0,29478	-0,92244**
6Q1	0,21202	0,27501	0,00709	-0,16744	0,30415	0,09433	-0,34884	0,30128	-0,48461**
7Q1	0,25953	0,27102	-0,48807*	-0,17939	0,17328	0,47012	-	0,27812	0,05388
3M11	0,30181	0,32591	-0,34629	-0,41225	0,34237	0,37386	-	0,34562	-0,70443**
OSBLOK	-0,05184	-0,41824	-0,04612	0,38386	-0,39773	0,34077	-0,19840	-0,39542	-0,93999**
SKAAPBLOK	0,42210	0,38456	-0,29254	-0,19803	0,42036	0,41707	0,37426	0,42581	-0,87549**
4Q4	-0,29117	-0,10472	0,04855	-0,07515	0,09414	-0,06044	-0,11482	-0,06739	-0,40156
25D10	-0,05552	0,02011	0,01715	-0,05769	0,05236	0,01129	-0,31129	0,05312	0,28422
5C5	0,23990	0,50560*	0,06641	-0,83568**	0,80105**	0,28391	0,44780	0,77190**	-0,84952**

* (S) SUBSOILS
* (T) TOPSOILS

7.2.2 Yield.

In general the relationships between the various parameters and yield are very poor, except for trials 4C5, 5C5 and Skaapblok (Table 7.6). For trial 4C5 only one significant relationship was obtained and for trial 5C5 two significant relationships were found. Only Skaapblok gave highly significant correlations for E.P.P. subsoils,(Ca + Mg)/K subsoils, and (Ca + Mg)/K leaves.

In two of these three trials other parameters viz. E.P.P. subsoils and (Ca + Mg)/K subsoils were better correlated with yield than either NH_4Ac-K or Exch-K (Table 7.6).

When considering the best relationships, one finds that only in the case of trial 5C5 Exch-K expressed the best relationship with yield. In all the other nine trials the best relationship is expressed by other parameters than either NH_4Ac-K or Exch-K (Table 7.6). The leaf potassium parameters, in general were poorly correlated with yield except for Skaapblok, where a highly significant relationship was found between (Ca+Mg)/K leaves and yield (Table 7.6). However, considering the best relationships, it can be seen that leaf K gave the best correlation in the case of two trials viz. 4B4 and 6Q1.

Table 7.6 Relationships Between Various Soil and Leaf Parameters and Yield

TRIAL NO.	E.P.P. (S)*	E.P.P. (T)*	$\frac{Ca + Mg}{K}$ (S)*	$\frac{Ca + Mg}{K}$ (T)*	LEAF-K	EXCH-K	P.A.R.	NH_4Ac-K	$\frac{Ca + Mg}{K}$ (LEAF)
1B2	0,10762	0,06877	0,07700	0,08130	0,15448	0,11886	0,29871	0,14568	-0,07707
4B4	-0,03684	-0,35126	-0,03885	0,08754	-0,46900	-0,25185	-0,23019	-0,24971	0,26755
4C5	-0,21722	-0,24407	-0,51580*	0,06724	-0,16810	-0,16135	-0,20898	-0,17190	0,07994
6L8	-0,07394	0,25536	0,15795	-0,31740	0,26974	0,14996	0,08939	0,18425	-0,22476
6Q1	-0,28815	0,17100	0,24495	-0,00067	-0,34884	0,16000	0,22685	0,15650	0,08610
OSBLOK	0,02723	0,05996	0,11792	0,01139	-0,19840	0,13393	0,20075	0,14425	0,21494
SKAAPBLOK	-0,73611**	0,38276	0,67862**	-0,37075	0,37426	0,37620	0,39471	0,37594	0,59744**
4Q4	-0,03295	-0,24599	-0,25074	0,39505	-0,11482	-0,38285	-0,32189	-0,34322	0,03728
24D10	0,05301	-0,03644	0,17359	0,10533	-0,31129	0,00999	-0,01473	-0,00660	-0,13883
5C5	0,36050	0,12522	0,10971	-0,41063	0,44780	0,58189*	0,22791	0,55710*	-0,22306

* (S) SUBSOILS
* (T) TOPSOILS

Considering the above it is obvious that in an attempt to predict cotton yield under these soil conditions, other parameters than NH_4Ac-K or Exch-K should be considered. The subsoil potassium status of these soils should also be considered in such a prediction.

Because of the foregoing it was decided that the results of these experiments must be treated in a different way to exclude any possible masking effects. The leaf K contents for all the experiments as well as the yield data for the 10 harvested experiments were therefore pooled for the calculation of correlation coefficients for the parameters, given in Table 7.4.

7.3 CORRELATION COEFFICIENTS FOR POOLED DATA

Although good correlation coefficients for yield were obtained in the pot experiment (See Table 3.3, Chapter 3), e.g. $r = 0{,}7013^{**}$ for (Ca+Mg)/K versus yield, the results for the pooled data showed poor interralationships (Table 7.7 and 7.8).

Table 7.7 Correlation coefficients for pooled data (yield).

		r	
E.P.P.	SUBSOILS	-0,43439	**
E.P.P.	TOPSOILS	-0,19336	**
(Ca+Mg)/K	SUBSOILS	0,48892	**
(Ca+Mg)/K	TOPSOILS	0,49217	**
K	LEAVES	-0,33292	**
Exch-K	TOPSOILS	-0,30192	**
P.A.R.	TOPSOILS	0,02566	-
NH_4Ac-K	TOPSOILS	-0,29740	**
(Ca+Mg)/K	LEAVES	-0,34115	**

Table 7.8. Correlation coefficients for pooled data (leaf K content).

		r	
E.P.P.	SUBSOILS	0,69557	**
E.P.P.	TOPSOILS	0,27877	**
(Ca+Mg)/K	SUBSOILS	-0,50890	**
(Ca+Mg)/K	TOPSOILS	-0,28736	**
Exch-K	TOPSOILS	0,47340	**
P.A.R.	TOPSOILS	0,31555	**
YIELD		-0,33292	**
NH_4Ac-K	TOPSOILS	0,49029	**
(Ca+Mg)/K	LEAVES	-0,63034	**

Because the pooling of all data also failed to explain the variation in the relationships between soil K and yield or leaf K to acceptable levels, it was decided to group the data according to certain soil properties, for further correlation studies.

7.4 RELATIONSHIPS BETWEEN SOIL AND PLANT PARAMETERS, LEAF-K CONTENT AND YIELD FOR THE GROUPED DATA

7.4.1 Grouping.

The data were grouped according to certain soil characteristics.

Inspection of the initial soil analysis data revealed some obvious differences in soil characteristics which could serve as a basis to group certain soils together. These were the clay content of both the topsoils and the subsoils, exchangeable potassium contents and the cation exchange capacity of the soils.

Grouping 1 - clay content of the topsoils.

(i) 8% clay
(ii) 10% clay
(iii) 12 - 16% clay

Grouping 2 - clay content of the subsoils.

(i) < 8% clay
(ii) > 8% clay

Grouping 3 - initial exchangeable (Ca+Mg)/K of the topsoils.

(i) (Ca+Mg)/K > 15
(ii) (Ca+Mg)/K < 15

Grouping 4 - initial NH_4Ac extractable K in the topsoils.

(i) < 0,20 me/100g K
(ii) 0,20 - 0,30 me/100g K
(iii) 0,30 - 0,40 me/100g K
(iv) > 0,40 me/100g K

Grouping 5 - cation exchange capacity of the topsoils.

(i) C.E.C. 4-5 me/100g
(ii) C.E.C. 5-6 me/100g
(iii) C.E.C. > 6 me/100g

Grouping 6 - initial exchangeable potassium percentage of the topsoils, (E.P.P.).

(i) E.P.P. < 4

(ii) E.P.P. > 4

The data for the various groups were then subjected to correlation procedures.

For the correlations involving leaf K contents the data for all 15 experiments were used. Yields of five experiments were not obtained due to crop damage. These correlation studies therefore include the results of only 10 experiments.

7.4.2 Relationships for leaf K content.

If the leaf K content is taken as a measure of potassium availability in soils, there should exist significant relationships between this category of K and certain soil K parameters, eg. water soluble K, exchangeable K or the ratio of divalent cations to K. Bearing in mind that very large quantities of K, as fertilizer, were applied to the experimental soils, it could be expected that cotton would take up K in luxury quantities. In such cases any quantity of "available" K would be reflected in the leaf K content.

The relationships obtained for the various parameters and leaf K content are presented in Appendix 27. Only the best relationships for each grouping are summarized in Table 7.9.

Table 7.9. Summary of the best correlations between the various parameters and leaf K for the grouped data.

GROUPING	PARAMETER	r VALUE
8% Clay in topsoils (10 experiments)	E.P.P. subsoils	0,80966**
10% Clay in topsoils (3 experiments)	E.P.P. topsoils	0,42471**
12-16% Clay in topsoils (2 experiments)	P.A.R. topsoils	0,77173**
8% Clay in subsoils (10 experiments)	E.P.P. subsoils	0,80852**
> 8% Clay in subsoils (5 experiments)	E.P.P. subsoils	0,55408**

Table 7.9 (continued)....

GROUPING	PARAMETER	r VALUE
(Ca+Mg)/K Topsoils > 15 (10 experiments)	E.P.P. topsoils	0,75682**
(Ca+Mg)/K Topsoils < 15 (5 experiments)	(Ca + Mg)/K subsoils	-0,71637**
NH_4Ac-K Topsoils < 0,20 me/100g (3 experiments)	E.P.P. topsoils	0,68155**
NH_4Ac-K Topsoils 0,20 - 0,30 me/100g (6 experiments)	E.P.P. subsoils	0,78055**
NH_4Ac-K Topsoils 0,30 - 0,40 me/100g (2 experiments)	(Ca + Mg)/K subsoils	-0,25028**
NH_4Ac-K Topsoils > 0,40 me/100g (4 experiments)	(Ca + Mg)/K subsoils	-0,70303**

Table 7.9 (continued)....

GROUPING	PARAMETER	r VALUE
C.E.C. in Topsoils 4-5 me/100g (3 experiments)	E.P.P. subsoils	0,87067**
C.E.C. in Topsoils 5-6 me/100g (9 experiments)	E.P.P. subsoils	0,77709**
C.E.C. in Topsoils > 6 me/100g (3 experiments)	NH_4Ac-K topsoils	0,66347**
E.P.P. Topsoils < 4 (5 experiments)	E.P.P. topsoils	0,69123**
E.P.P. Topsoils > 4 (10 experiments)	E.P.P. subsoils	0,67504**

Grouping of the soils resulted in the strengthening of the relationships between leaf K content and soil parameters. However, the best relationship for each grouping is not expressed by the same parameter in each case.

E.P.P. (subsoils) for instance showed the best relationship for the group with 8% clay in the topsoil, while P.A.R. (topsoils) was the best in the 12-16% clay group.

When the three groups with different clay contents in the topsoils are considered, it is evident that E.P.P. (subsoils) expresses a much better relationship than either NH_4Ac extractable K (topsoils) or exchangeable K (topsoils).

This same trend is evident when the soils are grouped according to clay contents of the subsoils. The best relationship, for both groups, is again expressed by E.P.P. (subsoils).

In the group of soils where (Ca+Mg)/K exceeds 15 in the topsoil, the best relationship was found for E.P.P. (topsoils) versus leaf K content. However, for the group where (Ca+Mg)/K (topsoils) is less than 15,(Ca + Mg)/K (subsoils) gave the best relationship.

When initial NH_4Ac potassium in the topsoil is less than 0,20 me/100g, E.P.P. (topsoils) gave the best relationship. For the group where NH_4Ac potassium in topsoils was 0,20 - 0,30 me/100g, E.P.P. (subsoils) strongly correlates with leaf K content to give the best relationship. In the soils with 0,30 - 0,40 me/100g K considerable weakening of relationship between all the parameters and leaf K content occurred. However,(Ca+Mg)/K (subsoils) still expressed a better relationship than either NH_4Ac-K (topsoils) or exchangeable K (topsoils). For these experiments with the highest initial NH_4Ac exchangeable K content in the topsoils (> 0,40 me/100g), the relationship between (Ca+Mg)/K (subsoils) and leaf K content was better than the relationships between all the other parameters and leaf K content.

When C.E.C. in the topsoil is less than 6 me/100g, the best relationship is expressed by E.P.P. (subsoils) in twelve of the fifteen experiments (Appendix 27). However, when C.E.C. in the topsoil exceeds 6 me/100g, then NH_4Ac-K in the topsoil expresses the best relationship. Once again there seems to be a limitation on the value of NH_4Ac-K as a predictor of K uptake by cotton grown on the soils of Vaalharts.

In the group with E.P.P. (topsoils) of less than 4 the highest correlation coefficient was between E.P.P. (topsoils) and leaf K. In this case the relationship for exchangeable potassium was almost the same, with r values of 0,6912** and 0,6745** respectively. If initial E.P.P. in the topsoils is greater than 4, the best relationship is expressed by E.P.P. (subsoils).

For the five experiments with more than 8% clay in the subsoils, there also exists a good relationship between yield and leaf K content. This relationship is also apparent when (Ca+Mg)/K is less than 15.

Considering these various relationships for leaf K content, it is evident that parameters other than exchangeable potassium in the soil also governs potassium nutrition of cotton. These are E.P.P. of both the topsoils and the subsoils, (Ca+Mg)/K (subsoils) and P.A.R. (topsoils). There is also some indication that subsoil potassium is important when soil potassium is related to leaf K content, because in nine of the thirteen groups of soils considered, subsoil potassium parameters expressed the best relationship with leaf K content.

Limited evidence was found, in two groups of soils only, that there exists a relationship between leaf K content and yield.

7.4.3 Relationships for yield.

When potassium fertilizers are applied to soils, with low levels of available K, significant yield responses are expected. It is inferred that applied potassium will affect leaf K content positively and ultimately also the yield. Again bearing in mind that relatively large quantities of potassium were applied to the experimental soils, with varying initial available soil K contents, certain significant relationships between soil exchangeable K parameters and yield could be expected.

The results for the various parameters tested and yield are presented in Appendix 28. The best relationships for all the groups of soils are summarized in Table 7.10.

The correlation coefficients for these relationships are generally smaller than those for leaf potassium.

Table 7.10. Summary of the best relationships between yield and different parameters for grouped data.

GROUPING	PARAMETER	r VALUE
10% Clay in topsoils (3 experiments)	(Ca + Mg)/K leaves	0,47782**
8% Clay in topsoils (7 experiments)	(Ca + Mg)/K topsoils	0,65814**
14% Clay in subsoils (1 experiment)	K leaves	0,34884**
10% Clay in subsoils (3 experiments)	(Ca + Mg)/K topsoils	0,10996
8% Clay in subsoils (7 experiments)	(Ca + Mg)/K topsoils	0,55742**
(Ca+Mg)/K Topsoils > 15 (8 experiments)	(Ca + Mg)/K topsoils	0,49223**
(Ca+Mg)/K Topsoils < 15 (2 experiments)	Exch-K topsoils	-0,80601**

Table 7.10 (continued)....

GROUPING	PARAMETER	r VALUE
NH_4Ac-K (me/100g) TOPSOILS		
< 0,20 (3 experiments)	(Ca + Mg)/K topsoils	0,75602**
0,20 - 0,30 (4 experiments)	E.P.P. subsoils	0,29729**
0,30 - 0,40 (3 experiments)	(Ca + Mg)/K topsoils	0,70209**
C.E.C. (me/100g) TOPSOILS		
4 - 5 (2 experiments)	K leaves	0,80686**
5 - 6 (7 experiments)	(Ca + Mg)/K topsoils	0,40616**
> 6 (1 experiment)	(Ca + Mg)/K subsoils	0,17359

Table 7.10 (continued)....

GROUPING	PARAMETER	r VALUE
E.P.P. TOPSOILS		
< 4 (5 experiments)	(Ca + Mg)/K topsoils	0,67230**
> 4 (5 experiments)	Exch-K topsoils	0,55314**

However, grouping of the data improved the relationships between various parameters and yield (Table 7.8 and 7.10). For instance, when the (Ca+Mg)/K (topsoils) is correlated with yield for the pooled data the correlation coefficient of 0,49217** indicates the non - existence of any relationship. For the group of experiments with 8% clay in the topsoil this relationship is increased considerably ($r = 0,65814^{**}$). When the clay content of the topsoils increases to 10% exchangeable K (topsoils) gives the best relationship. The difference in the relationship between (Ca+Mg)/K (topsoils) and exchangeable K (topsoils) is very small, suggesting that for this group of soils there is virtually no difference between (Ca+Mg)/K (topsoils) and exchangeable K (topsoils) as a predictor of cotton yield.

There are no meaningful significant relationships for the groups with more than 8% clay in the subsoil. This is not surprising in light of generally poor correlation coefficients for yields.

For those soils with (Ca+Mg)/K (topsoils) greater than 15 there is a correlation between yield and (Ca+Mg)/K (topsoils) of 0,4922**, which is considerably better than the value for either NH_4Ac extractable K or exchangeable K for topsoils. However, for those soils with (Ca+Mg)/K less than 15, exchangeable K (topsoils) expressed the best relationship with very little difference between exchangeable K (topsoils) and NH_4Ac-K topsoils. Generally values of (Ca+Mg)/K of 10-15 for topsoils are regarded as indicative of adequate potassium supply (Hagin, 1982; v.d. Merwe, 1972). It seems therefore, that if (Ca+Mg)/K > 15, implying that potassium is in short supply, exchangeable potassium does not reflect potassium requirements for cotton. However, when (Ca+Mg)/K is less than 15, implying adequate potassium supply, exchangeable potassium of the topsoils can be used to predict cotton yield.

For the group of soils with less than 0,20 me/100g initial exchangeable K in the topsoils,(Ca + Mg)/K (topsoils) gave the best relationship. Considering the group of experiments where exchangeable potassium is in the range 0,20 - 0,30 me/100g, no meaningful relationship between yield and any of the parameters was found. Although not meaningful, the correlation coefficients of -0,2973** for E.P.P. (subsoils) was much higher than the -0,0317 for exchangeable potassium in the topsoils.

In the group of soils with 0,30 - 0,40 me/100g, NH_4Ac extractable K in the topsoils, the parameter (Ca+Mg)/K (subsoils) expresses a slightly better relationship than the same parameter for topsoils.

When C.E.C. for topsoils is 4-5 me/100g the best relationship with yield is expressed by the parameter K - leaves. For the group of soils with C.E.C. values of 5-6 me/100g the ratio (Ca+Mg)/K (topsoil) gave the best correlation with yield. However, for the soil with a C.E.C. value of greater than 6 me/100g no meaningful relationship was found between any parameter and yield.

The best relationship for the group of soils, with E.P.P. (topsoils) of less than 4, is expressed by

(Ca+Mg)/K. However, when E.P.P. is greater than 4, the relationship between yield and any soil parameter is best expressed by exchangeable K of the topsoil. Regarding the relationships between the various soil parameters and yield of the grouped data, it is evident that as in the case for the leaf K content data, there are parameters other than exchangeable potassium that should be taken into account when cotton yield is predicted. Parameters that should be considered include (Ca+Mg)/K (topsoils), (Ca+Mg)/K (subsoils) and E.P.P. (subsoils).

The highest yields for the zero treatment were recorded for experiments 5C5 and Osblok (Appendix 25). On these soils applied potassium had no, or very little effect on the exchangeable potassium (Table 5.1).

The leaf K content for the zero treatment of experiment 5C5 was very low, in fact it was the lowest of those experiments which were ultimately harvested. It appears therefore, that large quantities of applied K to some of these soils have very little influence on soil and leaf K. Yet large seed cotton yields of over 3 tons were realized on these soils.

It has been stressed that the exchangeable potassium content of these soils is a poor measure of available K and hence of expected yield. If no other factor could be held responsible for limiting yields it is imperative that a reliable measure of K availability be found. The results of two experiments, viz. 6Q1 and Osblok, are however, very significant with regard to the relationship between exchangeable K and yield. There is a highly significant negative correlation coefficient of -0,806** for this relationship (Appendix 28). Bearing the findings of Wessels & Pretorius (1953) in mind, viz. depression of yield due to K fertilization, there appears to be an unknown factor which governs K nutrition of crops on these soils.

There are also indications that soils with extremely low "available" K contents, viz. that of experiment 5C5 with 0,15me exchangeable K /100g, can produce relatively high yields (Appendix 25). The aforementioned soil produced 3769kg of seed cotton per ha for the zero K treatment. Additional K did not improve the yields.

Furthermore, leaf K content is also negatively correlated with size of yield. This also emphasizes the anomalous behaviour of K as a plant nutrient in this soil/crop combination. No explanation is offered, but it is strongly suggested that further investigations involving the effects of climate, soil physical conditions, water regime etc., must be carried out at Vaalharts.

7.4.5 Regression Models.

In order to find out which one of the parameters tested was the most reliable predictor of yield, the yield data was fitted to a regression model in all possible combinations.

The models consisted of one parameter at a time, combinations of two parameters, combinations of three parameters etc., until all combinations of the ten parameters were fitted to the model.
The parameters were numbered as follows:-

V2 = E.P.P. subsoils
V3 = E.P.P. topsoils
V4 = (Ca + Mg)/K subsoils
V5 = (Ca + Mg)/K topsoils
V6 = Leaf K
V7 = Exch-K topsoils
V8 = P.A.R. topsoils
V9 = Yield
V10 = NH_4Ac-K topsoils
V11 = (Ca + Mg)/K leaves

The following is a summary of the results obtained

(Table 7.11) and includes only the highest R^2 values for each of the various combinations:

Table 7.11. R^2 Values for various regression models fitted to the yield data.

NUMBER IN MODEL	PARAMETER	R^2 VALUE
1	V5	0,2422*
2	V4 V5	0,3143**
3	V5 V6 V8	0,3591**
4	V2 V3 V5 V11	0,3841**
5	V2 V5 V7 V8 V11	0,4044**
6	V2 V3 V5 V7 V8 V11	0,4153**
7	V2 V3 V5 V6 V7 V8 V11	0,4174**
8	V2 V3 V4 V5 V6 V7 V8 V11	0,4182**
9	V2 V3 V4 V5 V6 V7 V8 V10 V11	0,4186**

The R^2 values increase as the number of parameters are increased (Table 7.11). Although the R^2 values are of a low order (Groeneveld, 1983) it is interesting to note that when only one parameter at a time is fitted to the model, V5 ((Ca+Mg)/K topsoils) has the highest R^2 value. In all the successive combinations, V5 is always present in the best combination.

It is also meaningful to note that V10 (NH_4Ac-K) appears only when all parameters are fitted to the model. Evidence, once again that other parameters than exchangeable K should be considered when cotton yield is to be predicted for the Vaalharts situation.

CHAPTER 8

A POTASSIUM SUPPLY BUDGET

In view of the lack of any consistant behaviour of potassium, either native or applied in these soils, one other approach was attempted and a potassium supply budget was calculated.

For this purpose the amounts of nutrients mobilised by a cotton crop as presented by Fauconnier (1978) was used and the results are presented in Table 8.1.

Initial NH_4Ac-K ranged from 0,10 meK/100g to 0,44 meK/100g for the harvested experiments.

From Table 8.1 it can be seen that the differences between amounts of potassium calculated for crop removal and the amounts of potassium applied is quite large, normally resulting in a loss.

Although an indirect method of calculation is used here (whole plant samples were not analised) some indication is found that the soils are capable of fixing quite large quantities of potassium. This is in accordance with the findings of Van der Merwe (1973).

TABLE 8.1 CALCULATED AMOUNTS OF POTASSIUM REMOVED BY THE CROP

		YIELD KgK/ha	SOIL Exc.K me/100g	SOIL KgK/ ha	SEED-COTTON KgK/ha	CAPSULES ROOTS LEAVES STEMS KgK/ha	TOTAL	GAIN or LOSS KgK/ha			YIELD KgK/ha	SOIL Exc.K me/100g	SOIL KgK/ ha	SEED-COTTON KgK/ha	CAPSULES STEMS ROOTS LEAVES KgK/ha	TOTAL	GAIN or LOSS KgK/ha
1B2	1	3296	-	-	-	-	-	-	OSBLOK	1	3784	-	-	-	-	-	-
	2	3388	0,05	78	26,6	98,8	203,4	+70,4		2	3418	-0,01	-15,6	26,9	53,6	64,9	-68,1
	3	3433	0,09	140,4	26,9	99,8	267,1	+ 2,1		3	3250	-0,01	-15,6	25,6	51,5	61,5	-203,5
	4	3342	0,13	202,8	26,3	97,8	326,9	-71,1		4	3113	0,01	15,6	24,1	59,8	99,5	-298,5
	5	3494	0,13	202,8	27,4	101,9	332,1	-197,9		5	3555	0,04	62,4	28,0	51,5	141,9	-388,1
4B4	1	2991	-	-	-	-	-	-	SKAAP	1	1892	-	-	-	-	-	-
	2	2966	0,04	62,4	23,2	86,3	171,9	+38,9	BLOK	2	1831	0,05	78,0	14,4	53,6	146,0	+13
	3	2807	0,08	124,8	22,1	82,2	229,1	-35,9		3	1770	0,11	171,6	13,9	51,5	237,0	-28
	4	2594	0,10	156,0	20,4	75,9	252,3	-145,7		4	2045	0,11	171,6	16,1	59,8	247,5	-150,5
	5	2801	0,15	234,0	22,0	81,6	337,6	-192,4		5	1770	0,15	234,0	13,9	51,5	299,4	-230,6
4C5	1	2594	-	-	-	-	-	-	4Q4	1	2151	-	-	-	-	-	-
	2	2624	0,03	46,8	20,6	76,4	143,8	+10,8		2	2380	0	0	17,6	65,5	83,1	-49,9
	3	2639	0,05	78,0	20,7	77,0	175,7	-89,3		3	2243	0,04	62,4	17,5	65,0	144,9	-120,1
	4	2685	0,08	124,8	21,1	78,5	224,4	-173,6		4	2045	0,04	62,4	16,1	59,8	138,3	-259,7
	5	2502	0,19	296,4	19,6	72,5	388,8	-141,2		5	2185	0,12	187,2	17,2	64,0	268,4	-261,6
6L8	1	3098	-	-	-	-	-	-	24D10	1	1984	-	-	-	-	-	-
	2	3037	0,04	62,4	23,9	88,9	175,2	+42,2		2	1923	0,01	15,6	15,1	56,2	86,9	-46,1
	3	3235	0,07	109,2	25,5	94,6	229,3	-35,7		3	1938	0,04	62,4	12,0	56,7	131,1	-133,9
	4	2731	0,05	78,0	21,4	79,6	179,0	-219,0		4	1938	0,05	78,0	12,0	56,7	146,7	-251,3
	5	3159	0,17	265,2	24,8	92,0	382,0	-148,0		5	1816	0,10	156,0	14,3	53,0	223,3	-306,7
6Q1	1	2151	-	-	-	-	-	-	5C5	1	3769	-	-	-	-	-	-
	2	2151	0,06	93,6	16,9	62,9	173,4	-40,4		2	3937	-0,01	-15,6	30,9	114,9	130,2	- 2,8
	3	2212	0,09	140,4	17,4	64,5	222,3	-42,7		3	3876	0,01	15,6	30,5	113,4	159,5	-105,5
	4	2395	0,08	124,8	18,9	70,2	213,9	-184,1		4	3952	0,01	15,6	31,1	115,4	162,1	-235,9
	5	2273	0,15	234,0	17,9	66,6	318,5	-211,5		5	3632	0	0	28,6	106,1	296,8	-233,2

CHAPTER 9

POT EXPERIMENT AT THE UNIVERSITY OF THE ORANGE FREE STATE

9.1 INTRODUCTION

In order to substantiate the results obtained in the field trials i.e. that other parameters than NH_4Ac extractable potassium are better predictors of cotton yield, ten soils were selected for a pot experiment in 1980. The soils were selected to provide a wide range of exchangeable potassium values.

The results of this investigation will be dealt with in the following sections.

9.2 PROCEDURE

Soil samples were collected from the field experimental sites for analysis and inclusion in the pot experiment. Enough soil was collected from each site to fill six 25 liter pots. Three pots were used as a control for each soil and received no potassium application. The other three pots received the equivalent of 1000 kg/ha potassium. All the pots received a standard dressing equivalent to 120 kg/ha nitrogen, 50 kg/ha phosphorus and 5 kg/ha zinc. The soils were kept at field capacity and three cotton seeds per pot were planted. After germination the plants were thinned out to one plant per pot. The plants were allowed to grow to full maturity. At 130 days leaf samples were collected, dried and analysed in the same way as described under section 4.5.2.At maturity yield samples were collected as well as soil samples from each pot. Soil samples were analysed in the same way as described under section 4.5.1.

9.3 RESULTS AND DISCUSSION

9.3.1 SOIL ANALYSIS RESULTS

General analytical data for the soils before the pot experiment commenced are presented in Table 9.1.

As can be seen the range of exchangeable potassium included values as low as 0,11 me/100g and as high as 0,68 me/100. Phosphorus and zinc were present in adequate quantities.

TABLE 9.1 SOIL ANALYSIS BEFORE COMMENCEMENT OF THE EXPERIMENT

SOIL	me/100g Ca++	Mg++	K+	Na+	mg/kg Zn	P	pH_{H20}
1B2	2,73	1,17	0,37	0,20	3,9	31,0	7,0
1R1	2,17	0,97	0,20	0,16	2,2	24,5	6,8
4C5	1,36	0,73	0,17	0,12	2,1	25,1	5,7
6L8	1,81	1,08	0,19	0,10	7,2	30,5	7,1
6Q1	1,76	0,92	0,26	0,09	5,7	37,7	7,0
7Q1	1,83	0,97	0,29	0,13	2,	26,5	6,5
3M11	6,28	2,00	0,68	0,24	3,1	45,4	7,3
OSBLOK	1,51	0,80	0,14	0,15	2,0	16,3	5,8
SKAAP-BLOK	1,58	0,90	0,16	0,14	2,4	37,7	6,1
5C5	1,56	0,87	0,11	0,08	6,0	20,0	7,6

From Table 9.2 it is evident that, as in the case of the field experiments, exchangeable potassium was increased in all the soils through application of potassium fertilizer.

Depletion of exchangeable potassium by the growing cotton is very much in evidence when the potassium values before commencement of the pot experiment

TABLE 9.2 EXCHANGEABLE + WATERSOLUBLE CATIONS (me/100g) IN THE SOILS AT THE END OF THE POT EXPERIMENT

TRIAL NO	TREATMENT	Ca^{++}				Mg^{++}				K^{+}				Na^{+}		
		1	2	3	AVE	1	2	3	AVE	1	2	3	AVE	1	2	3
1B2	OK	1,47	1,20	0,92	1,19	0,62	0,43	0,35	0,47	0,11	0,04	0,03	0,06	0,14	0,16	0,10
	1K	1,06	1,09	1,16	1,10	0,45	0,47	0,47	0,46	0,28	0,23	0,23	0,25	0,16	0,11	0,18
1R1	OK	0,84	1,04	0,63	0,84	0,37	0,48	0,30	0,38	0,03	0,13	0,28	0,15	0,12	0,21	0,13
	1K	0,68	0,64	0,89	0,74	0,30	0,27	0,40	0,32	0,22	0,23	0,22	0,22	0,13	0,16	0,13
4C5	OK	0,68	0,73	0,73	0,71	0,27	0,27	0,28	0,27	0,04	0,03	0,03	0,03	0,10	0,10	0,12
	1K	0,68	0,63	0,72	0,67	0,27	0,25	0,32	0,28	0,21	0,24	0,25	0,23	0,08	0,07	0,11
6L8	OK	0,67	0,72	0,74	0,71	0,37	0,37	0,37	0.37	0,05	0,05	0,05	0,05	0,11	0,11	0,12
	1K	0,67	0,61	0,65	0,64	0,32	0,25	0,27	0.28	0,21	0,21	0,25	0,22	0,11	0,10	0,10
6Q1	OK	0,69	0,73	0,78	0,73	0,30	0,30	0,33	0.31	0,06	0,06	0,05	0,06	0,12	0,10	0,11
	1K	0,58	0,54	0,61	0,58	0,23	0,23	0,23	0.23	0,19	0,23	0,24	0,22	0,07	0,11	0,14
7Q1	OK	0,91	0,89	0,83	0,88	0,38	0,42	0,37	0.36	0,05	0,05	0,04	0,05	0,13	0,16	0,14
	1K	0,65	0,88	0,90	0,81	0,30	0,33	0,45	0.36	0,22	0,31	0,35	0,29	0,09	0,13	0,13
3M11	OK	0,66	3,04	2,96	2,27	1,00	0,88	0,92	0.93	0,21	0,20	0,22	0,21	0,17	0,21	0,18
	1K	3,33	3,71	3,12	3,39	1,00	1,08	0,95	1.01	0,40	0,39	0,38	0,39	0,18	0,19	0,16
OSBLOK	OK	0,79	0,82	0,87	0,83	0,35	0,45	0,43	0.41	0,03	0,08	0,05	0,05	0,09	0,10	0,10
	1K	0,85	0,70	0,80	0,78	0,42	0,37	0,50	0.43	0,32	0,27	0,34	0,31	0,21	0,10	0,14
SKAAP-BLOK	OK	0,74	0,56	0,72	0,67	0,30	0,30	0,37	0.32	0,05	0,04	0,05	0,05	0,10	0,09	0,08
	1K	0,52	0,69	0,67	0,63	0,27	0,33	0,37	0.32	0,25	0,29	0,26	0,27	0,04	0,08	0,09
5C5	OK	0,91	1,39	1,30	1,20	0,30	0,40	0,38	0.36	0,03	0,03	0,03	0,03	0,07	0,09	0,09
	1K	0,56	0,62	0,75	0,64	0,22	0,25	0,30	0.26	0,17	0,18	0,19	0,18	0,07	0,09	0,09

(Table 9.1) are compared with the zero treatment (Table 9.2). The exchangeable potassium was depleted strongly in the zero K pots by the cotton. It varied from 0,05 me/100g for soil 1R1 to 0,47 me/100g for soil 3M11, emphasizing the variability in the potassium supplying power of these soils.

Calculated potassium parameters were also affected by the application of potassium (Table 9.3). This is in accordance with the results of the field experiments (see Table 5.1).

9.3.2 LEAF ANALYSIS RESULTS

The cation contents of the leaves are presented in Table 9.4. In the field trials values for the calcium contents of the leaves ranged from 3 - 7,6% (section 6.2.4). In the pot experiment the values for calcium ranged from 2,68 - 4,77% which is lower than the extreme value of 6,9% reported by Burger (1983) but calcium deficiency can safely be ruled out.

Magnesium seems to be present in adequate quantities when compared with values reported by Helmy *et al* (1960)

TABLE 9.3 POTASSIUM PARAMETERS FOR THE SOILS OF THE U.O.F.S. POT EXPERIMENT

TRIAL NO.	TREATMENT	(Ca + Mg)/K me/100g				P.A.R.				E.P.P.			
		1	2	3	AVE	1	2	3	AVE	1	2	3	AVE
1B2	0K	19,0	40,8	42,3	34,0	0,35	0,14	0,13	0,21	1,43	0,52	0,39	0,78
	1K	5,4	6,8	7,1	6,4	1,02	0,81	0,79	0,87	3,65	3,00	3,00	3,22
1R1	0K	40,3	11,7	3,3	18,4	0,14	0,45	1,30	1,63	0,64	2,78	5,99	3,14
	1K	4,5	4,0	5,9	4,8	0,99	1,06	0,85	0,91	4,71	4,93	4,71	4,78
4C5	0K	23,8	33,3	33,7	30,3	0,17	0,12	0,15	0,15	0,75	0,56	0,56	0,62
	1K	4,5	3,5	4,2	4,1	0,97	1,12	1,08	1,06	3,94	4,50	4,69	4,38
6L8	0K	20,8	21,8	22,2	21,6	0,20	0,20	0,22	0,21	0,88	0,88	0,88	0,88
	1K	4,7	4,1	3,9	4,2	0,93	0,99	1,15	1,02	3,70	3,70	4,41	3,94
6Q1	0K	16,5	17,2	22,2	18,6	0,26	0,24	0,22	0,24	1,13	1,13	0,94	1,07
	1K	4,3	3,4	3,5	3,7	0,94	1,17	1,17	1,09	3,57	4,32	4,50	4,13
7Q1	0K	7,9	19,6	17,6	15,0	0,19	0,21	0,16	0,19	0,60	0,60	0,48	0,56
	1K	10,9	12,3	10,71	11,3	1,01	1,26	1,36	1,21	2,64	3,72	4,20	3,52
3M11	0K	25,8	26,2	30,0	27,3	0,73	0,45	0,49	0,56	1,97	1,87	2,06	1,97
	1K	4,3	3,9	3,9	4,0	0,85	0,81	0,85	0,84	3,75	3,66	3,56	3,66
OSBLOK	0K	36,3	15,9	26,0	26,1	0,13	0,13	0,20	0,15	0,53	1,41	0,88	0,94
	1K	4,0	4,0	3,8	3,9	1,27	1,19	1,33	1,26	5,64	4,76	6,00	5,47
SKAAP-BLOK	0K	20,8	21,5	21,8	21,4	0,20	0,19	0,22	0,20	0,93	0,75	0,94	0,87
	1K	3,2	3,5	4,0	3,6	1,27	1,29	1,14	1,23	4,69	5,44	4,88	5,00
5C5	0K	40,3	59,7	56,0	52,0	0,20	0,11	0,11	0,12	0,69	0,69	0,69	0,69
	1K	4,6	4,8	5,5	5,0	0,84	0,87	0,84	0,85	3,93	4,16	4,39	4,16

TABLE 9.4 CATION CONTENTS OF THE LEAVES (%)

SOIL NO	TREATMENT	Ca++				Mg++				K+				Na+			
		1	2	3	AVE	1	2	3	AVE	1	2	3	AVE	1	2	3	AVE
1B2	OK	2,59	2,91	2,54	2,68	0,47	0,31	0,68	0,49	1,01	0,27	0,89	0,72	0,17	0,10	0,22	0,16
	1K	2,85	2,95	4,14	3,31	0,45	0,50	0,71	0,55	3,31	2,81	1,85	2,66	0,07	0,05	0,23	0,12
1R1	OK	3,88	5,92	3,36	4,39	0,37	0,62	0,88	0,62	2,62	2,30	2,16	2,36	0,05	0,16	0,14	0,12
	1K	4,70	4,55	4,70	4,65	0,23	0,52	0,13	0,29	1,48	4,00	0,91	2,13	0,02	0,17	0,03	0,07
4C5	OK	3,50	4,17	3,37	3,68	0,53	0,81	0,74	0,69	0,58	1,27	1,04	0,96	0,10	0,25	0,21	0,19
	1K	2,95	2,85	3,10	2,97	0,51	0,46	0,54	0,50	2,70	3,45	2,26	2,80	0,05	0,05	0,04	0,05
6L8	OK	3,70	2,63	4,40	3,58	0,70	0,31	0,77	0,59	1,49	0,54	2,10	1,37	0,12	0,02	0,09	0,08
	1K	3,20	3,38	3,18	3,25	0,50	0,75	0,62	0,62	3,22	5,78	3,40	3,43	0,04	0,06	0,05	0,05
6Q1	OK	3,00	3,65	2,95	3,20	0,94	0,69	0,74	0,79	4,48	2,42	6,56	4,50	0,15	0,09	0,10	0,11
	1K	3,10	2,85	3,73	3,22	0,47	0,58	0,58	0,54	4,55	2,75	2,30	3,20	0,05	0,06	0,07	0,06
7Q1	OK	3,80	3,65	3,58	3,68	0,65	0,67	0,97	0,76	1,47	1,75	1,72	1,65	0,20	0,17	0,08	0,15
	1K	2,70	3,38	3,40	3,16	0,55	0,75	0,66	0,65	2,89	5,78	4,56	4,41	0,05	0,06	0,08	0,06
3M11	OK	3,35	4,34	4,88	4,19	0,48	0,63	0,50	0,54	2,12	2,31	2,72	2,38	0,03	0,02	0,04	0,03
	1K	3,24	2,42	4,10	3,25	0,67	0,58	0,45	0,57	3,27	3,92	3,33	3,51	0,01	0,02	0,02	0,02
OSBLOK	OK	2,50	3,78	3,95	3,41	0,82	1,10	1,45	1,12	0,92	3,67	1,66	2,08	0,25	0,07	0,09	0,14
	1K	3,40	3,60	3,35	3,45	0,81	0,60	0,72	0,71	4,64	5,18	7,58	5,80	0,05	0,04	0,07	0,05
SKAAP-BLOK	OK	2,80	6,80	3,09	4,23	0,74	0,25	0,73	0,57	0,96	0,14	0,88	0,66	0,21	0,09	0,19	0,16
	1K	3,25	1,40	3,58	2,74	1,08	0,27	0,37	0,57	5,50	2,23	3,60	3,78	0,01	0,01	0,05	0,02
5C5	OK	3,75	5,19	5,36	4,77	0,77	1,89	1,29	1,32	1,28	0,92	0,57	0,92	0,15	0,33	0,14	0,21
	1K	2,90	3,90	2,70	3,17	0,53	0,13	0,23	0,30	2,92	0,83	0,84	1,53	0,05	0,02	0,01	0,03

Potassium application had an effect on the uptake of sodium (Table 9.4). For all the soils the amount of sodium present in the leaves from control pots is higher than that of the leaves from the potassium treated pots. It seems therefore that sodium did not interfere with potassium uptake.

In general 1,2% potassium in cotton leaves is regarded as critical for good crop growth (section 6.2.7). Values that can be associated with cotton deficiency were found in leaves from four of the soils, but only in the leaves from control pots (Table 9.4). The results from the potassium treated pots indicate adequate quantities of potassium present in the leaves.

Phosphorus values of 0,2 - 4% seem to fall in the range regarded by Burger (1983) as adequate for cotton, three soils falling outside this range (Table 9.5). In general it can be concluded that these plants were adequately supplied with phosphorus, especially in light of the rather high initial soil analysis (Table 9.1) and the subsequent dressing of an equivalent of 50kg P per ha.

TABLE 9.5 MICRONUTRIENT AND PHOSPHORUS CONTENTS OF THE LEAVES

SOIL NO	TREATMENT	Zn++ (mg/kg)				Fe++ (mg/kg)				Mn++ (mg/kg)				P%			
		1	2	3	AVE	1	2	3	AVE	1	2	3	AVE	1	2	3	AVE
1B2	OK	255	93	209	186	56	128	250	147	83	93	205	127	0,24	0,07	0,29	0,20
	1K	850	600	249	566	96	180	254	177	100	85	301	162	0,25	0,24	0,33	0,27
1R1	OK	557	187	65	270	398	484	424	435	387	458	220	355	0,23	0,55	0,48	0,42
	1K	263	212	548	341	62	114	370	182	109	339	152	200	0,08	0,23	0,05	0,12
4C5	OK	307	1375	289	657	143	171	231	182	296	207	195	233	0,18	0,25	0,17	0,20
	1K	857	1050	950	952	67	65	62	65	98	80	125	101	0,19	0,24	0,24	0,22
6L8	OK	200	117	250	189	167	194	207	189	165	88	150	134	0,43	0,25	0,48	0,38
	1K	350	287	243	293	128	171	201	167	80	112	109	100	0,27	0,30	0,42	0,33
6Q1	OK	103	240	191	181	156	126	146	143	256	150	234	213	0,36	0,32	0,31	0,33
	1K	400	850	1022	757	266	121	164	184	800	95	181	359	0,22	0,26	0,23	0,24
7Q1	OK	300	300	191	264	160	199	171	177	255	135	234	208	0,28	0,26	0,26	0,27
	1K	280	217	257	251	42	163	180	128	70	138	119	109	0,14	0,23	0,19	0,19
3M11	OK	506	70	76	215	202	205	388	265	115	136	148	133	0,29	0,30	0,32	0,30
	1K	134	117	100	117	282	201	146	210	156	134	140	143	0,28	0,32	0,28	0,29
OSBLOK	OK	300	163	139	201	98	111	87	99	110	112	180	134	0,22	0,36	0,30	0,29
	1K	156	140	120	139	172	186	164	174	172	260	100	177	0,30	0,40	0,26	0,32
SKAAP-BLOK	OK	350	158	499	336	231	97	303	210	160	66	182	136	0,29	0,06	0,29	0,21
	1K	202	176	129	167	110	67	189	122	117	110	182	136	0,37	0,16	0,31	0,28
5C5	OK	100	34	85	73	165	293	266	241	145	259	119	174	0,32	0,40	0,22	0,31
	1K	70	196	143	136	156	138	98	131	120	85	34	80	0,21	0,05	0,06	0,11

Micronutrient contents of the leaves also indicate an adequate supply of zinc, and manganese (Table 9.5). Although the inside of the pots were treated with bitumen, the extremely high zinc contents of the leaves suggests that contamination still took place from the galvanized pots.

9.4 YIELD

The results show clearly that potassium application resulted in lower yields in the case of seven of the ten soils (Table 9.6).

9.5 STATISTICAL TREATMENT OF THE DATA

9.5.1 ANALYSIS OF VARIANCE

Analysis of variance results for NH_4Ac-K, P.A.R., $\frac{Ca+Mg}{K}$, E.P.P., yield and leaf K are presented in Tables 9.7 and 9.8.

Application of potassium significantly influenced all the soil parameters for all the soils except soil 1R1. This soil had an initial NH4Ac-K content of

TABLE 9.6 YIELD mg SEEDCOTTON/POT U.O.F.S. POT EXPERIMENT

TRIAL NO	TREATMENT	1	2	3	AVE
1B2	OK	32,41	48,56	34,47	38,48
	1K	39,70	50,39	47,22	45,77
1R1	OK	43,55	43,95	39,99	42,50
	1K	36,83	16,01	7,65	20,18
4C5	OK	48,48	58,72	47,02	51,43
	1K	28,85	8,50	26,81	21,39
6L8	OK	41,17	51,90	30,34	41,14
	1K	50,60	23,32	5,77	26,56
6Q1	OK	53,58	43,39	37,71	44,89
	1K	56,52	52,02	41,46	50,00
7Q1	OK	46,66	67,94	61,02	58,54
	1K	12,64	2,57	10,83	8,68
3M11	OK	48,36	54,26	41,57	48,06
	1K	60,77	53,05	56,79	56,87
OSBLOK	OK	16,69	11,25	9,57	12,50
	1K	5,09	1,12	6,43	4,21
SKAAPBLOK	OK	41,64	30,70	26,03	37,79
	1K	1,83	1,95	11,49	5,09
5C5	OK	36,46	57,13	43,95	45,85
	1K	38,49	45,46	36,00	39,98

TABLE 9.7 INITIAL NH_4Ac-K OF THE SOILS IN ASCENDING ORDER

TRIAL NO		K_1-Ko	SIGNIFICANCE	LEAF K_1-Ko	SIGNIFICANCE
5C5	0,11	+ 0,19	Kl > Ko**	+ 0,61	NS
OSBLOK	0,14	+ 0,27	Kl > Ko**	+ 3,72	Kl > Ko*
SKAAP-BLOK	0,16	+ 0,22	Kl > Ko**	+ 3,12	Kl > Ko*
4C5	0,17	+ 0,20	Kl > Ko**	+ 1,84	Kl > Ko*
6L8	0,19	+ 0,17	Kl > Ko**	+ 2,06	Kl > Ko*
1R1	0,20	+ 0,07	NS	- 0,52	NS
6Q1	0,26	+ 0,16	Kl > Ko**	- 1,30	NS
7Q1	0,29	+ 0,24	Kl > Ko**	+ 2,76	Kl > Ko*
1B2	0,37	+ 0,19	Kl > Ko**	+ 1,94	Kl > Ko*
3M11	0,68	+ 0,18	Kl > Ko**	+ 1,13	Kl > Ko*

TABLE 9.8 THE EFFECT OF POTASSIUM APPLICATION ON VARIOUS SOIL AND LEAF PARAMETERS AS WELL AS YIELD (INDIVIDUAL SOILS)

TRIAL NO	NH_4Ac-K	P.A.R.	$\frac{Ca + Mg}{K}$	E.P.P.	YIELD	LEAF K
1B2	Kl>Ko**	Kl>Ko**	Kl>Ko*	Kl>Ko**	NS	Kl>Ko*
1R1	NS	NS	NS	NS	NS	NS
4C5	Kl>Ko**	Kl>Ko**	Kl>Ko**	Kl>Ko**	Ko>Kl*	Kl>Ko*
6L8	Kl>Ko**	Kl>Ko**	Kl>Ko**	Kl>Ko**	NS	Kl>Ko*
6Q1	Kl>Ko**	Kl>Ko**	Kl>Ko**	Kl>Ko**	NS	NS
7Q1	Kl>Ko**	Kl>Ko**	NS	Kl>Ko**	Ko>Kl**	Kl>Ko*
3M11	Kl>Ko**	Kl>Ko*	Kl>Ko**	Kl>Ko**	NS	Kl>Ko*
OSBLOK	Kl>Ko**	Kl>Ko**	Kl>Ko*	Kl>Ko**	Ko>Kx*	Kl>Ko*
SKAAP-BLOK	Kl>Ko**	Kl>Ko**	Kl>Ko**	Kl>Ko**	Ko>Kl**	Kl>Ko*
5C5	Kl>Ko**	Kl>Ko**	Kl>Ko**	Kl>Ko**	NS	NS

0,20 me/100g (Table 9.1). The average NH_4Ac-K content for the control was 0,15 me/100g (Table 9.2) indicating that very little potassium was removed by growing cotton.

Attention is drawn to the data of the field trials (Table 6.1) for this soil. The increase in NH_4Ac-K through application of potassium resulted in a decrease of leaf-K content. The results of the pot experiment (Table 9.7), are very similar.

The pattern of potassium uptake in the field trials (Table 6.1) was repeated in the pot experiment for six of the soils viz 1R1, 5C5, SKAAPBLOK, 4C5, 6L8 and 1B2. In soils OSBLOK, 6Q1 7Q1 and 3M11 the pattern was reversed. These soils have the highest clay contents.

Potassium applications had a highly significant effect on yield in only two of the soils viz. SKAAPBLOK and 7Q1. Significance at the 5% level was also attained in two soils viz. 4C5 and OSBLOK (Table 9.8). The negative effects are in accordance with the results of Wessels and Pretorius (1953). Significance was attained for leaf-K in seven of the soils as against three of the field trials.

9.5.2 RELATIONSHIPS BETWEEN VARIOUS SOIL PARAMETERS AND LEAF-K

In only three of the soils no relationship was found between any of the soil parameters and leaf-K viz. 1R1, 6Q1 and 5C5 (Table 9.9). The first two soils responded in the same way in the field trials where no relationship between applied potassium and leaf-K could be found (Table 7.5).

Although NH_4Ac-K was highly significantly correlated with leaf-K in two of the soils and significantly correlated in three more soils, it was never the best relationship (Table 9.9). This substantiates the results of the field trials (Table 7.5) and again emphasises that NH_4Ac-K is not a reliable predictor of the potassium nutrition of cotton.

9.5.3 RELATIONSHIPS BETWEEN VARIOUS SOIL AND LEAF POTASSIUM PARAMETERS AND YIELD

Significant and highly significant relationships exist between the soil and leaf parameters and yield in only four of the soils viz.4C5, 7Q1, OSBLOK and SKAAPBLOK (Table 9.10). The parameter NH_4Ac-K was highly significantly correlated with

TABLE 9.9 RELATIONSHIPS BETWEEN VARIOUS SOIL PARAMETERS AND LEAF K FOR INDIVIDUAL SOILS

SOIL NO	NH_4Ac-K	P.A.R.	$\frac{Ca + Mg}{K}$	E.P.P.
1B2	0,93060**	0,94773**	0,85403*	0,93063**
1R1	0,13380	0,02975	0,14695	0,13279
4C5	0,899904*	0,91875**	0,85008*	0,89883*
6L8	0,89613	0,90492*	0,90612*	0,89598*
6Q1	0,52563	0,50499	0,57504	0,54216
7Q1	0,92812**	0,91424*	0,29323	0,92812*
3M11	0,90625*	0,63674	0,86429*	0,91734**
OSBLOK	0,89857*	0,84980*	0,90731*	0,89884*
SKAAPBLOK	0,79257	0,84236*	0,85255*	0,79263
5C5	0,32634	0,39124	0,43008	0,32669

TABLE 9.10 RELATIONSHIPS BETWEEN VARIOUS SOIL AND LEAF PARAMETERS AND YIELD FOR INDIVIDUAL SOILS

SOIL NO	NH_4Ac-K	P.A.R.	$\frac{Ca + Mg}{K}$	E.P.P.	LEAF K
1B2	0,32808	0,32405	0,25190	0,32889	0,21258
1R1	0,44139	0,36898	0,44049	0,44253	0,06259
4C5	0,90863	0,92622**	0,89703*	0,90849*	0,91023*
5L8	0,54267	0,56857	0,46638	0,54322	0,60965
6Q1	0,28261	0,29794	0,47410	0,25912	0,09680
7Q1	0,93363**	0,95132**	0,63504	0,93363**	0,86514*
3M11	0,68715	0,60160	0,76519	0,67554	0,41824
OSBLOK	0,80414	0,82657*	0,89080*	0,80378	0,71383
SKAAP-BLOK	0,92471**	0,94429**	0,92061**	0,92460**	0,78135
5C5	0,40865	0,44434	0,56591	0,40862	0,32641

yield in two of these cases, however it was never the best relationship as was the case in the field trials. The best relationship with yield is always expressed by one of the other parameters (Table 9.10).

9.6 CONCLUSIONS

This investigation served to confirm certain results found in the field trials. It is clear that potassium fertilization has a measureable influence on soil potassium status and also on potassium uptake in one way or another. Furthermore evidence was again found that NH_4Ac-K is not the best predictor of potassium uptake or yield for cotton grown in these soils. It is very significant that potassium fertilization suppressed yield in four of these soils. No satisfactory explanation for this phenomenon is offered. Antagonistic interference with magnesium uptake may be ruled out because this element is apparently sufficiently supplied in all these soils.

CHAPTER 10

DIFFERENT FRACTIONS OF POTASSIUM IN THESE SOILS

10.1 INTRODUCTION

Because of the anomalous behaviour of these soils to potassium applications, it was decided to investigate the various potassium fractions in some of the soils. A series of experiments were designed whereby various fractions of potassium could be characterized as well as an experiment that would shed light on the fixation properties of these soils.The results of these investigations will be discussed in this chapter.

10.2 EXPERIMENTAL PROCEDURE

10.2.1 EXPERIMENT 1 - HNO_3 EXTRACTABLE POTASSIUM

10g Soil was boiled in $100cm^3$ 1 N HNO_3 for 10 minutes, filtered, washed and diluted to $200cm^3$.

10.2.2 EXPERIMENT 2 - EXCHANGEABLE POTASSIUM

5g Soil was equilibrated with 25cm^3 NH_4Ac at pH7 for one hour and leached to 500 cm^3.

10.2.3 EXPERIMENT 3 - POTASSIUM FIXATION

10g Soil was wetted with distilled water in a 250cm^3 beaker.A KCl solution in 5cm^3 was then evenly spread, drop by drop, over the entire surface and allowed to airdry. The samples were then kept at 50°C for 48 hours and leached with NH_4Ac to determine exchangeable potassium. One series of samples received only an additional 5cm^3 of distilled water and serves as control.

The following range of KCl solutions was used:

1. 0 KCl/100g soil (Distilled water)
2. 0,5 me/100g soil
3. 1,0 me/100g soil

10.2.4 EXPERIMENT 4 - TOTAL POTASSIUM

0,5g Soil was milled to pass through a 0,063mm sieve, treated with 5cm^3 HF and 2 cm^3 60% $HClO_4$ and left for 10 minutes at room temperature.

The treated samples were then slowly heated on a sandbath until $HClO_4$ vapour was observed. The solutions were filtered and diluted to 100cm^3.

Duplicate samples were used in all the experiments and all the potassium extracts were analised by atomic absorption.

10.3 RESULTS AND DISCUSSION

The various fractions of potassium that were determined are presented in Table 10.1.

TABEL 10.1 DIFFERENT FRACTIONS OF POTASSIUM PRESENT IN THE SOILS (meK/100g SOIL)

SOIL NO	% CLAY	C.E.C. (SOILS)	HNO_3 - K	EXCH-K	TOTAL-K
OSBLOK	8	5,67	1,77	0,50	25,64
OSBLOK (SUBSOIL)	10	6,33	1,61	0,36	27,69
5C5	8	4,33	1,02	0,27	17,69
6Q1	10	5,33	1,15	0,38	25,64
1B2	10	7,67	1,68	0,25	17,95
6L8	10	5,67	1,32	0,52	32,82
7Q1	12	8,33	2,30	0,57	46,92
3M11	16	10,67	1,42	0,34	80,51

Although total potassium appears to be relatively high very little of this potassium is present in the exchangeable form. Generally exchangeable potassium is less than 2% of the total potassium present (Table 10.1). The variation in total potassium, when compared to the clay contents, implies differences in primary minerals that are present. Also total potassium appears not to be related to exchangeable potassium, suggesting differences in clay mineralogy.

If the potassium extracted by 1 N HNO_3 is regarded as the difficultly exchangeable fraction, it is evident that a very small portion of the total potassium is present in this form. It is expected that this fraction will vary with the type of clay mineral present. This is illustrated by the results for soil 1B2 where the third highest value for HNO_3 extractable potassium was recorded while total potassium was low and exchangeable potassium was the lowest.

The expected difference in clay mineral composition of these soils is further illustrated by comparing total potassium to exchangeable and HNO_3 extractable potassium. Soil 3M11 has the highest total potassium content but not the highest exchangeable potassium, nor the highest HNO_3 extractable potassium.

It seems that in general these soils are able to fix quite large quantities of added potassium (Table 10.2). When 0,5 me K/100g soil was added an average of 53,7% of the amount added was fixed. For the second series, where 1,0me/100g was added, the average amount fixed was 43,5%.

TABLE 10.2 AMOUNT OF POTASSIUM FIXED BY THE DIFFERENT SOILS

SOIL NO	% CLAY	CONTROL	me K/100g FIXED 0,5 me K/100g	 1,0 me K/100g
OSBLOK	8	0,496	0,257	0,370
OSBLOK (SUBSOIL)	10	0,313	0,253	0,427
5C5	8	0,250	0,288	0,465
6Q1	10	0,354	0,206	0,390
1B2	10	0,193	0,317	0,453
6L8	10	0,556	0,262	0,459
7Q1	12	0,561	0,273	0,427
3M11	16	0,353	0,293	0,490

Considering the relatively low clay contents of these soils (Table 10.2) this phenomenon indicates the presence of clay minerals capable of fixing large quantities of potassium.

10.4 CONCLUSIONS

These soils contain quite large quantities of total potassium but very little of the total potassium is present in the exchangeable form or the difficultly exchangeable form.

The overall results indicate differences in mineralogical composition of these soils which are generally regarded as fairly homogeneous.

Furthermore,quite large quantities of potassium added to these soils end up as fixed potassium. This may be considered as one reason why applied fertilizer potassium behaves in an unpredictable manner. It is known that fixed potassium, i.e. fixed against chemical extraction, may be quite available to root extraction. The term 'available' describes a complex situation and must not be confused with the term 'available quantity' as is often done. In the last analysis all the potassium present in a soil is available, not just the exchangeable K but also the non-exchangeable potassium. Only the degree of availability differs because of differences in primary mineral and clay mineral composition. For plants it is not so much the quantity of potassium which is important but the rate at which the required quantity is supplied. Because of the influence of the content and mineralogical composition of the clay fraction on the degree of availability it is necessary to identify the clay minerals in these soils.Further investigations with regard to the extent and severity of potassium fixation in these soils under field conditions are therefore recommended, in particular long term exhaustion experiments with various crops.

CHAPTER 11

THE MINI POT EXPERIMENT

11.1 INTRODUCTION

In order to confirm the anomalous behaviour of applied potassium in the field experiments and the U.O.F.S. pot experiment, seven soils were selected for the mini pot experiment. The soils were selected on the grounds of anomalous behaviour regarding a soil or leaf potassium parameter. Three soils were included because no significant soil potassium response could be found in the field trials, viz. OSBLOK, 5C5 and 7Q1. In the U.O.F.S. pot experiment all three these soils showed significant responses to applied potassium.

Regarding leaf potassium the absence of any significant response to applied potassium in the field trials was evident for all seven soils.

The results of the U.O.F.S. pot experiment indicated that only two soils, viz. 5C5 and 6Q1 did not respond positively to applied potassium.

This pot experiment also offered the opportunity to investigate a factor in K nutrition which was thus far not considered. Boron appears to have a marked influence on potassium nutrition of crops, notably on cotton (Heathcote & Smithson, 1984).These authors found a significant interaction on cotton yield between potassium and boron.

Leaf analysis values reported in literature indicate that less than 16mg/kg boron in leaf blades is associated with deficiency symptoms. Values of 21 - 80 mg/kg boron are regarded as normal (Bradford, 1966). Honish (1975) reported best cotton yields when leaf boron contents was in the range of 20 - 30 mg/kg.

The soils included in this investigation covered the whole range of clay contents viz 8% - 16% in the topsoils and also provided an adequate range of exchangeable potassium values. The exchangeable potassium ranged from 0,17 me/100g to 0,48 me/100g.

11.2 PROCEDURE

Soils were collected as described in section 9.2

The soils were sieved to remove clods, stones etc and a sample of each soil was taken. Eight pots of 4 kg each were filled with each soil. The equivalent of 120 kg N/ha, 80 kg P/ha and 3 kg Zn/ha was mixed into each pot. Four pots did not receive any potassium while the equivalent of 1000 kg K/ha as KCl was added and mixed into the other four pots. In this way four pots served as control for each soil and four pots served as potassium treatment. The pots were arranged in a completely randomized design and 4 cotton seeds planted to each pot. Pots were watered according to mass.

After emergence the plants were thinned to one plant per pot. The plants were grown for 8 weeks in the glasshouse at a day temperature of 23°C and a night temperature of 20° C. At 8 weeks the plant material was harvested and separated into leaf blades, petiole,stems and roots for each pot. Because of the short growing period composite plant material samples were used. Soil samples were collected from each pot.

Soil and leaf samples were analysed in the same way as described in sections 4.5.1 and 4.5.2 except boron was analysed according to the method described by Smales, Allen, Allwell and Jones (1969), for plant material and as described by Jackson (1958) for soils. Phosphorus in the soils was extracted according to the modified Isfei method described by Van der Merwe et al (1980) and according to the Bray 1 method described by Buys (1980).

11.3 RESULTS AND DISCUSSION

11.3.1 SOIL ANALYSIS

General analytical data for the soils before commencement of the investigation are presented in Tables 11.1 and 11.2. From these data it can be seen that no obvious fertility problems were to be

TABLE 11.1 GENERAL ANALYTICAL DATA FOR THE SOILS OF THE MINI POT EXPERIMENT

			mg/kg				pH	me/100g	
SOIL NO	Ca^{++}	Mg^{++}	K^{+}	Na^{+}	P	Zn	($CaCl_2$)	C.E.C.	S-VALUE
7Q1	645	173	172	14	10	1	5,8	4,33	5,14
6L8	407	129	187	3	8	3	5,3	3,61	3,58
6Q1	371	96	148	4	10	6	5,7	2,61	3,04
3M11	414	183	113	30	8	4	6,5	3,37	3,99
5C5	275	78	77	20	7	4	5,2	2,26	2,30
OSBLOK	274	109	145	7	9	4	5,9	2,49	2,67
1B2	617	172	68	29	8	4	6,7	3,91	4,82

TABLE 11.2 GENERAL ANALYTICAL DATA FOR THE SOILS OF THE MINI POT EXPERIMENT

	me/100g					
SOIL NO	Ca^{++}	Mg^{++}	K^{+}	Na^{+}	$\frac{Ca+Mg}{K}$	E.P.P.
7Q1	3,23	1,44	0,44	0,06	10,6	10,2
6L8	2,04	1,08	0,48	0,01	6,5	13,3
6Q1	1,86	0,80	0,38	0,02	7,0	14,6
3M11	2,07	1,53	0,29	0,13	12,4	8,6
5C5	1,38	0,65	0,20	0,09	10,2	8,8
OSBLOK	1,37	0,91	0,37	0,03	6,2	14,9
1B2	3,09	1,43	0,17	0,13	26,6	4,3

expected. The values recorded for the various cations, phosphorus and zinc are similar to those recorded during the field trials.

It is obvious from Tables 11.3 and 11.4 that the application of potassium fertilizer to these soils increased exchangeable potassium in accordance with the results of the field trials and the U.O.F.S. pot experiment.

The potassium depletion in this investigation varied quite markedly from that found in the U.O.F.S. pot experiment.

Comparing the zero potassium treatment values at the end of the mini pot experiment (Table 11.4) to the values of exchangeable potassium before commencement of the experiment (Table 11.2) it is clear that the depletion of potassium from these soils was much less than the depletion from the same soils in the U.O.F.S. pot experiment. This is understandable in view of the fact that the exchangeable potassium status of these soils had been altered by several years of cropping. The bulk samples for the two experiments were also not collected from the exact same spot. Furthermore,

TABLE 11.3 CATION CONTENTS OF THE SOILS INCLUDED IN THE MINI POT EXPERIMENT (mg/kg)

SOIL NO	TREAT MENT	Ca++ REPLICATION 1	2	3	4	AVE	Mg++ REPLICATION 1	2	3	4	AVE	K+ REPLICATION 1	2	3	4	AVE	Na+ REPLICATION 1	2	3	4	AVE
7Q1	OK	642	602	583	639	617	178	174	174	173	175	168	155	151	146	155	20	19	22	26	22
	IK	569	568	611	636	596	161	158	165	180	166	721	699	679	751	713	29	23	29	34	29
6L8	OK	288	283	309	315	299	119	122	127	136	126	105	110	113	101	107	18	20	20	13	18
	IK	307	267	311	273	290	115	97	122	102	104	682	531	525	409	536	26	20	24	20	23
6Q1	OK	373	369	356	355	363	111	110	110	98	107	138	104	107	139	122	18	17	20	15	18
	IK	353	322	325	349	337	101	87	89	94	93	893	554	599	724	692	23	18	23	23	22
3M11	OK	337	532	741	463	518	89	43	68	49	63	89	49	148	80	92	1	3	1	1	2
	IK	359	402	491	440	423	139	171	213	178	175	620	521	788	803	683	36	48	56	59	50
5C5	OK	182	303	308	295	272	48	112	103	112	94	75	72	68	51	67	1	27	24	27	20
	IK	290	243	287	251	268	90	76	87	89	86	501	495	548	683	557	32	27	35	37	33
USBLOK	OK	420	442	460	474	449	145	156	155	170	156	127	163	192	168	163	20	15	19	21	19
	IK	425	404	421	381	408	147	134	141	118	135	696	717	617	744	693	24	21	20	20	21
	OK	651	664	681	691	672	174	182	182	178	179	56	60	56	58	58	43	45	31	43	41
	IK	746	667	640	691	686	194	174	172	181	180	521	530	573	541	541	59	53	52	55	55

TABLE 11.4 CATION CONTENTS OF THE SOILS INCLUDED IN THE MINI POT EXPERIMENT (me/100g)

SOIL NO	TREATMENT	Ca++ REPLICATION					Mg++ REPLICATION					K+ REPLICATION					Na+ REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	OK	3,21	3,01	2,91	3,20	3,08	1,48	1,45	1,45	1,44	1,46	0,43	0,40	0,39	0,37	0,40	0,09	0,08	0,10	0,11	0,10
	IK	2,86	2,84	3,06	3,18	2,99	1,34	1,32	1,38	1,50	1,39	1,85	1,79	1,74	1,93	1,83	0,13	0,10	0,13	0,15	0,13
6L8	OK	1,44	1,42	1,55	1,53	1,49	1,66	1,02	1,06	1,13	1,27	0,27	0,28	0,29	0,26	0,27	0,08	0,09	0,09	0,06	0,08
	IK	1,54	1,36	1,56	1,37	1,46	0,95	0,81	1,02	0,85	0,91	1,75	1,36	1,35	1,05	1,37	0,11	0,09	0,10	0,09	0,10
6Q1	OK	1,89	1,85	1,78	1,78	1,83	0,93	0,92	0,92	0,82	0,89	0,35	0,27	0,27	0,36	0,31	0,08	0,07	0,09	0,07	0,08
	IK	1,77	1,61	1,63	1,75	1,69	0,84	0,73	0,74	0,78	0,78	2,29	1,42	1,54	1,86	1,77	0,10	0,08	0,10	0,10	0,10
3M11	OK	1,69	2,66	3,71	2,32	2,60	0,74	0,36	0,57	0,41	0,53	0,23	0,13	0,38	0,21	0,24	0,01	0,01	0,01	0,01	0,01
	IK	1,80	2,01	2,46	2,20	2,12	1,16	1,43	1,78	1,48	1,46	1,59	1,34	2,02	2,06	1,75	0,16	0,21	0,24	0,26	0,22
5C5	OK	0,91	1,52	1,54	1,48	1,41	0,40	0,93	0,86	0,93	0,78	0,19	0,18	0,17	0,13	0,17	0,01	0,12	0,10	0,12	0,09
	IK	1,45	1,22	1,44	1,26	1,34	0,75	0,63	0,73	0,74	0,72	1,28	1,26	1,41	1,75	1,43	0,14	0,12	0,15	0,16	0,14
OSBLOK	OK	2,10	2,21	2,30	2,37	2,25	1,21	1,30	1,29	1,42	1,30	0,33	0,42	0,49	0,43	0,42	0,09	0,06	0,08	0,09	0,08
	IK	2,13	2,02	2,11	1,91	2,04	1,22	1,12	1,18	0,98	1,13	1,79	1,84	1,58	1,91	1,78	0,14	0,10	0,09	0,09	0,09
1B2	OK	3,26	3,32	3,41	3,46	3,36	1,45	1,52	1,52	1,48	1,49	0,14	0,15	0,14	0,15	0,19	0,19	0,20	0,13	0,19	0,18
	IK	3,73	3,34	3,20	3,46	3,43	1,62	1,45	1,43	1,51	1,50	1,34	1,36	1,47	1,39	1,39	0,26	0,23	0,23	0,24	0,24

the mini experiment ran for only eight weeks.

The potassium parameters, $\frac{Ca + Mg}{K}$ and E.P.P. were again influenced by the application of potassium fertilizer (Tables 11.2 and 11.5), in the same manner as for the field trials and the U.O.F.S. pot experiment (Section 9.3.1). Phosphorus, boron and zinc values for the soils indicate an adequate supply of these elements to the growing crop (Table 11.6). The large differences in phosphorus values extracted by the two methods cannot be explained, however these extractions were repeated by the Citrus Exchange laboratory and the same values recorded.

11.3.2 LEAF ANALYSIS

The cation contents for leaf blades are presented in Table 11.7 . From these results it seems that calcium and magnesium were taken up in adequate quantities.

Potassium was present in excess of the 1,2%

TABLE 11.5 $\frac{Ca+Mg}{K}$ AND E.P.P. FOR THE SOILS OF THE MINI POT EXPERIMENT

SOIL NO	TREATMENT	$\frac{Ca+Mg}{K}$ REPLICATION 1	2	3	4	AVE	E. P. P. REPLICATION 1	2	3	4	AVE
7Q1	OK	10,91	11,15	11,18	12,54	11,45	10,00	9,00	9,00	9,00	9,00
	1K	2,27	2,32	2,55	2,42	2,39	43,00	41,00	40,00	45,00	42,00
6L8	OK	11,48	8,71	9,0	10,23	9,86	7,48	7,76	8,03	7,20	7,62
	1K	1,42	1,60	1,91	2,11	1,76	48,48	37,67	37,40	29,09	38,16
6Q1	OK	8,06	10,26	10,0	7,22	8,89	13,41	10,34	10,34	13,79	11.97
	1K	1,14	1,65	1,54	1,36	1,42	87,74	54,41	59,0	71,26	68,10
3M11	OK	10,57	23,23	11,26	13,0	14,52	6,82	3,86	11,28	6,23	7,05
	1K	1,86	2,57	2,10	1,79	2,08	47,18	39,76	59,94	61,13	52,0
5C5	OK	6,89	13,61	14,12	18,54	13,29	8,41	7,96	7,52	5,75	7,41
	1K	1,72	1,47	1,54	1,14	1,47	56,64	55,75	62,39	77,43	63,05
USBLOK	OK	10,03	8,36	7,33	8,81	8,63	13,25	16,87	19,68	17,27	16,77
	1K	1,87	1,71	2,08	1,51	1,79	71,89	73,90	63,45	76,71	71,49
1B2	OK	33,64	32,27	35,21	32,93	33,51	3,58	3,84	3,58	3,84	3,71
	1K	4,0	3,52	3,15	3,58	3,56	34,27	34,78	37,60	35,55	35,55

TABLE 11.6 PHOSPORUS, ZINC AND BORON CONTENTS OF THE SOILS INCLUDED IN THE MINI POT EXPERIMENT (mg/kg)

SOIL	TREAT	P (ISFEI) REPLICATION					BRAY 1 REPLICATION					Zn REPLICATION					B REPLICATION				
NO	MENT	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q	OK	15	22	17	21	18,8	120	109	113	86	107,0	4	3	6	2	3,75	0,4	0,4	0,4	0,5	0,43
	IK	20	19	16	18	18,3	105	105	105	124	109,8	4	3	3	6	4,00	0,3	0,3	0,3	0,1	0,35
6L8	OK	11	11	12	15	12.3	113	143	120	105	120,3	4	4	16	16	10,00	0,5	0,6	0,6	0,5	0,55
	IK	9	8	9	7	8,3	143	116	135	116	127,5	6	4	5	4	4,75	0,6	0,5	0,4	0,4	0,48
6Q1	OK	12	15	13	15	13,8	218	218	184	206	206,5	8	7	7	7	7,25	0,4	0,5	0,6	0,4	0,48
	IK	6	8	7	8	7,3	206	203	218	225	213,0	7	7	7	9	7,50	0,4	0,4	0,4	0,4	0,40
3M11	OK	7	7	7	7	7,0	116	124	154	105	124,8	6	6	6	7	6,25	0,6	0,6	0,7	0,7	0,65
	IK	14	5	9	9	9,3	128	105	131	98	115,5	7	5	6	7	6,25	0,4	0,4	0,6	0,4	0,45
5C5	OK	10	10	9	10	9,8	101	94	83	98	94,0	4	6	5	5	5,00	0,7	0,5	0,5	0,4	0,53
	IK	11	10	10	9	10,0	98	90	105	105	99,5	6	5	3	3	4.25	0,6	0,7	0,6	0,6	0,63
OSBLOK	OK	16	13	18	16	15,8	124	124	109	116	118,3	3	4	4	4	3,75	0,4	0,4	0,5	0,6	0,48
	IK	17	19	22	19	19,3	113	128	109	109	114,8	6	5	3	4	4,50	0,5	0,4	0,4	0,5	0,45
IB2	OK	9	7	8	7	7,8	90	180	94	83	111,8	4	10	7	4	6,25	0,5	0,5	0,5	0,6	0,53
	IK	8	8	7	11	8,5	101	75	90	120	96,5	4	4	6	7	5,25	0,4	0,4	0,4	0,5	0,43

TABLE 11.7 CATION CONTENTS OF LEAFBLADES IN THE MINI POT EXPERIMENT (% OF DRY MATTER)

		Ca^{++}	Mg^{++}	K^{+}	Na^{++}
7Q1	OK	3,67	0,92	1,96	0,08
	IK	3,34	0,81	3,28	0,06
6L8	OK	2,92	0,94	2,58	0,06
	IK	1,95	0.65	5,87	0,07
6Q1	OK	3,39	0,78	2,73	0,06
	IK	2,57	0,61	6,14	0,06
3M11	OK	3,79	1,37	1,98	0,13
	IK	2,52	0,95	4,14	0,06
5C5	OK	3,33	1,04	1,65	0,14
	IK	2,52	0,72	7,08	0,11
OSBLOK	OK	2,60	0,75	3,40	0,03
	IK	2,91	0,87	4,90	0,05
1B2	OK	4,25	1,51	0,98	0,13
	IK	3,39	0,86	3,50	0,07

generally regarded as critical (Section 6.2.7) in all the samples except in the zero treatment sample from soil 1B2 (Table 11.7). This soil had the lowest initial exchangeable potassium content, viz.0,17 me/100g. The results further indicate that the possibility of potassium deficiency can safely be ruled out in all the potassium treated samples.

Nitrogen, phosphorus, zinc and boron values for the leafblades seem not to indicate any deficiency of these elements (Table 11.8).

TABLE 11.8 NITROGEN, PHOSPORUS, ZINC AND BORON CONTENT OF LEAF BLADES IN THE MINI POT EXPERIMENT

		N(%)	P(%)	Zn mg/kg	B mg/kg
7Q1	OK	3,31	0,63	17	30
	IK	3,94	0,62	24	25
6L8	OK	4,06	0,56	31	28
	IK	3,97	0,68	33	15
6Q1	OK	4,17	0,61	38	28
	IK	3,92	0,85	42	20
3M11	OK	3,48	0,66	29	53
	IK	3,81	0,47	26	30
5C5	OK	3,42	0,56	51	40
	IK	3,53	0,51	54	25
OSBLOK	OK	4,06	0,44	68	25
	IK	4,05	0,43	43	25
1B2	OK	3,59	0,51	26	50
	IK	4,20	0,42	24	28

Although these soils contain very little boron (Table 11.6) the values of 0,35 to 0,65 mg/kg seem to fall within a range that ensures a normal supply of boron to growing cotton (Honish, 1975). The overall picture would indicate that boron was taken up in sufficient quantities from these soils to ensure normal crop growth.

The values for petioles are presented in Tables 11.9 and 11.10 for the sake of completeness. These data do not contribute in any way to clarify the pattern of potassium reactions in the soil and uptake by the plant.

11.3.3 DRY MATTER PRODUCTION (YIELD)

The dry matter production, after growing the cotton for 8 weeks, is presented in Table 11.11. In this investigation the yield of stems, petioles and leaf blades was regarded as an expression of dry matter production and thus yield.

From these results it is clear that suppression of yield occurred on all the soils. This differs from

TABLE 11.9 CATION CONTENTS OF PETIOLES IN THE MINI POT EXPERIMENT (% OF DRY MATTER)

		Ca^{++}	Mg^{++}	K^{+}	Na^{+}
7Q1	OK	1,62	0,67	2,15	0,08
	IK	2,18	0,87	4,02	0,14
6L8	OK	1,42	0,84	3,01	0,09
	IK	1,28	0,56	5,44	0,20
6Q1	OK	1,89	0,69	2,93	0,08
	IK	1,70	0,76	5,95	0,20
3M11	OK	1,72	1,22	2,10	0,22
	IK	1,38	1,10	4.76	0,14
5C5	OK	1,16	0,69	2,03	0,16
	IK	1,35	0,8	5,90	0,20
OSBLOK	OK	1,42	0,68	3,12	0,10
	IK	1,72	1,04	5,28	0,14
1B2	OK	1,71	1,04	1,07	0,20
	IK	1,96	0,86	4,68	0,14

TABLE 11.10 NITROGEN, PHOSPORUS, ZINC AND BORON CONTENT OF THE PETIOLES IN THE MINI POT EXPERIMENT

		N %	P %	Zn(mg/kg)	B(mg/kg)
7Q1	OK	1,39	0,34	11	15
	IK	1,63	0,36	20	6
6L8	OK	1,76	0,34	26	15
	IK	1,76	0,31	248	80
6Q1	OK	2,09	0,52	29	18
	IK	1,97	0,48	190	25
3M11	OK	1,79	0,44	74	6
	IK	1,53	0,30	92	6
5C5	OK	1,58	0,31	9	15
	IK	1,78	0,26	25	5
OSBLOK	OK	1,87	0,27	100	6
	IK	1,86	0,25	88	5
1B2	OK	1,65	0,33	16	15
	IK	1,63	0,23	14	6

TABLE 11.11 DRY MATTER PRODUCTION IN THE MINI POT EXPERIMENT (g/pot)

		ROOTS (a)	STEMS (b)	LEAVES (c)	PETIOLES (d)	TOTAL (b+c+d)
7Q1	OK	2,62	6,24	6,81	1,34	14,39
	IK	2,65	3,54	4,80	0,81	9,15
6L8	OK	3,60	7,19	8,03	1,25	16,47
	IK	1,23	2,03	1,65	1,19	4,87
6Q1	OK	3,65	6,28	6,97	1,48	14,73
	IK	1,08	2,08	1,47	1,14	4,69
3M11	OK	3,55	5,64	7,42	2,07	15,13
	IK	1,96	2,05	3,18	1,47	6,70
5C5	OK	4,64	9,64	9,85	2,11	21,60
	IK	1,71	2,90	3,00	1,08	6,98
OSBLOK	OK	2,60	3,61	5,15	0,87	9,63
	IK	1,15	1,23	1.98	0,77	3,98
1B2	OK	3,55	5,81	7,71	1,28	14,80
	IK	2,01	2,41	3,69	0,82	6,92

the previous pot experiment in which seven out of ten soils responded in suppression of yield (Section 9.4). The soils that responded in exactly the same way, viz.suppression of yield, in both pot experiments are 7Q1, 6L8, 5C5 and OSBLOK.

The other three soils that were included in both experiments viz.6Q1, 3M11 and 1B2 gave higher yields in the U.O.F.S. pot experiment (Table 9.6),but in the mini pot experiment supppression of yield was recorded (Table 11.11).

Using soils 3M11 and 1B2, it may be illustrated that their initial exchangeable K contents is a poor measure of their continued potassium supplying power to a growing crop. Samples of these soils used in the U.O.F.S. experiment contained 0,68 and 0,37 me K/100g respectively. Those samples used in the mini experiment had 0,29 and 0,17 me exchangeable K per 100 g. Notwithstanding their higher initial K contents in the first experiment the cotton responded positively to applied potassium fertilizer. In the mini experiment, with soil K levels at which one could expect yield increases, applied potassium markedly suppressed the yields of dry matter. This also applied to the other five soils.

Leaf K values, on the other hand, showed exactly the opposite trend. It may however be concluded that, at eight weeks age of the cotton plants, potassium uptake from the fertilized soil was limited to approximately the same level as from the unfertilized soil.

It does not however reflect the potassium supplying power of a soil over a full growing season or over the long term. The data for soils 3M11 and 1B2, as discussed above, thus merely prove that a better method for the evaluation of the K status of these soils is needed.

11.3.4 STATISTICAL TREATMENT OF THE DATA

11.3.4.1 ANALYSIS OF VARIANCE

The analysis of variance results for NH_4Ac-K, Ca+Mg and E.P.P. are presented in Table 11.12

K

TABLE 11.12 THE EFFECT OF POTASSIUM APPLICATION ON VARIOUS SOIL PARAMETERS.

SOIL NO	NH_4Ac-K	$\frac{Ca+Mg}{K}$	E.P.P.
7Q1	Kl > Ko*	Kl < Ko*	Kl > Ko*
6L8	Kl > Ko*	Kl < Ko*	Kl > Ko*
6Q1	Kl > Ko*	Kl < Ko*	Kl > Ko*
3M11	Kl > Ko*	Kl < Ko*	Kl > Ko*
5C5	Kl > Ko*	Kl < Ko*	Kl > Ko*
OSBLOK	Kl > Ko*	Kl < Ko*	Kl > Ko*
1B2	Kl > Ko*	Kl < Ko*	Kl > Ko*

It is obvious that potassium application significantly influenced the soil potassium parameters in accordance with the other pot and field experiments.

11.3.4.2 RELATIONSHIPS BETWEEN VARIOUS SOIL PARAMETERS AND LEAF K.

TABLE 11.13 RELATIONSHIPS BETWEEN VARIOUS SOIL PARAMETERS AND LEAF POTASSIUM AND BORON

PARAMETER	VALUE
NH_4Ac-K vs leaf K	0,7597**
NH_4Ac-K vs petiole K	0,8817**
E.P.P. vs leaf K	0,8683**
E.P.P. vs petiole K	0,9229**
$\frac{Ca+Mg}{K}$ vs leaf K	- 0,7651**
$\frac{Ca+Mg}{K}$ vs petiole K	- 0,8582**
Boron (soil) vs leaf K	- $0{,}0640^{ns}$
Boron (soil vs petiole K	- $0{,}2466^{ns}$
NH_4Ac-K vs boron (leaf)	- 0,6175*
NH_4Ac-K vs boron (petiole)	- $0{,}0700^{ns}$

NH_4Ac-K did not give the best indication of potassium content of the leaves (Table 11.13). E.P.P. expressed the best relationship between soil potassium and leaf potassium. It is also clear that the potassium content of the petioles is an excellent parameter for expressing the relationship between soil potassium and plant potassium.

The significant relationship between NH_4Ac-K and the boron content of the leaves shows that there excists some interaction between boron and potassium.

11.3.4.3 RELATIONSHIPS BETWEEN SOIL-K, LEAF-K AND DRY MATTER PRODUCTION

Although NH_4Ac-K was highly significantly correlated with dry matter production E.P.P. once again expressed the better relationsnip (Table 11.14).

TABLE 11.14 RELATIONSHIPS BETWEEN SOIL AND LEAF POTASSIUM PARAMETERS AND DRY MATTER PRODUCTION

PARAMETER		VALUE
NH_4Ac-K vs dry matter	-	0,8399**
E.P.P. vs dry matter	-	0,8663**
$\frac{Ca+Mg}{K}$ vs dry matter	-	0,6660*
Leaf K vs dry matter	-	0,8208**
Petiole K vs dry matter	-	0,8754**
Boron (soil) vs dry matter	-	$0,3604^{ns}$
Boron (leaf) vs dry matter	-	0,6603**
Boron (petiole) vs dry matter	-	$0,1963^{ns}$

The petiole potassium content expressed the best relationship between any parameter and dry matter production (Table 11.14)

No relationship between the boron content of the soil and dry matter production could be found. However a highly significant relationship between the boron content of the leaves and dry matter production is indicated. It appears therefore that the applied K suppressed the B uptake.

11.4 CONCLUSIONS

This pot experiment was designed to clarify the anomalous behaviour of potassium in certain Vaalharts soils. Conversely it may be stated that a solution for the anomalous behaviour of certain soils with respect to potassium fertilization was seeked.

These results served, however, merely to confirm those of the other field and pot experiments. Some were rather conflicting, and others brought more unsolved questions to light, e.g. the role of boron in K nutrition of cotton.

CHAPTER 12

CONCLUSIONS AND RECOMMENDATIONS

The results obtained in the first pot experiment indicated that the $(Ca^{++} + Mg^{++})/K^{+}$ ratio in the soil was a much better predictor of cotton yield ($r = 0{,}7013^{**}$) than NH_4Ac-K, ($r = 0{,}4880^{ns}$). The relationship between E.P.P. and yield ($r = 0{,}5920^{*}$) was also better than that between NH_4Ac-K and yield.

In the fifteen field experiments the initial NH_4Ac-K ranged from 0,10 me K/100g to 0,64 me K/100g. Although the yield of five experiments was lost, the ten remaining experiments still had a NH_4Ac-K range of 0,10 me K/100g to 0,44 me K/100g.

In general all the soil potassium parameters that were measured and calculated were influenced by the application of potassium fertilizers to these soils. Analysis of variance data (Table 7.2a) for the various parameters, showed significant differences among potassium treatments. In the few cases where no responses to applied potassium could be detected, it is attributed to potassium fixation.

Comparing leaf K content data with literature criteria only three of the fifteen experiments had values below the critical 1 % K level. It is therefore concluded that, despite the heavy dressings of potassium, deficiencies of potassium could have occurred in these three experiments (See page 72).

No significant yield increases were obtained through the application of potassium fertilizers. Micronaire values were also not significantly affected.

This is contrary to the expected beneficial effects of K on the quality of cotton lint, especially in view of rather low leaf K contents on some of the soils. Fauconnier (1978) stressed the benefits derived frpm K fertilization on fibre length, fibre percentage and micronaire value.

From the leaf K content data for the individual experiments it is quite clear (Table 7.5), that other parameters than NH_4Ac-K and Exch-K should be considered when describing the relationship between soil potassium and leaf potassium. Parameters that should be taken into account are E.P.P. (topsoils), E.P.P. (subsoils) and (Ca+Mg)/K (topsoils). In addition to E.P.P. and (Ca+Mg)/K which in certain instances give improved norms for the K status of these soils, other soil K parameters must also be considered. These must preferably not be related to exchangeable K, because there is evidence that applied potassium can under certain conditions be immobilized in fixed forms, e.g. experiment 5C5. Methods of determining the K status of soils which might be considered are electro ultrafiltration, step K, 1 normal boiling HNO_3, resin exchangeable K and exhaustive cropping.

As regards the soil K parameters, these also showed a poor correlation with yield. In only three experiments could any significant relationships with either E.P.P.,(Ca + Mg)/K or exchangeable K be established (Table 7.6). This again emphasises the importance of further investigation into the reactions of potassium in these soils, and also its adsorption on and fixation in clay minerals of the expanding type and its release to growing plant roots.

It was rather surprising that there was a complete lack of any relationship between leaf K and yield. The case of experiment 5C5 especially illustrates this point. The soil had a very low exchangeable K content (0,15 me/100g) and exhibited an apparent severe K fixation, while the cotton had an apparent leaf K deficiency (0,75% K). This soil nevertheless produced the highest yield of seed cotton (Appendix 25).

Pooling of the yield and leaf-K data of all the trials brought about significantly improved relationships for all the parameters, excepting P.A.R. However, the magnitude of the correlation coefficients were found to be unacceptable. (Tables 7.7 and 7.8).

Grouping of the data according to various soil parameters i.e. topsoil clay content, subsoil clay content, E.P.P. topsoils, E.P.P. subsoils,(Ca + Mg)/K topsoils,(Ca + Mg)/Ksubsoils, P.A.R. topsoils, Exch-K topsoils and NH_4Ac-K topsoils, resulted in considerable increases in the correlation coefficients between the parameters and yield as well as leaf K data (Tables 7.9 and 7.10).

By grouping the data evidence was found that NH_4Ac-K (topsoils) and Exch-K (topsoils) are not reliable measurements of the potassium needs of cotton grown on these soils. In predicting cotton yield these two parameters should rather be considered together with other parameters such as (Ca+Mg)/K (topsoils), E.P.P. (subsoils) leaf K content and K parameters related to reactions of potassium with 2:1 clay minerals.

This investigation has proved that the potassium nutrition of cotton on the sandy soils of Vaalharts is only partly understood. There is a special need to define the potassium status of these soils with regard to their ability to supply crops with this nutrient.

I wish therefore, to recommend that the following aspects receive the necessary attention :

1) Long term fertility and exhaustive cropping experiments to monitor changes in the various categories of potassium in the soil.

2) Selection of soil samples from the original experimental sites to investigate anomalous behaviour e.g. Osblok and 5C5 by means of glasshouse and laboratory experimentation.

3) Investigation of soil sampling techniques for available potassium determinations e.g. analysis at field wetness and drying of samples prior to analysis.

4) An extensive study on the clay mineralogy of the soils where differences in reaction to potassium application were found. This study is intended to ascertain whether these differences maybe attributed to differences in clay mineral composition and whether potassium fixation played a significant part.

5) Investigation of plant sampling techniques. Evidence was presented that large differences exists in the cation contents of respectively petioles and leaf blades.

6) All the above investigations should be used to find a

reliable routine method for determination of available potassium status.

7. The influence of boron on applied potassium in this plant/soil relationship warrants further investigation.

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APPENDIX 1 GENERAL ANALATICAL DATA TOPSOILS

TRIAL NO.	COARSE SAND %	MEDIUM SAND %	FINE SAND %	SILT %	CLAY %	pH H_2O	pH $CaCl_2$	CONDUCTIVITY mS/m 25°C	SATURATION PERCENTAGE
1B2	16,8	0	72,6	0	10	6,8	6,4	58	26,8
1R1	15,8	0	75,6	0	8	7,1	6,2	61	26,9
2A5	18,1	0	74,2	0	8	6,9	6,3	38	27,3
3K9	28,8	0	62,4	2	8	6,7	6,4	109	26,3
4B4	32,4	0	60,8	0	8	6,8	6,2	51	27,8
4C5	24,8	0	67,2	0	8	6,9	6,2	54	28,8
6L8	29,2	0	60,8	2	10	7,0	6,4	55	25,6
6Q1	18,6	0	68,2	2	10	6,8	6,2	47	25,0
7Q1	17,6	0	67,0	2	12	6,8	6,3	45	25,7
3M11	22,5	0	61,7	0	16	6,9	6,5	192	28,0
OSBLOK	30,0	0	60,6	0	8	6,6	6,1	83	26,3
SKAAPBLOK	20,8	0	71,4	0	8	6,5	6,1	102	27,0
4Q4	25,2	0	66,6	0	8	6,9	6,3	40	25,6
24D10	22,6	0	68,6	2	8	6,5	6,2	109	27,5
5C5	25,4	0	66,8	0	8	6,5	6,2	55	27,0

APPENDIX 2 GENERAL ANALATICAL DATA SUBSOILS

TRIAL NO.	COARSE SAND %	MEDIUM SAND %	FINE SAND %	SILT %	CLAY %	pH H_2O	pH $CaCl_2$	CONDUCTIVITY mS/m 25°C	SATURATION PERCENTAGE
1B2	22,0	0	69,4	0	10	7,0	6,5	58	27,2
1R1	16,9	0	75,0	0	8	7,2	6,4	40	30,0
2A5	25,2	0	65,6	0	8	6,8	6,3	58	26,8
3K9	31,8	0	60,0	0	8	7,2	6,6	186	25,5
4B4	21,2	0	70,2	0	8	7,3	6,6	154	25,7
4C5	22,0	0	69,8	0	8	7,4	6,6	90	28,6
6L8	28,0	0	62,8	0	8	7,1	6,5	44	26,2
6Q1	15,8	0	68,2	2	14	6,9	6,4	40	27,2
7Q1	14,2	0	64,2	0	20	7,1	6,5	40	30,4
3M11	27,4	0	50,5	0	22	7,0	6,6	162	30,4
OSBLOK	19,0	0	70,0	0	10	6,7	6,3	47	29,4
SKAAPBLOK	18,2	0	73,4	0	8	6,7	6,4	58	26,4
4Q4	24,6	0	66,6	0	8	7,3	6,4	32	27,7
24D10	24,8	0	66,0	2	8	6,6	6,3	160	26,7
5C5	28,4	0	63,4	0	8	7,0	6,5	42	25,3

APPENDIX 3 EXCHANGEABLE & WATER SOLUBLE CATIONS, PHOSPHORUS AND ZINC TOPSOILS

TRIAL NO.	Na^+	K^+ me/100g	Ca^{++}	Mg^{++}	S VALUE	CEC me/100g	EPP (me/100g)	$\frac{Ca+Mg}{K}$ (me/100g)	P mg/kg	Zn mg/kg
1B2	0,26	0,10	6,20	3,17	9,73	7,67	1,3	94	23	1,70
1R1	0,26	0,26	2,60	3,00	6,12	4,67	5,6	22	19	1,45
2A5	0,30	0,26	2,80	1,58	4,94	5,67	4,6	17	15	1,60
3K9	0,61	0,46	3,20	3,00	7,27	5,33	8,6	13	50	1,75
4B4	0,35	0,28	2,80	2,90	6,2	4,67	6,0	20	14	1,05
4C5	0,15	0,21	2,80	1,42	4,4	5,33	3,9	20	0	1,10
6L8	0,30	0,21	3,20	1,42	5,0	5,67	3,7	22	12	1,25
6Q1	0,30	0,44	3,20	1,67	5,6	5,33	8,3	11	15	2,85
7Q1	0,30	0,64	2,60	2,25	5,7	8,33	7,7	8	2	0,95
3M11	0,43	0,51	5,20	2,42	8,1	10,67	4,8	15	29	2,40
OSBLOK	0,30	0,31	3,20	1,58	5,2	5,67	5,5	15	24	1,75
SKAAPBLOK	0,20	0,18	2,60	3,00	5,7	5,33	3,4	31	8	1,05
4Q4	0,26	0,28	2,40	2,92	5,7	5,33	5,3	19	8	1,05
24D10	0,30	0,38	3,40	3,00	6,8	5,67	6,7	17	34	1,80
5C5	0,15	0,15	2,60	2,90	5,7	4,33	3,5	37	17	1,80

APPENDIX 4

EXCHANGEABLE & WATER SOLUBLE CATIONS, PHOSPHORUS AND ZINC SUBSOILS

TRIAL NO.	Na^+	K^+ me/100g	Ca^{++}	Mg^{++}	S VALUE	CEC (me/100g)	EPP (me/100g)	$\frac{Ca+Mg\ (me/100g)}{K}$	P mg/kg	Zn mg/kg
1B2	0,30	0,26	2,80	1,58	4,8	6,67	3,9	17	8	2,20
1R1	0,35	0,26	2,60	2,92	6,0	5,33	4,9	21	19	1,00
2A5	0,22	0,26	3,80	2,08	6,3	5,67	4,6	23	9	1,10
3K9	0,26	0,59	2,80	3,00	6,3	4,67	2,6	10	15	1,30
4B4	0,39	0,26	2,60	2,90	5,7	4,67	5,6	21	0	1,20
4C5	0,26	0,10	2,60	3,00	5,7	4,33	2,3	56	0	1,50
6L8	0,26	0,18	2,00	2,75	5,0	4,67	3,9	26	0	1,05
6Q1	0,30	0,46	3,80	2,58	7,0	9,33	4,9	14	0	1,00
7Q1	0,50	0,56	4,20	3,80	8,9	10,67	5,2	14	0	0,95
3M11	0,57	0,46	5,20	4,00	9,7	13,00	3,5	20	0	1,90
OSBLOK	0,41	0,23	3,40	1,58	5,5	6,33	3,6	22	9	1,35
SKAAPBLOK	0,28	0,15	2,60	3,00	5,9	5,67	2,6	37	6	0,95
4Q4	0,11	0,38	2,00	2,92	5,3	4,67	8,1	13	0	0,85
24D10	0,41	0,33	3,20	1,58	5,1	6,33	5,2	14	20	1,30
5C5	0,26	0,08	2,60	1,42	4,3	4,33	1,8	50	0	2,45

APPENDIX 5 EXCHANGEABLE & WATER SOLUBLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	0,13	0,17	0,14	0,13	0,14	0,35	0,28	0,31	0,31	0,31	1,47	2,13	1,20	1,07	1,47	1,73	1,80	1,47	1,33	1,58
	2	0,14	0,14	0,14	0,14	0,14	0,33	0,33	0,37	0,39	0,36	1,87	1,87	1,87	1,60	1,80	1,80	1,60	1,47	1,33	1,55
	3	0,14	0,14	0,14	0,17	0,15	0,41	0,37	0,41	0,39	0,40	1,87	1,87	0,53	1,87	1,54	1,73	1,47	1,47	1,47	1,54
	4	0,29	0,18	0,18	0,36	0,27	0,37	0,41	0,48	0,48	0,44	1,87	1,60	1,60	2,67	1,94	1,80	1,47	1,40	1,60	1,57
	5	0,14	0,17	0,17	0,25	0,18	0,43	0,37	0,50	0,46	0,44	1,87	2,30	1,60	2,27	1,97	1,60	1,27	1,53	1,53	1,48
1R1	1	0,41	0,29	0,32	0,29	0,33	0,26	0,21	0,26	0,23	0,24	2,20	1,87	1,87	1,87	1,95	1,33	1,13	1,33	1,33	1,28
	2	0,26	0,29	0,29	0,47	0,33	0,34	0,30	0,30	0,30	0,31	2,27	2,33	2,00	1,53	2,03	1,33	1,47	1,27	1,27	1,34
	3	0,38	0,32	0,26	0,47	0,36	0,32	0,41	0,30	0,34	0,34	2,20	2,20	2,00	1,53	1,98	1,27	1,27	1,27	1,27	1,27
	4	0,38	0,26	0,29	0,50	0,36	0,38	0,36	0,43	0,41	0,40	2,20	1,87	2,20	2,00	2,07	1,47	1,27	1,27	1,33	1,34
	5	0,29	0,35	0,32	0,41	0,34	0,56	0,32	0,32	0,34	0,39	1,87	2,20	1,53	1,67	1,82	1,27	1,33	1,13	1,27	1,25
2A5	1	0,29	0,31	0,31	0,62	0,38	0,29	0,32	0,23	0,23	0,27	3,33	3,00	3,07	2,80	3,05	2,27	2,07	1,40	1,20	1,74
	2	0,33	0,29	0,57	0,18	0,34	0,27	0,27	0,28	0,23	0,26	3,67	3,00	3,07	3,07	3,20	2,13	2,00	1,40	1,40	1,73
	3	0,28	0,38	0,23	0,48	0,34	0,38	0,36	0,28	0,26	0,32	3,33	3,00	2,80	2,67	2,95	2,13	2,13	1,40	1,20	1,72
	4	0,31	0,71	0,18	0,48	0,42	0,43	0,43	0,33	0,31	0,38	2,87	3,33	2,80	3,07	3,02	1,93	1,40	1,33	1,40	1,52
	5	0,28	0,34	0,62	0,12	0,34	0,40	0,38	0,28	0,43	0,37	3,87	3,07	2,80	3,07	3,20	2,13	1,40	1,33	1,20	1,52
3K9	1	0,34	0,41	0,26	0,30	0,33	0,29	0,40	0,40	0,33	0,36	2,33	2,33	2,00	2,53	2,30	1,33	1,13	1,33	1,27	1,27
	2	0,36	0,41	0,30	0,22	0,32	0,29	0,33	0,33	0,28	0,31	2,33	2,33	2,00	2,80	2,37	1,33	1,27	1,13	1,00	1,18
	3	0,24	0,38	0,38	0,20	0,30	0,52	0,47	0,42	0,27	0,41	2,33	2,33	2,33	2,27	2,32	1,27	1,13	1,27	1,00	1,17
	4	0,36	0,41	0,30	0,15	0,31	0,42	0,42	0,42	0,40	0,42	2,33	2,33	2,53	2,27	2,37	0,93	1,27	1,33	0,73	1,07
	5	0,34	0,49	0,28	0,18	0,32	0,47	0,40	0,27	0,40	0,39	2,00	2,33	2,33	2,27	2,23	1,13	1,33	1,27	0,80	1,13

APPENDIX 5 (continued) EXCHANGEABLE & WATER SOLUBLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	0,32	0,37	0,41	0,32	0,36	0,22	0,22	0,24	0,26	0,24	1,73	1,87	1,73	1,47	1,70	1,13	1,07	1,00	1,00	1,05
	2	0,28	0,28	0,37	0,28	0,30	0,30	0,26	0,26	0,30	0,28	1,47	1,73	1,73	1,73	1,67	1,07	1,07	1,07	1,07	1,07
	3	0,37	0,29	0,28	0,29	0,31	0,28	0,30	0,30	0,41	0,32	1,73	1,87	1,73	1,73	1,77	1,00	1,07	1,00	1,07	1,04
	4	0,29	0,23	0,26	0,50	0,32	0,28	0,43	0,35	0,30	0,34	1,73	1,87	1,47	2,40	1,87	1,00	1,00	1,00	1,47	1,12
	5	0,33	0,29	0,29	0,37	0,32	0,48	0,30	0,43	0,35	0,39	1,73	1,73	1,47	1,87	1,70	1,00	1,33	1,00	1,07	1,10
4C5	1	0,30	0,21	0,23	0,23	0,24	0,19	0,18	0,17	0,18	0,18	0,80	1,60	1,60	1,07	1,27	1,93	0,93	1,07	0,93	1,22
	2	0,23	0,21	0,21	0,30	0,24	0,25	0,18	0,21	0,21	0,21	1,33	1,33	1,07	1,33	1,27	1,07	0,93	0,93	0,47	0,85
	3	0,25	0,21	0,28	0,27	0,25	0,23	0,23	0,23	0,23	0,23	1,07	1,33	1,33	0,53	1,07	0,67	1,27	0,47	0,87	0,82
	4	0,21	0,25	0,21	0,36	0,26	0,33	0,25	0,29	0,18	0,26	1,60	1,60	1,33	1,07	1,40	0,73	0,93	0,40	0,47	0,63
	5	0,27	0,20	0,23	0,36	0,27	0,38	0,42	0,29	0,39	0,37	1,60	1,33	1,60	1,60	1,53	0,93	0,67	0,60	0,60	0,70
6L8	1	1,62	1,40	1,15	0,20	1,09	0,28	0,27	0,25	0,31	0,28	2,67	1,20	1,47	1,20	1,64	1,33	1,33	1,07	1,20	1,23
	2	1,40	1,62	1,12	0,25	1,07	0,31	0,28	0,33	0,36	0,32	0,67	0,67	0,93	2,33	1,15	1,00	1,00	1,07	1,33	1,10
	3	1,12	1,48	1,43	0,21	1,06	0,33	0,37	0,38	0,30	0,35	0,93	0,93	0,93	2,53	1,33	1,07	1,07	1,00	1,13	1,07
	4	1,58	1,48	1,58	0,19	1,21	0,34	0,33	0,45	0,38	0,33	1,20	0,93	1,20	2,00	1,33	1,00	1,07	1,07	1,13	1,07
	5	1,48	1,43	1,68	0,27	1,22	0,49	0,45	0,54	0,33	0,45	1,20	2,27	1,73	2,33	1,88	1,20	1,07	1,00	1,27	1,14
6Q1	1	0,30	0,30	0,27	0,31	0,30	0,44	0,42	0,39	0,42	0,42	3,60	4,13	2,67	3,87	3,57	1,60	1,67	1,67	1,60	1,64
	2	0,30	0,30	0,30	0,31	0,30	0,51	0,42	0,51	0,48	0,48	3,60	4,00	4,13	3,87	3,90	1,60	1,67	1,67	2,00	1,74
	3	0,31	0,27	0,31	0,29	0,30	0,44	0,51	0,51	0,57	0,51	4,53	3,60	4,40	3,33	3,97	1,93	1,67	2,07	2,00	1,92
	4	0,25	0,27	0,30	0,29	0,28	0,53	0,44	0,55	0,48	0,50	1,07	4,13	3,33	2,80	4,33	1,47	1,47	1,60	1,87	1,60
	5	0,28	0,31	0,28	0,34	0,30	0,48	0,58	0,60	0,62	0,57	3,33	3,33	3,07	3,47	3,30	1,40	1,67	1,40	1,87	1,59

APPENDIX 5 (continued) EXCHANGEABLE & WATER SOLUBLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	0,37	0,33	0,35	0,37	0,36	0,80	0,62	0,57	0,62	0,65	4,20	3,67	4,00	3,33	3,80	2,13	2,40	2,93	2,27	2,43
	2	0,33	0,40	0,37	0,29	0,35	0,64	0,59	0,59	0,50	0,58	4,00	4,00	3,67	3,33	3,75	2,40	2,60	2,47	2,73	2,55
	3	0,35	0,33	0,35	0,27	0,33	0,55	0,64	0,69	0,59	0,62	3,33	3,33	4,00	2,93	3,40	2,13	2,27	2,40	2,87	2,42
	4	0,55	0,28	0,33	0,29	0,36	0,69	0,74	0,64	0,66	0,68	3,67	3,33	4,20	2,13	3,33	2,40	2,27	2,67	2,60	2,49
	5	0,40	0,28	0,33	0,30	0,33	0,64	0,59	0,64	0,73	0,65	3,67	3,67	4,20	2,40	3,49	2,13	2,40	2,47	2,47	2,37
3M11	1	0,42	0,58	0,49	0,42	0,48	0,42	0,44	0,35	0,42	0,41	5,87	5,60	5,87	5,20	5,64	2,67	2,60	3,07	2,47	2,70
	2	0,39	0,39	0,52	0,39	0,42	0,39	0,48	0,35	0,31	0,38	5,20	5,60	6,27	5,33	5,60	2,47	2,60	2,87	3,00	2,74
	3	0,49	0,49	0,52	0,42	0,48	0,39	0,39	0,37	0,48	0,41	5,60	5,87	5,33	5,33	5,53	2,20	2,87	2,60	2,67	2,50
	4	0,45	0,58	0,52	0,42	0,49	0,62	0,60	0,37	0,56	0,54	5,87	5,87	5,33	5,33	5,60	2,47	2,67	2,80	2,47	2,60
	5	0,69	0,41	0,41	0,67	0,55	0,56	0,62	0,56	0,60	0,59	5,87	5,60	5,20	5,87	5,64	2,47	2,67	2,47	3,33	2,74
OSBLOK	1	0,31	0,24	0,33	0,37	0,31	0,21	0,17	0,19	0,15	0,18	2,27	2,27	2,53	2,53	2,40	1,20	1,33	1,20	1,20	1,23
	2	0,24	0,26	0,34	0,37	0,30	0,21	0,18	0,12	0,15	0,17	2,00	2,00	2,80	2,13	2,23	1,00	1,20	1,20	1,20	1,15
	3	0,29	0,27	0,35	0,33	0,31	0,17	0,17	0,21	0,12	0,17	2,27	2,00	2,27	2,67	2,30	1,33	1,33	1,20	1,27	1,28
	4	0,27	0,35	0,40	0,40	0,36	0,17	0,15	0,23	0,21	0,19	2,27	2,53	2,13	2,53	2,37	1,33	1,20	1,07	1,20	1,20
	5	0,24	0,43	0,35	0,62	0,41	0,36	0,21	0,17	0,12	0,22	1,73	2,40	2,40	2,67	2,30	0,80	1,20	1,20	1,20	1,12
SKAAP BLOK	1	0,57	0,36	0,59	0,44	0,49	0,17	0,17	0,16	0,17	0,17	2,67	2,27	2,27	2,80	2,50	1,73	1,53	1,47	1,60	1,58
	2	0,42	0,37	0,39	0,44	0,41	0,24	0,17	0,24	0,24	0,22	2,80	2,53	2,67	2,80	2,70	1,67	1,33	1,47	1,53	1,50
	3	0,37	0,39	0,63	0,34	0,43	0,37	0,24	0,27	0,24	0,28	2,53	2,27	2,80	3,33	2,73	1,47	1,27	1,77	2,00	1,62
	4	0,36	0,39	0,44	0,49	0,42	0,33	0,33	0,20	0,27	0,28	2,53	2,27	2,80	2,80	2,60	1,47	1,33	1,53	1,67	1,50
	5	0,36	0,34	0,46	0,42	0,40	0,50	0,28	0,24	0,27	0,32	2,53	2,53	2,53	2,80	2,60	1,47	1,47	1,53	1,67	1,54

APPENDIX 5 (continued) EXCHANGEABLE & WATER SOLUBLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT-MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	0,29	0,23	0,23	0,25	0,25	0,33	0,27	0,25	0,27	0,28	2,13	2,40	1,87	2,13	2,13	1,00	1,27	1,27	1,27	1,20
	2	0,29	0,25	0,27	0,25	0,27	0,31	0,31	0,25	0,23	0,28	2,13	1,87	2,27	2,13	2,10	1,13	1,33	1,27	1,27	1,25
	3	0,27	0,25	0,23	0,25	0,25	0,33	0,38	0,31	0,27	0,32	2,13	2,13	2,13	2,13	2,13	1,27	1,47	1,33	1,37	1,34
	4	0,27	0,23	0,25	0,23	0,25	0,33	0,31	0,35	0,28	0,32	2,13	1,87	2,13	2,27	2,10	1,20	1,13	1,13	1,27	1,18
	5	0,25	0,25	0,29	0,29	0,27	0,46	0,35	0,46	0,31	0,40	2,40	1,60	2,00	2,00	2,00	1,33	1,13	1,27	1,13	1,22
24D10	1	0,09	0,08	0,09	0,11	0,09	0,33	0,32	0,33	0,32	0,33	2,40	2,00	2,13	2,40	2,23	1,33	1,33	1,33	2,00	1,50
	2	0,09	0,08	0,11	0,09	0,09	0,37	0,33	0,32	0,32	0,34	2,40	2,00	2,40	2,13	2,23	1,27	1,27	1,33	1,40	1,32
	3	0,09	0,09	0,09	0,09	0,09	0,37	0,40	0,36	0,33	0,37	2,40	2,13	2,13	2,13	2,20	1,27	1,27	1,27	1,27	1,27
	4	0,09	0,09	0,09	0,09	0,09	0,37	0,45	0,37	0,32	0,38	2,40	2,00	2,40	2,27	2,27	1,27	1,27	1,27	1,40	1,30
	5	0,09	0,09	0,09	0,09	0,09	0,47	0,49	0,33	0,42	0,43	2,53	2,00	2,40	2,40	2,33	1,27	1,13	1,47	1,47	1,34
5C5	1	0,25	0,25	0,23	0,27	0,25	0,18	0,17	0,14	0,17	0,17	2,00	2,27	2,13	2,13	2,13	1,20	1,53	1,47	1,53	1,43
	2	0,23	0,19	0,27	0,25	0,24	0,21	0,13	0,17	0,13	0,16	2,00	2,00	2,13	1,33	1,87	1,33	1,33	1,60	1,33	1,40
	3	0,25	0,25	0,23	0,23	0,24	0,13	0,17	0,21	0,19	0,18	2,00	2,27	1,87	1,13	1,82	1,33	1,33	1,33	1,20	1,30
	4	0,25	0,23	0,23	0,27	0,25	0,18	0,17	0,21	0,17	0,18	2,00	2,13	2,00	1,33	1,87	1,27	1,33	1,53	1,33	1,37
	5	0,23	0,25	0,27	0,25	0,25	0,17	0,18	0,21	0,13	0,17	2,00	2,13	1,47	1,33	1,73	1,33	1,33	1,40	1,60	1,42

APPENDIX 6 EXCHANGEABLE & WATER SOLUBLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT-MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	0,37	0,23	0,53	0,25	0,35	0,20	0,21	0,25	0,27	0,26	2,80	2,93	2,67	2,67	2,77	2,07	2,00	1,90	1,80	1,94
	2	0,24	0,39	0,23	0,80	0,42	0,23	0,25	0,27	0,25	0,25	2,27	2,27	2,40	2,93	2,47	1,90	1,93	1,73	1,80	1,84
	3	0,36	0,24	0,44	0,24	0,32	0,25	0,27	0,21	0,27	0,25	2,67	2,27	2,67	2,67	2,57	1,90	1,80	2,07	1,90	1,92
	4	0,25	0,33	0,21	0,33	0,28	0,21	0,25	0,33	0,32	0,28	2,93	2,27	1,90	2,67	2,44	1,90	2,00	1,90	1,90	1,93
	5	0,37	0,24	0,36	0,24	0,30	0,29	0,38	0,19	0,32	0,30	2,67	2,40	2,67	2,67	2,60	1,73	1,73	1,90	1,80	1,79
1R1	1	0,41	0,13	0,13	0,13	0,20	0,26	0,24	0,30	0,33	0,28	1,87	0,93	2,40	2,13	1,83	1,33	1,13	1,47	1,33	1,32
	2	0,87	0,14	0,11	0,33	0,36	0,30	0,31	0,26	0,33	0,30	2,00	1,07	2,13	2,13	1,83	1,33	1,53	1,33	1,47	1,42
	3	0,50	0,14	0,16	0,29	0,27	0,28	0,39	0,33	0,37	0,34	1,53	1,07	2,13	1,87	1,65	1,27	1,53	1,47	1,20	1,37
	4	0,50	0,13	0,13	0,26	0,26	0,34	0,33	0,33	0,43	0,36	1,87	1,07	2,40	1,73	1,77	1,33	1,47	1,47	1,40	1,42
	5	0,17	0,17	0,18	0,26	0,20	0,37	0,33	0,43	0,37	0,38	0,80	0,40	1,87	1,47	1,14	1,40	1,60	1,20	1,47	1,47
2A5	1	0,23	0,45	0,31	0,42	0,35	0,09	0,14	0,26	0,25	0,19	3,07	3,07	3,33	2,53	3,00	1,33	1,40	1,60	1,80	1,53
	2	0,34	0,48	0,17	0,41	0,35	0,09	0,14	0,12	0,14	0,12	3,07	3,07	2,27	2,87	2,82	1,40	1,37	1,40	1,80	1,49
	3	0,27	0,34	0,49	0,56	0,42	0,09	0,18	0,17	0,17	0,15	2,80	2,80	2,53	2,53	2,67	1,40	1,37	1,80	1,80	1,59
	4	0,17	0,17	0,60	0,38	0,33	0,17	0,14	0,17	0,17	0,16	3,07	2,80	2,53	2,53	2,73	1,40	1,40	1,67	1,93	1,60
	5	0,43	0,15	0,38	0,65	0,40	0,17	0,17	0,12	0,12	0,15	3,07	2,80	2,87	3,00	2,94	1,60	1,40	1,80	2,27	1,77
3K9	1	0,18	0,22	0,18	0,23	0,20	0,24	0,59	0,24	0,38	0,36	2,00	1,47	2,00	1,73	1,80	0,87	0,87	1,20	1,07	1,00
	2	0,23	0,20	0,23	0,23	0,22	0,28	0,31	0,28	0,28	0,29	1,73	1,73	1,73	1,07	1,57	0,80	1,07	1,00	1,00	0,97
	3	0,18	0,22	0,18	0,17	0,19	0,59	0,64	0,33	0,31	0,47	1,47	1,47	1,47	2,00	1,60	0,80	0,80	0,87	1,00	0,87
	4	0,22	0,28	0,26	0,18	0,24	0,47	0,28	0,38	0,35	0,37	1,47	2,00	1,73	1,73	1,73	0,80	1,00	1,07	1,20	1,02
	5	0,23	0,31	0,22	0,20	0,24	0,38	0,28	0,28	0,35	0,32	1,47	2,00	1,47	1,73	1,67	0,93	0,87	0,93	1,07	0,95

APPENDIX 6 (continued) EXCHANGEABLE & WATER SOLUBLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT-MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	0,37	0,10	0,05	0,07	0,15	0,26	0,14	0,21	0,18	0,20	1,87	1,70	1,47	2,00	1,76	1,53	1,27	1,33	1,33	1,37
	2	0,37	0,07	0,11	0,10	0,16	0,39	0,21	0,17	0,18	0,24	1,87	2,00	1,47	1,47	1,70	1,53	1,47	1,33	1,27	1,40
	3	0,09	0,10	0,10	0,09	0,10	0,21	0,23	0,22	0,22	0,22	2,00	1,70	1,47	1,47	1,66	1,33	1,27	1,33	1,27	1,30
	4	0,09	0,07	0,09	0,09	0,09	0,23	0,22	0,27	0,22	0,24	2,00	1,47	1,47	2,00	1,74	1,47	1,33	1,27	1,33	1,35
	5	0,13	0,09	0,09	0,11	0,11	0,27	0,18	0,22	0,23	0,23	1,70	1,47	2,13	1,70	1,75	1,47	1,13	1,27	1,33	1,30
4C5	1	0,25	0,28	0,07	0,25	0,21	0,10	0,10	0,06	0,11	0,09	0,27	1,33	1,33	2,00	1,23	0,93	0,47	1,47	1,60	1,12
	2	0,23	0,13	0,05	0,25	0,17	0,13	0,06	0,06	0,13	0,10	2,13	1,33	1,33	2,00	1,70	0,47	1,70	1,47	1,53	1,29
	3	0,27	0,10	0,29	0,23	0,22	0,13	0,06	0,08	0,08	0,09	1,07	1,47	2,13	2,00	1,67	0,60	2,00	1,53	1,33	1,37
	4	0,23	0,07	0,31	0,23	0,21	0,13	0,06	0,17	0,11	0,12	0,53	1,47	2,00	1,73	1,43	0,47	1,70	1,47	1,33	1,24
	5	0,25	0,09	0,29	0,35	0,25	0,13	0,06	0,11	0,08	0,10	0,80	1,47	2,13	2,13	1,63	0,87	1,47	1,67	1,93	1,49
6L8	1	0,21	0,23	0,23	0,21	0,22	0,16	0,18	0,16	0,24	0,19	1,67	2,00	2,33	1,53	1,88	1,27	1,27	1,33	1,27	1,29
	2	0,21	0,19	0,23	0,23	0,22	0,14	0,18	0,26	0,20	0,20	2,00	2,00	1,67	2,20	1,97	1,27	1,27	1,27	1,27	1,27
	3	0,19	0,19	0,25	0,23	0,22	0,18	0,14	0,20	0,20	0,18	2,20	2,00	2,67	2,00	2,22	1,27	1,13	1,47	1,27	1,29
	4	0,25	0,21	0,23	0,23	0,23	0,24	0,16	0,18	0,23	0,20	2,20	2,00	2,00	1,67	1,97	1,27	1,33	1,33	1,27	1,30
	5	0,23	0,27	0,21	0,23	0,24	0,20	0,20	0,24	0,24	0,22	2,00	3,20	1,67	2,00	2,22	1,27	1,53	1,27	1,07	1,29
6Q1	1	0,31	0,35	0,41	0,31	0,35	0,48	0,38	0,45	0,38	0,42	3,07	3,33	3,33	5,07	3,70	2,27	2,27	2,27	3,13	2,49
	2	0,34	0,27	0,27	0,34	0,31	0,38	0,36	0,54	0,43	0,43	3,33	3,73	2,80	3,07	3,23	2,00	2,13	2,33	3,07	2,38
	3	0,34	0,41	0,33	0,31	0,35	0,34	0,43	0,43	0,45	0,41	4,13	3,60	3,60	3,07	3,60	2,13	2,20	2,33	2,60	2,32
	4	0,34	0,34	0,27	0,31	0,32	0,32	0,34	0,48	0,43	0,39	3,47	4,53	3,60	3,60	3,80	1,87	1,07	2,80	2,53	2,07
	5	0,31	0,31	0,36	0,31	0,32	0,38	0,43	0,41	0,53	0,44	3,07	3,60	4,13	9,07	4,97	2,13	2,47	2,80	2,27	2,42

APPENDIX 6 (continued) EXCHANGEABLE & WATER SOLUBLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT-MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^+ REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	0,35	0,39	0,44	0,42	0,40	0,71	0,68	0,56	0,63	0,65	2,40	1,33	3,20	1,60	2,13	3,47	4,27	5,27	4,73	4,44
	2	0,41	0,41	0,44	0,42	0,42	0,53	0,49	0,71	0,58	0,58	2,40	0,27	1,87	1,60	1,54	3,93	4,00	5,40	4,87	4,55
	3	0,35	0,39	0,39	0,42	0,39	0,49	0,63	0,73	0,58	0,61	2,40	1,40	1,60	0,80	1,55	3,53	4,27	4,73	4,40	4,23
	4	0,39	0,39	0,42	0,42	0,41	0,49	0,71	0,56	0,56	0,58	2,40	0,80	1,60	2,13	1,73	4,00	4,40	5,40	5,00	4,70
	5	0,32	0,41	0,46	0,44	0,41	0,60	0,51	0,51	0,53	0,54	1,87	2,93	1,60	1,60	2,00	3,13	4,13	4,73	5,00	4,25
3M11	1	0,69	0,68	1,15	0,89	0,85	0,37	0,47	0,33	0,40	0,39	5,87	6,20	8,20	6,87	6,79	5,27	6,33	9,73	7,47	7,20
	2	0,62	0,79	0,95	0,82	0,80	0,35	0,54	0,36	0,29	0,39	6,27	6,53	8,53	8,53	7,47	5,07	7,00	8,53	7,60	7,05
	3	0,60	0,98	0,92	1,00	0,88	0,50	0,33	0,49	0,45	0,44	5,60	8,20	7,53	7,20	7,13	4,20	8,87	7,73	7,93	7,18
	4	0,64	0,59	1,03	0,79	0,76	0,39	0,54	0,45	0,45	0,46	6,53	7,53	6,53	7,53	7,03	5,20	7,00	8,33	6,87	6,85
	5	0,66	0,92	1,00	1,29	0,97	0,43	0,40	0,47	0,32	0,41	6,87	6,87	7,53	8,87	7,54	6,07	7,93	7,93	9,00	7,73
OSBLOK	1	0,45	0,57	0,57	0,33	0,48	0,15	0,12	0,42	0,16	0,14	2,53	3,07	2,67	2,13	2,60	1,27	1,47	1,27	1,20	1,30
	2	0,40	0,45	0,34	0,31	0,38	0,17	0,15	0,41	0,13	0,14	2,53	2,80	2,40	2,13	2,47	1,27	1,27	1,20	1,20	1,24
	3	0,41	0,43	0,31	0,28	0,36	0,12	0,11	0,16	0,13	0,13	2,67	2,67	2,40	2,67	2,60	1,13	1,27	1,07	1,27	1,19
	4	0,31	0,47	0,31	0,30	0,35	0,15	0,12	0,16	0,13	0,14	2,40	2,80	2,53	2,67	2,60	1,20	1,33	1,40	1,20	1,28
	5	0,41	0,47	0,30	0,30	0,37	0,19	0,12	0,14	0,13	0,15	2,40	2,53	2,40	2,67	2,50	1,20	1,20	1,47	1,20	1,27
SKAAP BLOK	1	0,33	0,26	0,24	0,34	0,29	0,16	0,21	0,23	0,23	0,21	2,93	2,27	2,80	2,27	2,57	1,73	1,53	1,67	1,53	1,62
	2	0,67	0,24	0,26	0,29	0,37	0,17	0,21	0,29	0,21	0,22	3,07	2,40	2,27	2,27	2,50	1,73	1,33	1,33	1,53	1,48
	3	0,53	0,26	0,23	0,29	0,33	0,22	0,25	0,21	0,23	0,23	3,20	2,53	2,53	2,53	2,70	1,73	1,53	1,13	1,53	1,48
	4	0,44	0,26	0,31	0,27	0,32	0,20	0,25	0,29	0,21	0,24	3,33	2,00	2,00	2,53	2,47	1,87	1,20	1,27	1,73	1,52
	5	0,29	0,27	0,27	0,27	0,28	0,25	0,25	0,25	0,27	0,26	2,53	2,80	2,27	2,27	2,47	1,53	1,53	1,53	1,53	1,53

APPENDIX 6 (continued) EXCHANGEABLE & WATER SOLUBLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	0,29	0,11	0,11	0,13	0,16	0,39	0,45	0,39	0,48	0,43	2,40	2,13	2,13	2,13	2,20	1,47	1,33	1,53	1,53	1,17
	2	0,27	0,11	0,10	0,08	0,14	0,33	0,48	0,41	0,41	0,41	2,13	1,87	2,13	2,13	2,07	1,33	1,20	1,33	1,33	1,30
	3	0,29	0,11	0,11	0,72	0,31	0,33	0,50	0,41	0,48	0,43	1,87	2,13	2,13	1,73	1,97	1,47	1,47	1,47	1,53	1,49
	4	0,27	0,11	0,10	0,13	0,15	0,38	0,45	0,43	0,45	0,43	2,13	2,13	2,13	2,13	2,13	1,33	1,47	1,47	1,53	1,45
	5	0,11	0,10	0,10	0,11	0,11	0,48	0,43	0,53	0,45	0,47	2,40	2,13	1,87	2,13	2,13	1,47	1,47	1,47	1,33	1,44
24D10	1	0,13	0,37	0,35	0,45	0,33	0,32	0,19	0,26	0,19	0,24	2,67	2,40	2,13	2,13	2,33	1,67	1,60	1,67	1,60	1,64
	2	0,14	0,28	0,37	0,40	0,30	0,29	0,30	0,24	0,17	0,25	2,67	2,13	2,40	2,40	2,40	1,60	1,27	1,60	1,60	1,52
	3	0,17	0,32	0,32	0,40	0,30	0,23	0,30	0,22	0,17	0,23	2,67	2,13	1,87	2,13	2,20	2,00	1,47	1,27	1,60	1,59
	4	0,19	0,33	0,35	0,28	0,29	0,25	0,17	0,19	0,26	0,22	2,67	2,40	2,13	1,87	2,27	2,00	1,57	1,60	1,27	1,64
	5	0,37	0,33	0,45	0,41	0,39	0,24	0,28	0,17	0,26	0,24	2,93	1,60	2,40	2,13	2,27	1,80	1,20	1,67	1,67	1,59
5C5	1	0,25	0,27	0,27	0,37	0,29	0,08	0,08	0,06	0,08	0,08	1,20	2,80	1,20	3,10	2,08	1,40	1,40	1,53	1,53	1,47
	2	0,23	0,27	0,27	0,47	0,31	0,12	0,08	0,12	0,06	0,10	1,20	1,33	1,33	3,60	1,87	1,40	1,40	1,53	1,60	1,48
	3	0,27	0,29	0,25	0,31	0,28	0,08	0,08	0,12	0,10	0,10	1,20	3,10	1,20	2,80	2,08	1,40	1,60	1,53	1,60	1,53
	4	0,27	0,25	0,31	0,31	0,29	0,08	0,08	0,08	0,06	0,08	1,20	1,33	2,80	2,80	2,03	1,33	1,40	1,60	1,40	1,43
	5	0,25	0,29	0,27	0,31	0,28	0,08	0,08	0,10	0,08	0,09	2,13	1,33	1,33	1,33	1,53	1,40	1,33	1,40	1,53	1,42

APPENDIX 7 WATER SOLUBLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT-MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	0,03	0,02	0,03	0,02	0,025	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,02	0,02	0,01	0,01	0,015
	2	0,02	0,02	0,02	0,02	0,020	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010
	3	0,03	0,02	0,03	0,03	0,028	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,02	0,01	0,02	0,01	0,015
	4	0,03	0,02	0,03	0,02	0,025	0,01	0,01	0,02	0,01	0,015	0,01	0,01	0,01	0,01	0,010	0,02	0,01	0,02	0,01	0,015
	5	0,02	0,03	0,03	0,02	0,025	0,01	0,01	0,02	0,01	0,013	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010
1R1	1	0,02	0,04	0,02	0,03	0,028	0,01	0,01	0,01	0,01	0,010	0,02	0,05	0,01	0,01	0,023	0,03	0,06	0,02	0,03	0,035
	2	0,04	0,03	0,02	0,05	0,035	0,02	0,01	0,01	0,01	0,013	0,04	0,01	0,01	0,01	0,018	0,05	0,03	0,02	0,03	0,033
	3	0,03	0,03	0,02	0,03	0,028	0,01	0,02	0,01	0,01	0,013	0,01	0,01	0,01	0,01	0,010	0,03	0,03	0,02	0,03	0,028
	4	0,03	0,02	0,02	0,03	0,025	0,02	0,01	0,02	0,02	0,018	0,04	0,01	0,01	0,02	0,023	0,05	0,01	0,02	0,03	0,028
	5	0,02	0,03	0,02	0,02	0,023	0,03	0,01	0,01	0,01	0,015	0,01	0,01	0,01	0,01	0,010	0,02	0,03	0,01	0,02	0,020
2A5	1	0,02	0,02	0,03	0,03	0,025	0,01	0,01	0,01	0,01	0,010	0,02	0,02	0,02	0,02	0,020	0,04	0,02	0,03	0,03	0,030
	2	0,02	0,02	0,03	0,03	0,025	0,01	0,01	0,01	0,01	0,010	0,02	0,01	0,02	0,02	0,018	0,03	0,02	0,03	0,03	0,028
	3	0,01	0,02	0,03	0,03	0,023	0,01	0,01	0,01	0,01	0,010	0,01	0,02	0,02	0,02	0,018	0,01	0,02	0,03	0,03	0,023
	4	0,01	0,03	0,04	0,03	0,028	0,01	0,01	0,02	0,02	0,015	0,02	0,02	0,04	0,05	0,033	0,02	0,03	0,06	0,06	0,043
	5	0,01	0,02	0,02	0,03	0,020	0,02	0,01	0,01	0,03	0,018	0,02	0,02	0,02	0,06	0,030	0,03	0,03	0,02	0,07	0,038
3K9	1	0,01	0,02	0,01	0,01	0,013	0,01	0,02	0,01	0,01	0,013	0,02	0,02	0,02	0,03	0,023	0,02	0,02	0,02	0,02	0,020
	2	0,02	0,01	0,01	0,02	0,015	0,02	0,01	0,01	0,02	0,015	0,06	0,02	0,02	0,03	0,033	0,05	0,02	0,02	0,03	0,030
	3	0,02	0,02	0,01	0,04	0,023	0,04	0,02	0,02	0,02	0,030	0,05	0,02	0,02	0,18	0,068	0,04	0,01	0,02	0,12	0,048
	4	0,02	0,01	0,02	0,01	0,015	0,03	0,02	0,02	0,04	0,028	0,03	0,02	0,03	0,03	0,028	0,02	0,02	0,02	0,03	0,023
	5	0,01	0,01	0,01	0,03	0,015	0,02	0,02	0,01	0,03	0,020	0,01	0,04	0,05	0,03	0,033	0,01	0,03	0,04	0,03	0,028

APPENDIX 7 (continued) WATER SOLUBLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	0,05	0,07	0,04	0,03	0,048	0,01	0,01	0,01	0,01	0,010	0,07	0,14	0,03	0,02	0,065	0,07	0,12	0,04	0,02	0,063
	2	0,04	0,05	0,09	0,04	0,055	0,01	0,01	0,02	0,02	0,015	0,03	0,03	0,14	0,05	0,063	0,04	0,04	0,14	0,06	0,070
	3	0,06	0,04	0,03	0,03	0,040	0,02	0,01	0,01	0,02	0,015	0,07	0,03	0,05	0,02	0,043	0,08	0,03	0,05	0,03	0,048
	4	0,04	0,05	0,05	0,09	0,058	0,01	0,05	0,04	0,04	0,035	0,02	0,07	0,06	0,32	0,118	0,02	0,06	0,07	0,27	0,105
	5	0,06	0,03	0,03	0,04	0,040	0,05	0,01	0,03	0,03	0,030	0,06	0,02	0,03	0,05	0,040	0,06	0,03	0,03	0,06	0,045
4C5	1	0,02	0,02	0,02	0,01	0,018	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,01	0,03	0,02	0,02	0,020
	2	0,02	0,02	0,02	0,02	0,020	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,02	0,02	0,02	0,02	0,020
	3	0,03	0,02	0,02	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,02	0,03	0,03	0,03	0,028
	4	0,02	0,02	0,02	0,02	0,020	0,02	0,01	0,02	0,01	0,015	0,01	0,01	0,01	0,01	0,010	0,02	0,02	0,02	0,02	0,020
	5	0,02	0,02	0,02	0,03	0,023	0,02	0,03	0,01	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,01	0,02	0,02	0 04	0,023
6L8	1	0,02	0,02	0,03	0,02	0,025	0,01	0,01	0,01	0,01	0,010	0,01	0,04	0,01	0,01	0,018	0,02	0,06	0,03	0,02	0,033
	2	0,02	0,02	0,02	0,01	0,018	0,02	0,01	0,02	0,01	0,015	0,03	0,01	0,01	0,01	0,015	0,05	0,02	0,02	0,01	0,025
	3	0,02	0,02	0,02	0,01	0,018	0,01	0,02	0,03	0,01	0,018	0,01	0,01	0,03	0,01	0,015	0,02	0,02	0,05	0,01	0,025
	4	0,02	0,02	0,02	0,01	0,018	0,02	0,01	0,02	0,02	0,018	0,01	0,01	0,01	0,01	0,010	0,02	0,02	0,02	0,01	0,018
	5	0,03	0,02	0,02	0,01	0,020	0,04	0,03	0,03	0,01	0,028	0,01	0,01	0,01	0,01	0,010	0,02	0,03	0,02	0,02	0,023
6Q1	1	0,03	0,02	0,02	0,03	0,025	0,01	0,01	0,01	0,01	0,010	0,02	0,01	0,01	0,06	0,025	0,02	0,01	0,01	0,05	0,023
	2	0,03	0,03	0,02	0,02	0,025	0,01	0,01	0,01	0,01	0,010	0,03	0,02	0,01	0,01	0,018	0,03	0,02	0,02	0,02	0,023
	3	0,02	0,02	0,02	0,02	0,020	0,01	0,01	0,01	0,01	0,010	0,03	0,01	0,02	0,02	0,020	0,02	0,01	0,02	0,02	0,018
	4	0,04	0,02	0,03	0,02	0,028	0,02	0,01	0,01	0,01	0,015	0,12	0,01	0,02	0,01	0,040	0,09	0,01	0,02	0,02	0,035
	5	0,03	0,03	0,03	0,02	0,028	0,01	0,01	0,01	0,02	0,013	0,02	0,02	0,01	0,03	0,020	0,02	0,02	0,01	0,02	0,018
7Q1	1	0,02	0,05	0,03	0,03	0,033	0,02	0,03	0,01	0,03	0,023	0,02	0,05	0,04	0,07	0,045	0,03	0,08	0,07	0,11	0,073
	2	0,02	0,03	0,04	0,02	0,028	0,02	0,03	0,03	0,02	0,025	0,03	0,10	0,06	0,04	0,058	0,04	0,12	0,09	0,02	0,068
	3	0,02	0,03	0,04	0,03	0,030	0,01	0,04	0,03	0,02	0,025	0,01	0,01	0,05	0,03	0,025	0,01	0,12	0,09	0,08	0,075
	4	0,02	0,03	0,04	0,03	0,030	0,01	0,05	0,03	0,02	0,028	0,01	0,07	0,07	0,02	0,043	0,02	0,10	0,10	0,07	0,073
	5	0,04	0,04	0,05	0,04	0,043	0,02	0,04	0,04	0,03	0,033	0,02	0,11	0,14	0,05	0,080	0,04	0,14	0,17	0,09	0,011

APPENDIX 7 (continued) WATER SOLUBLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
3M11	1	0,06	0,03	0,04	0,04	0,043	0,01	0,01	0,01	0,01	0,010	0,16	0,04	0,02	0,06	0,070	0,14	0,04	0,02	0,06	0,065
	2	0,05	0,06	0,06	0,03	0,050	0,02	0,02	0,01	0,01	0,015	0,10	0,12	0,16	0,02	0,010	0,07	0,10	0,15	0,03	0,088
	3	0,05	0,04	0,02	0,04	0,038	0,01	0,01	0,01	0,01	0,010	0,10	0,05	0,02	0,04	0,053	0,08	0,05	0,02	0,04	0,048
	4	0,04	0,03	0,03	0,04	0,035	0,02	0,01	0,01	0,01	0,013	0,06	0,04	0,06	0,04	0,050	0,05	0,03	0,05	0,04	0,043
	5	0,05	0,06	0,04	0,05	0,050	0,02	0,02	0,01	0,01	0,015	0,10	0,10	0,07	0,05	0,080	0,07	0,09	0,06	0,05	0,068
OSBLOK	1	0,03	0,03	0,02	0,02	0,025	0,01	0,01	0,01	0,01	0,010	0,02	0,03	0,05	0,04	0,035	0,03	0,03	0,03	0,03	0,030
	2	0,04	0,03	0,02	0,02	0,028	0,01	0,01	0,01	0,01	0,010	0,03	0,02	0,04	0,06	0,038	0,03	0,03	0,02	0,03	0,028
	3	0,04	0,02	0,02	0,02	0,025	0,01	0,01	0,01	0,01	0,010	0,02	0,01	0,06	0,03	0,030	0,02	0,02	0,05	0,02	0,028
	4	0,04	0,03	0,02	0,02	0,028	0,01	0,01	0,01	0,01	0,010	0,02	0,03	0,03	0,06	0,035	0,03	0,03	0,02	0,04	0,030
	5	0,04	0,02	0,02	0,02	0,025	0,02	0,01	0,01	0,01	0,010	0,02	0,04	0,03	0,04	0,033	0,03	0,03	0,02	0 03	0,028
SKAAP-BLOK	1	0,02	0,02	0,02	0,02	0,020	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,02	0,01	0,013	0,01	0,01	0,02	0,01	0,013
	2	0,02	0,02	0,03	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,02	0,01	0,02	0,01	0,015	0,02	0,01	0,02	0,01	0,015
	3	0,02	0,03	0,03	0,02	0,025	0,01	0,01	0,01	0,01	0,010	0,01	0,02	0,03	0,01	0,018	0,01	0,02	0,03	0,01	0,018
	4	0,02	0,03	0,02	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,01	0,02	0,03	0,01	0,018	0,01	0,02	0,03	0,01	0,018
	5	0,03	0,02	0,02	0,02	0,023	0,02	0,01	0,01	0,01	0,013	0,01	0,01	0,02	0,01	0,013	0,01	0,01	0,01	0,01	0,010
4Q4	1	0,02	0,03	0,02	0,03	0,025	0,01	0,01	0,01	0,01	0,010	0,01	0,03	0,02	0,02	0,020	0,02	0,03	0,02	0,03	0,025
	2	0,02	0,03	0,02	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,02	0,02	0,01	0,01	0,015	0,02	0,02	0,02	0,02	0,020
	3	0,02	0,02	0,02	0,03	0,023	0,01	0,03	0,01	0,01	0,013	0,02	0,02	0,02	0,02	0,020	0,02	0,02	0,02	0,03	0,023
	4	0,02	0,02	0,02	0,03	0,023	0,01	0,01	0,02	0,01	0,010	0,01	0,01	0,02	0,02	0,015	0,02	0,02	0,02	0,02	0,020
	5	0,02	0,02	0,02	0,03	0,023	0,02	0,02	0,02	0,01	0,018	0,01	0,02	0,01	0,01	0,013	0,01	0,02	0,01	0,01	0,013

APPENDIX 7 (continued) WATER SOLUBLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
24D10	1	0,02	0,02	0,01	0,02	0,018	0,02	0,01	0,01	0,01	0,013	0,06	0,03	0,04	0,04	0,043	0,05	0,03	0,04	0,04	0,040
	2	0,02	0,01	0,03	0,01	0,018	0,02	0,01	0,02	0,01	0,015	0,04	0,03	0,07	0,04	0,045	0,04	0,02	0,07	0,04	0,043
	3	0,02	0,02	0,03	0,01	0,020	0,02	0,02	0,02	0,01	0,018	0,03	0,03	0,04	0,02	0,030	0,03	0,03	0,04	0,03	0,033
	4	0,02	0,02	0,02	0,01	0,018	0,02	0,02	0,02	0,01	0,018	0,02	0,02	0,02	0,02	0,020	0,03	0,02	0,02	0,02	0,023
	5	0,02	0,01	0,02	0,01	0,015	0,02	0,02	0,02	0,02	0,020	0,03	0,02	0,05	0,03	0,033	0,03	0,02	0,04	0,03	0,030
5C5	1	0,02	0,03	0,02	0,03	0,023	0,01	0,01	0,01	0,01	0,010	0,08	0,02	0,02	0,06	0,045	0,06	0,02	0,02	0,05	0,038
	2	0,02	0,02	0,02	0,05	0,028	0,01	0,01	0,01	0,04	0,018	0,02	0,02	0,02	0,02	0,020	0,02	0,02	0,02	0,05	0,028
	3	0,02	0,01	0,02	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,01	0,02	0,02	0,02	0,018	0,02	0,02	0,02	0,02	0,020
	4	0,02	0,02	0,02	0,03	0,023	0,01	0,01	0,01	0,01	0,010	0,01	0,03	0,02	0,06	0,030	0,02	0,03	0,02	0,03	0,025
	5	0,02	0,01	0,02	0,02	0,018	0,01	0,01	0,01	0,01	0,010	0,02	0,02	0,04	0,02	0,025	0,02	0,02	0,04	0,02	0,025

APPENDIX 8 WATER SOLUBLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	0,02	0,03	0,02	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,03	0,02	0,02	0,02	0,023	0,03	0,03	0,03	0,02	0,028
	2	0,02	0,03	0,02	0,04	0,028	0,01	0,01	0,01	0,01	0,010	0,01	0,02	0,01	0,14 x	0,045	0,01	0,03	0,01	0,12	0,043
	3	0,04	0,02	0,04	0,04	0,035	0,01	0,01	0,01	0,01	0,010	0,09	0,01	0,08	0,02	0,080	0,08	0,01	0,07	0,03	0,048
	4	0,03	0,02	0,2	0,03	0,025	0,01	0,01	0,01	0,01	0,010	0,02	0,01	0,01	0,01	0,013	0,02	0,02	0,02	0,02	0,020
	5	0,02	0,02	0,03	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,013	0,01	0,01	0,04	0,02	0,020
1R1	1	0,02	0,05	0,03	0,04	0,035	0,01	0,02	0,01	0,01	0,013	0,02	0,12	0,02	0,02	0,043	0,03	0,10	0,02	0,02	0,043
	2	0,03	0,02	0,03	0,12	0,050	0,01	0,01	0,01	0,01	0,010	0,03	0,01	0,01	0,02	0,018	0,03	0,01	0,02	0,02	0,020
	3	0,05	0,04	0,03	0,04	0,040	0,02	0,02	0,01	0,01	0,015	0,11	0,02	0,01	0,02	0,040	0,16	0,03	0,01	0,02	0,065
	4	0,04	0,03	0,03	0,04	0,035	0,02	0,01	0,01	0,02	0,015	0,07	0,01	0,01	0,02	0,028	0,10	0,01	0,01	0,02	0,035
	5	0,04	0,03	0,04	0,04	0,038	0,01	0,01	0,02	0,01	0,013	0,01	0,01	0,02	0,01	0,013	0,02	0,01	0,03	0,02	0,020
2A5	1	0,08	0,07	0,02	0,03	0,050	0,01	0,01	0,01	0,01	0,010	0,13	0,08	0,02	0,06	0,073	0,12	0,08	0,02	0,05	0,068
	2	0,06	0,14	0,08	0,05	0,083	0,01	0,01	0,01	0,01	0,010	0,06	0,17	0,17	0,13	0,133	0,06	0,02	0,15	0,10	0,083
	3	0,09	0,06	0,04	0,05	0,060	0,01	0,01	0,01	0,01	0,010	0,14	0,09	0,10	0,06	0,098	0,15	0,09	0,07	0,05	0,090
	4	0,05	0,06	0,03	0,04	0,045	0,01	0,01	0,01	0,01	0,010	0,07	0,08	0,02	0,05	0,055	0,07	0,08	0,02	0,04	0,053
	5	0,10	0,04	0,03	0,11	0,070	0,01	0,01	0,01	0,01	0,010	0,02	0,03	0,03	0,25	0,128	0,23	0,03	0,03	0,21	0,150
3K9	1	0,02	0,03	0,03	0,03	0,028	0,01	0,06	0,02	0,03	0,030	0,01	0,04	0,10	0,03	0,045	0,01	0,03	0,09	0,03	0,040
	2	0,03	0,02	0,02	0,06	0,033	0,02	0,02	0,01	0,03	0,020	0,02	0,02	0,02	0,08	0,035	0,02	0,02	0,02	0,07	0,033
	3	0,01	0,02	0,02	0,01	0,015	0,03	0,04	0,01	0,02	0,025	0,01	0,01	0,01	0,02	0,013	0,01	0,01	0,01	0,02	0,013
	4	0,02	0,04	0,03	0,03	0,030	0,05	0,04	0,03	0,05	0,043	0,03	0,21	0,04	0,23	0,130	0,03	0,15	0,04	0,16	0,095
	5	0,02	0,02	0,02	0,03	0,023	0,02	0,02	0,02	0,02	0,020	0,01	0,04	0,02	0,02	0,023	0,01	0,04	0,02	0,02	0,023

APPENDIX 8 (continued) WATER SOLUBLE CATION (me/100g) SUBSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	0,06	0,07	0,03	0,04	0,050	0,01	0,01	0,01	0,02	0,013	0,07	0,07	0,06	0,06	0,065	0,07	0,10	0,06	0,07	0,075
	2	0,05	0,05	0,06	0,02	0,045	0,02	0,02	0,01	0,01	0,015	0,06	0,06	0,06	0,06	0,060	0,05	0,06	0,07	0,07	0,063
	3	0,07	0,05	0,05	0,04	0,053	0,02	0,03	0,01	0,02	0,020	0,05	0,06	0,05	0,06	0,065	0,06	0,07	0,06	0,07	0,065
	4	0,06	0,03	0,04	0,06	0,048	0,03	0,02	0,03	0,03	0,028	0,11	0,06	0,05	0,11	0,083	0,14	0,06	0,06	0,14	0,100
	5	0,09	0,03	0,03	0,06	0,053	0,03	0,01	0,02	0,02	0,020	0,07	0,04	0,05	0,06	0,055	0,08	0,05	0,06	0,06	0,063
4C4	1	0,03	0,04	0,04	0,04	0,038	0,01	0,01	0,01	0,01	0,010	0,02	0,07	0,03	0,08	0,050	0,05	0,11	0,04	0,04	0,068
	2	0,05	0,03	0,03	0,02	0,033	0,01	0,01	0,01	0,01	0,010	0,05	0,04	0,03	0,02	0,035	0,09	0,04	0,04	0,02	0,048
	3	0,03	0,08	0,04	0,03	0,045	0,01	0,01	0,01	0,01	0,010	0,02	0,11	0,07	0,07	0,068	0,03	0,16	0,06	0,06	0,078
	4	0,03	0,04	0,05	0,02	0,035	0,01	0,01	0,01	0,01	0,010	0,02	0,03	0,09	0,01	0,038	0,03	0,04	0,08	0,01	0,040
	5	0,04	0,05	0,06	0,08	0,058	0,01	0,01	0,01	0,01	0,010	0,05	0,09	0,15	0,18	0,118	0,07	0,14	0,16	0,18	0,138
6L8	1	0,02	0,02	0,02	0,01	0,018	0,01	0,01	0,01	0,01	0,010	0,01	0,02	0,02	0,01	0,015	0,02	0,03	0,03	0,01	0,023
	2	0,02	0,01	0,01	0,01	0,013	0,01	0,01	0,01	0,01	0,010	0,04	0,01	0,01	0,01	0,018	0,05	0,01	0,01	0,01	0,020
	3	0,02	0,02	0,03	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,02	0,01	0,14	0,05	0,055	0,03	0,01	0,17	0,05	0,065
	4	0,02	0,01	0,01	0,02	0,015	0,01	0,01	0,01	0,01	0,010	0,02	0,02	0,02	0,13	0,048	0,03	0,03	0,02	0,15	0,058
	5	0,02	0,03	0,01	0,02	0,020	0,01	0,01	0,01	0,01	0,010	0,04	0,01	0,01	0,04	0,025	0,05	0,05	0,02	0,04	0,040
6Q1	1	0,02	0,02	0,02	0,02	0,020	0,01	0,01	0,01	0,01	0,010	0,02	0,03	0,02	0,04	0,028	0,02	0,02	0,01	0,04	0,023
	2	0,02	0,03	0,02	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,03	0,05	0,02	0,04	0,035	0,02	0,04	0,02	0,04	0,030
	3	0,03	0,02	0,02	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,06	0,03	0,02	0,03	0,035	0,04	0,02	0,02	0,02	0,025
	4	0,03	0,02	0,02	0,01	0,020	0,01	0,01	0,01	0,01	0,010	0,05	0,03	0,03	0,02	0,035	0,03	0,02	0,03	0,02	0,025
	5	0,03	0,02	0,03	0,02	0,025	0,01	0,01	0,01	0,01	0,010	0,03	0,05	0,04	0,07	0,048	0,03	0,04	0,04	0,04	0,038

APPENDIX 8 (continued) WATER SOLUBLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	0,06	0,05	0,08	0,07	0,065	0,02	0,01	0,01	0,01	0,013	0,03	0,04	0,03	0,04	0,035	0,13	0,11	0,15	0,17	0,140
	2	0,09	0,08	0,09	0,08	0,085	0,01	0,01	0,01	0,01	0,010	0,11	0,07	0,05	0,09	0,080	0,24	0,20	0,23	0,024	0,228
	3	0,06	0,08	0,08	0,08	0,075	0,01	0,01	0,02	0,01	0,013	0,05	0,05	0,04	0,07	0,053	0,10	0,24	0,17	0,25	0,190
	4	0,07	0,07	0,10	0,09	0,083	0,01	0,02	0,01	0,01	0,013	0,09	0,07	0,07	0,05	0,070	0,16	0,19	0,36	0,23	0,235
	5	0,03	0,09	0,11	0,10	0,083	0,01	0,01	0,01	0,01	0,010	0,01	0,07	0,08	0,09	0,063	0,06	0,32	0,35	0,36	0,265
3M11	1	0,16	0,15	0,30	0,14	0,188	0,01	0,01	0,01	0,01	0,010	0,22	0,27	0,36	0,22	0,268	0,35	0,41	0,71	0,30	0,443
	2	0,10	0,26	0,19	0,14	0,173	0,01	0,01	0,01	0,01	0,010	0,12	0,65	0,33	0,31	0,353	0,16	0,83	0,47	0,42	0,470
	3	0,12	0,26	0,11	0,12	0,153	0,01	0,01	0,01	0,01	0,010	0,18	0,51	0,13	0,13	0,238	0,27	0,74	0,20	0,15	0,340
	4	0,18	0,11	0,21	0,10	0,150	0,01	0,01	0,01	0,01	0,010	0,40	0,22	0,26	0,22	0,275	0,46	0,32	0,50	0,27	0,388
	5	0,13	0,21	0,20	0,24	0,195	0,01	0,01	0,01	0,01	0,010	0,31	0,33	0,27	0,33	0,310	0,38	0,58	0,41	0,53	0,475
OSBLOK	1	0,04	0,04	0,05	0,04	0,043	0,01	0,01	0,01	0,01	0,010	0,04	0,04	0,06	0,02	0,040	0,03	0,03	0,04	0,02	0,030
	2	0,05	0,04	0,03	0,04	0,040	0,01	0,01	0,01	0,01	0,010	0,04	0,05	0,05	0,03	0,043	0,03	0,03	0,02	0,02	0,025
	3	0,05	0,03	0,05	0,04	0,043	0,01	0,01	0,01	0,01	0,010	0,06	0,05	0,06	0,03	0,050	0,04	0,03	0,05	0,02	0,035
	4	0,02	0,03	0,06	0,04	0,038	0,01	0,01	0,01	0,01	0,010	0,04	0,04	0,06	0,03	0,043	0,02	0,03	0,05	0,03	0,033
	5	0,03	0,03	0,05	0,04	0,038	0,01	0,01	0,01	0,01	0,010	0,04	0,06	0,05	0,03	0,045	0,03	0,03	0,04	0,03	0,033
SKAAP BLOK	1	0,03	0,03	0,03	0,03	0,030	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,02	0,01	0,01	0,01	0,013
	2	0,05	0,03	0,03	0,03	0,035	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010
	3	0,04	0,03	0,02	0,02	0,028	0,01	0,01	0,01	0,01	0,010	0,04	0,02	0,02	0,01	0,023	0,04	0,02	0,02	0,01	0,023
	4	0,04	0,03	0,02	0,02	0,028	0,01	0,01	0,01	0,01	0,010	0,09	0,01	0,01	0,01	0,030	0,07	0,01	0,01	0,01	0,025
	5	0,04	0,04	0,03	0,02	0,033	0,01	0,01	0,01	0,01	0,010	0,01	0,02	0,01	0,01	0,013	0,01	0,02	0,01	0,01	0,015

APPENDIX 8 (continued) WATER SOLUBLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT-MENT	Na$^+$ REPLICATION					K$^+$ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	0,02	0,03	0,02	0,03	0,025	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010
	2	0,02	0,03	0,02	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010
	3	0,03	0,03	0,03	0,02	0,028	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,02	0,01	0,01	0,01	0,013
	4	0,02	0,03	0,02	0,02	0,023	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010
	5	0,03	0,02	0,02	0,03	0,025	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010	0,01	0,01	0,01	0,01	0,010
24D10	1	0,03	0,06	0,06	0,011	0,065	0,01	0,01	0,01	0,01	0,010	0,01	0,14	0,14	0,13	0,128	0,06	0,22	0,16	0,14	0,145
	2	0,05	0,04	0,06	0,09	0,060	0,01	0,02	0,01	0,01	0,013	0,15	0,12	0,14	0,14	0,138	0,08	0,09	0,15	0,16	0,120
	3	0,06	0,04	0,05	0,07	0,055	0,01	0,01	0,01	0,01	0,010	0,18	0,07	0,13	0,13	0,012	0,17	0,06	0,13	0,12	0,120
	4	0,07	0,06	0,05	0,04	0,055	0,01	0,01	0,01	0,01	0,010	0,18	0,12	0,11	0,05	0,115	0,16	0,14	0,10	0,04	0,110
	5	0,09	0,02	0,07	0,09	0,068	0,01	0,01	0,01	0,01	0,010	0,20	0,04	0,15	0,10	0,123	0,34	0,03	0,17	0,10	0,160
5C5	1	0,03	0,03	0,04	0,11	0,053	0,01	0,01	0,01	0,01	0,010	0,04	0,09	0,08	0,18	0,098	0,04	0,06	0,06	0,01	0,043
	2	0,03	0,03	0,02	0,16	0,060	0,01	0,01	0,01	0,01	0,010	0,05	0,06	0,05	0,24	0,100	0,04	0,05	0,04	0,02	0,038
	3	0,02	0,04	0,02	0,04	0,030	0,01	0,01	0,01	0,01	0,010	0,03	0,12	0,08	0,14	0,093	0,03	0,08	0,06	0,01	0,045
	4	0,02	0,03	0,07	0,07	0,048	0,01	0,01	0,01	0,01	0,010	0,02	0,08	0,16	0,16	0,105	0,02	0,06	0,01	0,01	0,048
	5	0,02	0,03	0,03	0,06	0,035	0,01	0,01	0,01	0,01	0,010	0,06	0,08	0,09	0,16	0,098	0,04	0,06	0,07	0,01	0,045

APPENDIX 9 EXCHANGEABLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT-MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B1	1	0,10	0,15	0,11	0,11	0,12	0,34	0,27	0,30	0,30	0,30	1,46	2,12	1,19	1,06	1,46	1,71	1,78	1,46	1,32	1,57
	2	0,12	0,12	0,12	0,12	0,12	0,32	0,32	0,36	0,39	0,35	1,86	1,86	1,86	1,59	1,79	1,79	1,59	1,46	1,32	1,54
	3	0,11	0,12	0,11	0,14	0,12	0,40	0,36	0,40	0,38	0,39	1,86	1,86	0,52	1,86	1,53	1,71	1,46	1,45	1,46	1,52
	4	0,26	0,16	0,20	0,34	0,24	0,36	0,40	0,45	0,47	0,42	1,86	1,59	1,59	2,66	1,93	1,78	1,46	1,38	1,59	1,55
	5	0,12	0,14	0,11	0,23	0,15	0,42	0,36	0,48	0,45	0,43	1,86	2,12	1,59	2,26	1,96	1,59	1,26	1,52	1,52	1,47
1R1	1	0,39	0,25	0,30	0,26	0,30	0,25	0,20	0,25	0,22	0,23	2,18	1,82	1,86	1,86	1,93	1,30	1,07	1,31	1,30	1,23
	2	0,22	0,26	0,27	0,42	0,29	0,32	0,29	0,29	0,29	0,30	2,23	2,32	1,99	1,52	2,02	1,28	1,44	1,25	1,24	1,30
	3	0,35	0,29	0,24	0,43	0,33	0,31	0,39	0,29	0,33	0,33	2,19	2,19	1,99	1,52	1,97	1,24	1,24	1,25	1,24	1,24
	4	0,35	0,24	0,27	0,47	0,33	0,36	0,35	0,41	0,39	0,38	2,16	1,86	2,19	1,99	2,05	1,42	1,26	1,25	1,30	1,31
	5	0,27	0,32	0,30	0,39	0,32	0,53	0,29	0,29	0,33	0,36	1,86	2,19	1,52	1,66	1,81	1,25	1,30	1,12	1,25	1,23
2A5	1	0,27	0,29	0,28	0,59	0,36	0,28	0,31	0,22	0,22	0,26	3,31	2,98	3,05	2,78	3,03	2,23	2,05	1,37	1,17	1,71
	2	0,31	0,27	0,54	0,15	0,32	0,26	0,26	0,27	0,22	0,25	3,65	2,99	3,05	3,05	3,19	2,10	1,98	1,37	1,37	1,71
	3	0,27	0,36	0,20	0,45	0,32	0,37	0,35	0,27	0,25	0,31	3,32	2,98	2,78	2,65	2,93	2,12	2,11	1,37	1,17	1,69
	4	0,30	0,68	0,14	0,45	0,39	0,42	0,42	0,31	0,29	0,36	2,85	3,31	2,76	3,02	2,99	1,91	1,37	1,27	1,34	1,47
	5	0,27	0,32	0,60	0,09	0,32	0,38	0,37	0,27	0,40	0,36	3,85	3,05	2,78	3,01	3,17	2,10	1,37	1,31	1,13	1,48
3K9	1	0,33	0,39	0,25	0,29	0,32	0,28	0,38	0,39	0,32	0,34	2,31	2,31	1,98	2,50	2,28	1,31	1,11	1,31	1,25	1,25
	2	0,34	0,40	0,29	0,20	0,31	0,27	0,32	0,32	0,26	0,29	2,27	2,31	1,98	2,77	2,33	1,28	1,25	1,11	0,97	1,15
	3	0,22	0,36	0,37	0,16	0,28	0,48	0,45	0,40	0,25	0,40	2,28	2,31	2,31	2,09	2,25	1,23	1,12	1,25	0,88	1,12
	4	0,34	0,40	0,28	0,14	0,29	0,39	0,40	0,40	0,36	0,39	2,30	2,31	2,50	2,24	2,34	0,91	1,25	1,31	0,70	1,04
	5	0,33	0,48	0,27	0,15	0,31	0,45	0,38	0,26	0,37	0,37	1,99	2,29	2,28	2,24	2,20	1,12	1,30	1,23	0,77	1,11

APPENDIX 9 (continued) EXCHANGEABLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	0,27	0,30	0,37	0,29	0,31	0,21	0,21	0,23	0,25	0,23	1,66	1,73	1,70	1,45	1,64	1,06	0,95	0,96	0,98	0,99
	2	0,24	0,23	0,28	0,24	0,25	0,29	0,25	0,24	0,28	0,27	1,44	1,70	1,59	1,68	1,60	1,03	1,03	0,93	1,01	1,00
	3	0,31	0,25	0,25	0,26	0,27	0,26	0,29	0,29	0,39	0,31	1,66	1,84	1,58	1,71	1,70	0,92	1,04	0,95	1,04	0,99
	4	0,25	0,18	0,21	0,41	0,26	0,27	0,38	0,31	0,26	0,31	1,71	1,80	1,41	2,08	1,75	0,98	0,94	0,93	1,20	1,01
	5	0,27	0,26	0,26	0,33	0,28	0,43	0,29	0,40	0,32	0,36	1,67	1,71	1,43	1,82	1,66	0,94	1,30	0,97	1,01	1,06
4C5	1	0,28	0,19	0,21	0,22	0,23	0,18	0,17	0,16	0,17	0,17	0,79	1,59	1,59	1,06	1,26	1,92	0,90	1,05	0,91	1,20
	2	0,21	0,19	0,19	0,28	0,22	0,24	0,07	0,20	0,20	0,20	1,32	1,32	1,06	1,32	1,26	1,05	0,91	0,91	0,45	0,83
	3	0,22	0,19	0,26	0,25	0,23	0,22	0,22	0,22	0,22	0,22	1,06	1,32	1,32	0,52	1,06	0,65	1,24	0,44	0,84	0,79
	4	0,19	0,23	0,19	0,34	0,24	0,31	0,24	0,27	0,17	0,25	1,59	1,59	1,32	1,06	1,39	0,71	0,91	0,38	0,45	0,61
	5	0,25	0,18	0,21	0,33	0,24	0,36	0,39	0,28	0,36	0,35	1,59	1,32	1,59	1,59	1,52	0,92	0,65	0,58	0,56	0,68
6L8	1	1,59	1,38	1,12	0,18	1,07	0,27	0,26	0,24	0,30	0,27	2,66	1,16	1,46	1,19	1,62	1,31	1,27	1,04	1,18	1,20
	2	1,38	1,50	1,10	0,24	1,06	0,29	0,27	0,31	0,35	0,31	0,64	0,66	0,92	2,32	1,14	0,95	0,98	1,05	1,32	1,08
	3	1,10	1,46	1,41	0,20	1,04	0,32	0,35	0,35	0,29	0,33	0,92	0,92	0,90	2,52	1,32	1,05	1,05	0,95	1,12	1,04
	4	1,56	1,46	1,56	0,18	1,19	0,32	0,32	0,43	0,36	0,36	1,19	0,92	1,19	1,99	1,32	0,98	1,05	1,05	1,12	1,05
	5	1,46	1,41	1,66	0,26	1,20	0,45	0,42	0,51	0,32	0,43	1,19	2,26	1,72	2,32	1,87	1,18	1,04	0,98	1,25	1,11
6Q1	1	0,27	0,28	0,25	0,28	0,27	0,43	0,41	0,38	0,41	0,41	3,58	4,12	2,66	3,81	3,54	1,58	1.66	1,66	1,55	1,61
	2	0,27	0,27	0,28	0,29	0,28	0,50	0,41	0,50	0,47	0,47	3,57	3,98	4,12	3,86	3,88	1,57	1,65	1,65	1,98	1,71
	3	0,29	0,25	0,29	0,27	0,28	0,43	0,50	0,50	0,56	0,50	4,50	3,59	4,38	3,31	3,95	1,91	1,66	2,05	1,98	1,90
	4	0,21	0,25	0,27	0,27	0,25	0,51	0,43	0,54	0,47	0,49	6,95	4,12	3,31	2,79	4,29	1,38	1,46	1,58	1,86	1,57
	5	0,25	0,28	0,25	0,32	0,28	0,47	0,57	0,59	0,60	0,56	3,31	3,31	3,06	3,44	3,28	1,38	1,65	1,39	1,85	1,57

APPENDIX 9 (continued) EXCHANGEABLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	0,35	0,28	0,32	0,34	0,32	0,78	0,59	0,56	0,59	0,63	4,18	3,62	3,96	3,26	3,76	2,10	2,32	2,86	2,16	2,36
	2	0,31	0,36	0,33	0,27	0,32	0,62	0,56	0,56	0,48	0,56	3,97	3,99	3,61	3,29	3,72	2,36	2,48	2,38	2,71	2,48
	3	0,33	0,30	0,31	0,24	0,30	0,54	0,60	0,66	0,57	0,59	3,32	3,32	3,95	2,90	3,37	2,12	2,15	2,31	2,79	2,34
	4	0,53	0,25	0,29	0,26	0,33	0,68	0,69	0,61	0,64	0,66	3,66	3,26	4,13	2,11	3,29	2,38	2,17	2,57	2,53	2,41
	5	0,36	0,24	0,28	0,26	0,29	0,62	0,55	0,66	0,70	0,63	3,65	3,56	4,06	2,35	3,41	2,09	2,26	2,30	2,38	2,25
3M11	1	0,36	0,55	0,45	0,38	0,44	0,41	0,43	0,34	0,41	0,40	5,71	5,56	5,85	5,14	5,57	2,53	2,56	3,05	2,41	2,64
	2	0,34	0,33	0,46	0,36	0,37	0,37	0,46	0,34	0,30	0,37	5,10	5,48	6,11	5,31	5,50	2,40	2,50	2,72	2,97	2,65
	3	0,44	0,45	0,50	0,38	0,44	0,38	0,38	0,36	0,47	0,40	5,50	5,82	5,31	5,29	5,48	2,12	2,82	2,58	2,63	2,54
	4	0,41	0,53	0,49	0,38	0,45	0,60	0,59	0,36	0,55	0,53	5,81	5,83	5,27	5,29	5,55	2,42	2,64	2,75	2,43	2,56
	5	0,64	0,35	0,37	0,62	0,50	0,54	0,60	0,55	0,59	0,57	5,77	5,50	5,13	5,82	5,56	2,40	2,58	2,41	3,28	2,67
OSBLOK	1	0,28	0,21	0,31	0,35	0,29	0,20	0,16	0,18	0,14	0,17	2,25	2,24	2,48	2,49	2,37	1,17	1,30	1,17	1,17	1,20
	2	0,22	0,23	0,32	0,35	0,28	0,26	0,17	0,11	0,14	0,16	1,97	1,98	2,76	2,07	2,20	1,97	1,17	1,18	1,17	1,37
	3	0,25	0,25	0,33	0,31	0,29	0,16	0,16	0,20	0,11	0,16	2,25	1,99	2,21	2,64	2,27	1,31	1,31	1,15	1,25	1,26
	4	0,23	0,32	0,38	0,38	0,33	0,16	0,14	0,22	0,20	0,18	2,25	2,50	2,10	2,47	2,33	1,30	1,17	1,05	1,16	1,17
	5	0,20	0,41	0,33	0,60	0,39	0,34	0,20	0,16	0,11	0,20	1,17	2,36	2,37	2,63	2,27	0,77	1,17	1,18	1,24	1,09
SKAAP BLOK	1	0,55	0,34	0,57	0,42	0,47	0,16	0,16	0,15	0,16	0,16	2,66	2,26	2,25	2,79	2,49	1,72	1,52	1,45	1,59	1,57
	2	0,40	0,35	0,36	0,42	0,38	0,23	0,16	0,23	0,23	0,21	2,78	2,52	2,65	2,79	2,69	1,65	1,32	1,45	1,52	1,49
	3	0,35	0,36	0,60	0,32	0,41	0,36	0,23	0,26	0,23	0,27	2,52	2,25	2,77	3,32	2,72	1,46	1,25	1,70	1,99	1,60
	4	0,34	0,36	0,42	0,47	0,40	0,32	0,32	0,19	0,26	0,27	2,52	2,25	2,77	2,79	2,58	1,46	1,31	1,50	1,66	1,48
	5	0,33	0,32	0,44	0,40	0,40	0,48	0,27	0,23	0,26	0,31	2,52	2,52	2,51	2,79	2,59	1,46	1,46	1,52	1,66	1,53

APPENDIX 9 (continued) EXCHANGEABLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	0,27	0,20	0,21	0,22	0,23	0,32	0,26	0,24	0,26	0,27	2,12	2,37	1,85	2,11	2,11	0,98	1,24	1,25	1,24	1,18
	2	0,27	0,22	0,25	0,23	0,24	0,30	0,30	0,26	0,22	0,27	2,11	1,85	2,26	2,12	2,09	1,11	1,31	1,25	1,23	1,23
	3	0,25	0,23	0,21	0,22	0,23	0,32	0,36	0,30	0,26	0,31	2,11	2,11	2,11	2,11	2,11	1,35	1,45	1,31	1,24	1,31
	4	0,25	0,21	0,23	0,20	0,22	0,32	0,30	0,33	0,27	0,31	2,12	1,86	2,11	2,25	2,09	1,18	1,11	1,11	1,25	1,16
	5	0,23	0,23	0,27	0,26	0,25	0,44	0,33	0,44	0,30	0,38	2,39	1,58	1,99	1,99	1,99	1,32	1,11	1,26	1,12	1,20
24D10	1	0,07	0,06	0,08	0,09	0,08	0,31	0,31	0,32	0,31	0,31	2,36	1,97	2,09	2,36	2,20	1,28	1,30	1,29	1,96	1,46
	2	0,07	0,07	0,08	0,08	0,08	0,35	0,32	0,30	0,31	0,32	2,36	1,97	2,33	2,09	2,19	1,23	1,25	1,26	1,36	1,28
	3	0,07	0,07	0,07	0,08	0,07	0,35	0,43	0,35	0,31	0,36	2,37	2,10	2,09	2,11	2,17	1,24	1,24	1,23	1,24	1,24
	4	0,07	0,07	0,07	0,08	0,07	0,35	0,43	0,35	0,31	0,36	2,38	1,98	2,38	2,25	2,25	1,24	1,25	1,25	1,38	1,28
	5	0,07	0,08	0,06	0,08	0,07	0,45	0,47	0,31	0,40	0,41	2,50	1,98	2,35	2,37	2,30	1,24	1,11	1,43	1,44	1,31
5C5	1	0,23	0,23	0,21	0,24	0,23	0,17	0,16	0,13	0,16	0,16	1,92	2,25	2,11	2,07	2,09	1,14	1,51	1,45	1,48	1,40
	2	0,21	0,17	0,25	0,20	0,21	0,20	0,12	0,16	0,13	0,15	1,98	1,98	2,11	1,31	1,85	1,31	1,31	1,58	1,28	1,37
	3	0,23	0,24	0,21	0,21	0,22	0,12	0,16	0,20	0,18	0,17	1,99	2,25	1,85	1,11	1,80	1,31	1,31	1,31	1,18	1,28
	4	0,23	0,21	0,21	0,24	0,22	0,17	0,16	0,20	0,16	0,17	1,99	2,10	1,45	1,27	1,70	1,23	1,31	1,52	1,30	1,34
	5	0,21	0,24	0,25	0,23	0,23	0,16	0,17	0,20	0,12	0,16	1,98	2,11	1,43	1,31	1,71	1,31	1,31	1,36	1,58	1,39

APPENDIX 10 EXCHANGEABLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	0,35	0,20	0,51	0,23	0,32	0,28	0,20	0,24	0,26	0,25	2,77	2,91	2,65	2,65	2,75	2,04	1,97	1,87	1,78	1,92
	2	0,22	0,36	0,78	0,38	0,44	0,22	0,24	0,26	0,24	0,24	2,26	2,25	2,39	2,79	2,42	1,89	1,90	1,72	1,68	1,80
	3	0,32	0,22	0,40	0,28	0,31	0,24	0,26	0,20	0,26	0,24	2,58	2,26	2,59	2,65	2,52	1,82	1,79	2,00	1,89	1,88
	4	0,22	0,31	0,19	0,30	0,26	0,20	0,24	0,32	0,31	0,27	2,91	2,26	1,89	2,66	2,43	1,89	1,98	1,88	1,88	1,91
	5	0,35	0,22	0,33	0,22	0,28	0,28	0,37	0,18	0,31	0,29	2,66	2,39	2,65	2,66	2,59	1,72	1,72	1,86	1,78	1,77
1R1	1	0,39	0,08	0,10	0,09	0,17	0,25	0,22	0,29	0,32	0,27	1,85	0,81	2,38	2,12	1,79	1,30	1,03	1,45	1,31	1,27
	2	0,84	0,12	0,08	0,21	0,31	0,29	0,30	0,25	0,32	0,29	1,97	1,06	2,12	2,11	1,82	1,30	1,52	1,31	1,45	1,40
	3	0,45	0,10	0,13	0,25	0,23	0,26	0,37	0,32	0,36	0,33	1,42	1,05	2,12	1,85	1,61	1,11	1,50	1,46	1,18	1,31
	4	0,46	0,10	0,10	0,22	0,22	0,32	0,32	0,32	0,41	0,34	1,80	1,06	2,39	1,71	1,74	1,23	1,46	1,46	1,38	1,38
	5	0,13	0,13	0,14	0,22	0,16	0,36	0,32	0,41	0,36	0,36	0,79	0,39	1,85	1,46	1,12	1,58	1,59	1,17	1,45	1,45
2A5	1	0,15	0,38	0,29	0,39	0,30	0,08	0,13	0,25	0,24	0,18	2,94	2,99	3,31	2,47	2,93	1,21	1,32	1,58	1,75	1,47
	2	0,28	0,37	0,09	0,36	0,28	0,08	0,13	0,11	0,13	0,11	3,01	2,90	2,10	2,74	2,69	1,34	1,35	1,25	1,70	1,41
	3	0,18	0,28	0,45	0,51	0,36	0,08	0,17	0,16	0,16	0,14	2,66	2,71	2,43	2,47	2,57	1,25	1,28	1,73	1,75	1,50
	4	0,12	0,11	0,57	0,34	0,29	0,16	0,13	0,16	0,16	0,15	3,00	2,72	2,51	2,48	2,68	1,33	1,32	1,65	1,89	1,55
	5	0,33	0,11	0,35	0,54	0,33	0,16	0,16	0,11	0,11	0,14	2,87	2,77	2,84	2,75	2,81	1,37	1,37	1,77	2,06	1,64
3K9	1	0,16	0,19	0,15	0,20	0,18	0,23	0,53	0,22	0,35	0,33	1,99	1,43	1,99	1,70	1,78	0,86	0,84	1,11	1,04	0,96
	2	0,20	0,18	0,21	0,17	0,19	0,26	0,29	0,27	0,25	0,27	1,71	1,71	1,71	0,99	1,53	0,78	1,05	0,98	0,93	0,94
	3	0,17	0,20	0,16	0,16	0,17	0,56	0,60	0,32	0,29	0,44	1,46	1,46	1,46	1,98	1,59	0,79	0,79	0,86	0,98	0,86
	4	0,20	0,24	0,23	0,15	0,21	0,42	0,24	0,35	0,30	0,33	1,43	1,79	1,69	1,50	1,60	0,77	0,85	1,03	1,04	0,92
	5	0,21	0,29	0,20	0,17	0,22	0,36	0,26	0,26	0,33	0,30	1,46	1,96	1,45	1,71	1,65	0,92	0,83	0,91	1,05	0,93

APPENDIX 10 (continued) EXCHANGEABLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	0,31	0,03	0,02	0,03	0,10	0,25	0,13	0,20	0,16	0,19	1,80	1,63	1,41	1,94	1,70	1,46	1,17	1,27	1,26	1,29
	2	0,32	0,02	0,05	0,08	0,12	0,37	0,19	0,16	0,17	0,22	1,81	1,94	1,41	1,41	1,64	1,48	1,41	1,26	1,20	1,34
	3	0,02	0,05	0,05	0,05	0,04	0,19	0,20	0,21	0,20	0,20	1,95	1,64	1,42	1,41	1,61	1,27	1,20	1,27	1,20	1,24
	4	0,03	0,04	0,05	0,03	0,04	0,20	0,20	0,24	0,19	0,21	1,99	1,41	1,42	1,99	1,70	1,36	1,27	1,21	1,19	1,26
	5	0,01	0,04	0,06	0,03	0,04	0,24	0,17	0,20	0,21	0,21	1,63	1,43	2,08	1,64	1,70	1,39	1,08	1,21	1,27	1,24
4C5	1	0,22	0,24	0,03	0,21	0,18	0,09	0,09	0,05	0,10	0,08	0,25	1,26	1,30	1,92	1,18	0,88	0,36	1,43	1,53	1,05
	2	0,18	0,10	0,02	0,23	0,13	0,12	0,05	0,05	0,12	0,09	2,08	1,29	1,30	1,98	1,66	0,38	1,66	1,43	1,51	1,25
	3	0,24	0,02	0,25	0,20	0,18	0,12	0,05	0,07	0,07	0,08	1,05	1,36	2,06	1,93	1,60	1,97	1,37	1,27	1,31	1,48
	4	0,20	0,03	0,26	0,21	0,18	0,12	0,05	0,16	0,10	0,11	0,51	1,44	1,91	1,72	1,40	0,44	1,66	1,39	1,38	1,20
	5	0,21	0,04	0,23	0,27	0,19	0,12	0,05	0,10	0,07	0,09	0,75	1,38	1,98	1,95	1,33	0,80	1,33	1,51	1,85	1,37
6L8	1	0,19	0,21	0,21	0,20	0,20	0,15	0,17	0,15	0,23	0,18	1,66	1,98	2,31	1,52	1,87	1,25	1,24	1,30	1,26	1,26
	2	0,19	0,18	0,22	0,22	0,20	0,13	0,17	0,25	0,19	0,19	1,96	1,99	1,66	2,19	1,94	1,22	1,26	1,26	1,26	1,25
	3	0,17	0,17	0,23	0,21	0,20	0,17	0,13	0,19	0,19	0,17	2,17	1,99	2,53	1,95	2,16	1,24	1,12	1,30	1,22	1,22
	4	0,23	0,20	0,22	0,21	0,22	0,23	0,15	0,17	0,22	0,19	2,18	1,98	1,98	1,54	1,92	1,24	1,30	1,31	1,12	1,24
	5	0,21	0,24	0,20	0,21	0,22	0,19	0,19	0,23	0,23	0,21	1,96	3,19	1,66	1,96	2,19	1,22	1,51	1,25	1,03	1,25
6Q1	1	0,29	0,33	0,39	0,39	0,35	0,47	0,37	0,44	0,37	0,41	3,05	3,30	3,31	5,04	3,68	2,25	2,25	2,26	3,09	2,46
	2	0,32	0,24	0,25	0,32	0,28	0,37	0,35	0,53	0,42	0,42	3,30	3,68	2,78	3,04	3,20	1,98	2,09	2,31	3,03	2,35
	3	0,31	0,39	0,31	0,29	0,33	0,33	0,42	0,42	0,44	0,40	4,07	3,57	3,58	3,04	3,57	2,09	2,18	2,31	2,58	2,29
	4	0,31	0,32	0,25	0,30	0,30	0,31	0,33	0,47	0,42	0,38	3,42	4,50	3,57	3,58	3,77	1,84	1,05	2,77	2,51	2,04
	5	0,28	0,29	0,33	0,29	0,30	0,37	0,42	0,40	0,52	0,43	3,04	3,55	4,09	9,00	4,92	2,10	2,43	2,76	2,23	2,38

APPENDIX 10 (continued) EXCHANGEABLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT -MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	0,29	0,34	0,36	0,35	0,34	0,69	0,67	0,55	0,62	0,63	2,37	1,29	3,17	1,56	2,10	3,34	4,16	5,12	4,56	4,30
	2	0,32	0,33	0,35	0,34	0,34	0,52	0,48	0,70	0,57	0,57	1,29	0,27	1,82	1,51	1,22	3,69	3,80	5,17	4,63	4,32
	3	0,29	0,31	0,31	0,34	0,31	0,48	0,62	0,71	0,57	0,60	2,35	1,35	1,56	0,73	1,50	3,43	4,03	4,56	4,15	4,04
	4	0,32	0,32	0,32	0,32	0,32	0,48	0,69	0,55	0,55	0,57	2,31	0,73	1,53	2,08	1,66	3,84	4,21	5,04	4,77	4,47
	5	0,29	0,32	0,35	0,34	0,33	0,59	0,50	0,50	0,52	0,53	1,86	2,86	1,52	1,51	1,94	3,07	3,81	4,38	4,67	3,98
3M11	1	0,53	0,53	0,85	0,75	0,67	0,36	0,46	0,32	0,39	0,39	5,65	5,93	7,84	6,65	6,52	4,92	5,92	9,02	7,17	6,76
	2	0,52	0,53	0,76	0,68	0,62	0,34	0,53	0,35	0,28	0,38	6,15	5,88	8,20	8,22	7,11	4,91	6,17	8,06	7,18	6,58
	3	0,48	0,72	0,81	0,88	0,72	0,49	0,32	0,48	0,44	0,43	5,42	7,69	7,40	7,07	6,90	3,93	8,13	7,53	7,78	6,84
	4	0,46	0,48	0,82	0,69	0,61	0,38	0,53	0,44	0,44	0,45	6,13	7,31	6,27	7,31	6,76	4,74	6,68	7,83	6,60	6,46
	5	0,53	0,71	0,80	1,05	0,77	0,42	0,39	0,46	0,31	0,40	6,56	6,54	7,26	8,54	7,23	5,69	7,35	7,52	8,47	7,26
OSBLOK	1	0,41	0,53	0,52	0,29	0,44	0,14	0,11	0,11	0,15	0,13	2,49	3,03	2,61	2,11	2,56	1,24	1,44	1,23	1,18	1,27
	2	0,35	0,41	0,31	0,27	0,34	0,16	0,14	0,10	0,12	0,13	2,49	2,75	2,35	2,10	2,42	1,24	1,24	1,18	1,18	1,21
	3	0,36	0,40	0,26	0,24	0,32	0,11	0,10	0,15	0,12	0,12	2,61	2,62	2,34	2,57	2,54	1,09	1,24	1,02	1,25	1,15
	4	0,29	0,44	0,25	0,26	0,31	0,14	0,11	0,15	0,12	0,13	2,36	2,76	2,47	2,64	2,56	1,18	1,30	1,35	1,17	1,25
	5	0,38	0,44	0,25	0,26	0,33	0,18	0,11	0,13	0,12	0,14	2,36	2,47	2,35	2,64	2,46	1,17	1,17	1,43	1,17	1,24
SKAAP BLOK	1	0,30	0,23	0,21	0,31	0,26	0,15	0,20	0,22	0,22	0,20	2,92	2,26	2,79	2,26	2,56	1,71	1,52	1,66	1,52	1,60
	2	0,62	0,21	0,23	0,26	0,33	0,16	0,20	0,28	0,20	0,21	3,06	2,39	2,26	2,26	2,49	1,72	1,32	1,32	1,52	1,47
	3	0,49	0,23	0,21	0,27	0,30	0,21	0,24	0,20	0,22	0,22	3,16	2,51	2,52	2,52	2,68	1,69	1,51	1,11	1,52	1,46
	4	0,04	0,23	0,29	0,25	0,29	0,19	0,24	0,28	0,20	0,23	3,24	1,99	1,99	2,52	2,44	1,80	1,19	1,26	1,72	1,49
	5	0,25	0,23	0,24	0,25	0,24	0,24	0,24	0,24	0,26	0,25	2,52	2,78	2,26	2,26	2,46	1,52	1,51	1,52	1,52	1,52

APPENDIX 10 (continued) EXCHANGEABLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT-MENT	Na^+ REPLICATION					K^+ REPLICATION					Ca^{++} REPLICATION					Mg^{++} REPLICATION				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	0,27	0,08	0,08	0,10	0,13	0,38	0,44	0,38	0,47	0,42	2,39	2,12	2,12	2,12	2,19	1,46	1,32	1,52	1,52	1,46
	2	0,25	0,08	0,08	0,06	0,12	0,32	0,47	0,40	0,40	0,40	2,12	1,86	2,12	2,12	2,06	1,32	1,19	1,32	1,32	1,29
	3	0,26	0,08	0,08	0,70	0,12	0,32	0,49	0,40	0,47	0,42	1,86	2,12	2,12	1,72	1,96	1,45	1,46	1,46	1,52	1,47
	4	0,25	0,08	0,08	0,11	0,13	0,37	0,44	0,42	0,44	0,42	2,12	2,12	2,12	2,12	2,12	1,32	1,46	1,46	1,52	1,44
	5	0,08	0,08	0,08	0,08	0,08	0,47	0,42	0,52	0,44	0,46	2,39	2,12	1,86	2,12	2,12	1,46	1,46	1,46	1,32	1,43
24D10	1	0,10	0,31	0,29	0,34	0,26	0,31	0,18	0,25	0,18	0,23	2,57	2,26	1,99	2,00	2,21	1,61	1,38	1,51	1,46	1,49
	2	0,09	0,24	0,31	0,31	0,24	0,28	0,28	0,23	0,16	0,24	2,52	2,01	2,26	2,26	2,26	1,52	1,18	1,45	1,44	1,40
	3	0,11	0,28	0,27	0,33	0,25	0,22	0,29	0,21	0,16	0,22	2,49	2,06	1,74	2,00	2,07	1,83	1,41	1,14	1,48	1,47
	4	0,12	0,27	0,30	0,24	0,23	0,24	0,16	0,18	0,25	0,21	2,49	2,28	2,02	1,82	2,14	1,86	1,53	1,50	1,23	1,53
	5	0,28	0,31	0,38	0,32	0,32	0,23	0,27	0,16	0,25	0,23	2,73	1,56	2,25	2,03	2,14	1,46	1,17	1,50	1,57	1,43
5C5	1	0,22	0,24	0,23	0,26	0,24	0,07	0,07	0,05	0,07	0,065	1,16	2,71	1,12	2,92	1,98	1,36	1,34	1,47	1,52	1,45
	2	0,20	0,24	0,25	0,31	0,25	0,11	0,07	0,11	0,05	0,085	1,15	1,27	1,28	3,36	1,77	1,36	1,35	1,49	1,58	1,45
	3	0,25	0,25	0,23	0,27	0,25	0,07	0,07	0,11	0,09	0,085	1,17	2,98	1,12	2,66	1,98	1,37	1,52	1,47	1,59	1,49
	4	0,25	0,22	0,24	0,24	0,24	0,07	0,07	0,07	0,05	0,065	1,18	1,25	1,64	1,64	1,43	1,31	1,34	1,59	1,30	1,39
	5	0,23	0,26	0,24	0,25	0,25	0,07	0,07	0,09	0,07	0,075	2,07	1,25	1,24	1,17	1,43	1,36	1,27	1,33	1,52	1,37

APPENDIX 11 EXCHANGEABLE & WATER SOLUBLE CATIONS TOPSOILS

TRIAL NO.	TREAT -MENT	S VALUE (me/100g)					C.E.C. (me/100g)					E.P.P. (me/100g)					$\frac{Ca + Mg}{K}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	3,6	4,3	3,1	2,8	3,5	5,5	6,4	5,5	5,5	5,7	6,4	4,4	5,6	5,6	5,5	9,1	14,0	8,6	7,7	9,9
	2	4,1	3,9	3,8	3,4	3,8	5,5	5,5	5,5	4,7	5,3	6,0	6,0	6,7	8,3	6,8	11,1	10,5	9,0	7,5	9,5
	3	4,1	3,8	2,5	3,9	3,6	5,5	5,5	5,5	3,3	5,0	7,5	6,7	7,5	11,8	8,4	8,8	9,0	4,9	8,6	7,8
	4	4,3	3,6	3,6	5,1	4,2	6,8	5,5	5,5	4,8	5,7	5,4	7,5	8,7	10,0	7,9	9,9	7,5	6,3	8,9	8,2
	5	4,0	3,9	3,7	4,5	4,0	5,1	5,1	5,5	4,8	5,1	8,4	7,3	9,1	9,6	8,6	8,1	9,2	6,3	8,3	8,0
1R1	1	4,1	3,4	3,7	3,6	3,7	3,6	3,6	3,9	3,6	3,7	7,2	5,8	6,7	6,4	6,5	13,6	14,3	12,3	13,9	13,5
	2	4,1	4,3	3,8	3,5	3,9	4,3	3,6	4,3	3,6	4,0	7,9	8,3	7,0	8,3	7,9	10,6	12,7	10,9	9,3	10,9
	3	4,1	4,1	3,8	3,5	3,9	3,6	4,5	3,9	4,3	4,1	8,9	9,1	7,7	7,9	8,4	10,8	8,5	10,9	8,2	9,6
	4	4,3	3,7	4,1	4,2	4,1	4,3	3,6	4,3	4,3	4,1	8,8	10,0	10,0	9,5	9,6	9,7	8,7	8,1	8,1	8,7
	5	3,9	4,1	3,3	3,6	3,7	3,6	3,9	4,3	3,9	3,9	15,6	8,2	7,4	8,7	10,0	5,6	11,0	8,3	8,6	8,4
2A5	1	6,1	5,6	4,9	4,8	5,4	5,0	4,7	5,7	5,3	5,2	5,8	6,9	4,1	4,3	5,3	19,3	15,8	19,4	17,4	18,0
	2	6,3	5,5	5,2	4,8	5,5	5,0	4,7	5,5	6,0	5,3	5,4	5,8	5,1	3,8	5,0	21,5	18,5	16,0	19,4	18,9
	3	6,1	5,8	4,6	4,5	5,3	4,7	5,0	5,8	6,2	5,4	8,1	7,2	4,9	4,2	6,1	14,4	14,3	15,0	14,9	14,7
	4	5,5	5,8	4,5	5,1	5,2	4,7	5,4	6,7	7,5	6,1	9,2	7,9	4,9	4,1	6,5	11,2	11,0	12,5	14,4	12,3
	5	6,6	5,1	5,0	4,6	5,3	5,0	4,7	5,3	7,5	5,6	8,0	8,1	5,3	5,7	6,8	15,0	11,8	15,0	9,9	12,9
3K9	1	4,2	4,2	3,9	4,4	4,2	9,0	8,7	8,7	11,7	9,5	3,2	4,6	4,6	2,8	3,8	12,6	8,7	8,3	11,5	10,3
	2	4,2	4,3	3,7	4,2	4,1	9,0	8,7	9,3	7,3	8,6	3,2	3,8	3,5	3,3	3,6	12,6	10,9	9,5	13,6	11,7
	3	4,2	4,2	4,3	3,4	4,0	9,9	8,7	11,7	3,3	8,4	5,3	5,4	3,6	8,2	5,6	6,9	7,4	8,6	12,1	8,8
	4	3,9	4,4	4,5	3,4	4,1	10,1	9,3	11,7	3,3	8,6	4,1	4,5	3,6	12,1	6,1	7,8	8,6	9,2	7,5	8,3
	5	3,9	4,5	4,0	3,5	4,0	8,7	9,9	9,9	3,7	8,1	5,4	4,1	2,7	10,8	5,8	6,7	9,2	13,3	7,7	9,2

APPENDIX 11 (continued) EXCHANGEABLE & WATER SOLUBLE CATIONS TOPSOILS

TRIAL NO.	TREAT-MENT	S VALUE (me/100g)					C.E.C. (me/100g)					E.P.P. (me/100g)					$\frac{Ca + Mg}{K}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	3,2	3,2	3,3	3,0	3,2	3,9	4,5	3,5	3,9	4,0	5,7	4,9	6,8	6,7	6,0	13,0	13,4	11,4	9,5	11,8
	2	3,0	3,2	3,0	3,2	3,1	4,2	4,2	3,9	4,2	4,1	7,1	6,2	6,7	7,1	6,8	8,5	10,8	10,8	9,3	9,9
	3	3,2	3,4	3,2	3,4	3,3	3,9	4,2	3,9	3,9	4,0	7,2	7,2	7,8	10,6	8,2	9,8	9,8	9,1	6,8	8,9
	4	3,2	3,3	2,9	3,9	3,3	3,9	3,9	3,9	3,9	3,9	7,2	11,1	9,0	7,8	8,8	9,8	6,7	7,1	12,9	9,1
	5	3,3	3,6	3,1	3,5	3,4	4,5	4,2	3,9	4,2	4,2	10,6	7,1	11,1	8,3	9,3	5,7	10,2	5,7	8,4	7,5
4C5	1	3,2	2,9	3,0	2,4	2,9	2,5	3,3	2,9	4,0	3,2	7,6	5,5	5,9	4,5	5,9	14,4	14,1	15,7	11,1	13,8
	2	2,8	2,6	2,4	2,3	2,5	3,1	3,6	3,3	3,3	3,3	8,1	5,0	6,4	6,4	6,5	9,6	12,6	9,5	8,6	10,1
	3	2,2	3,0	2,2	1,8	2,3	4,0	4,3	3,3	3,6	3,8	5,8	5,3	7,0	6,4	6,1	7,6	11,3	7,8	6,1	8,2
	4	2,8	3,0	2,2	2,0	2,0	4,3	3,6	3,3	3,3	3,6	7,7	6,9	8,8	5,5	7,2	7,1	10,1	6,0	8,6	8,0
	5	3,1	2,6	2,7	2,8	2,8	4,0	3,3	2,9	4,7	3,7	9,5	12,7	10,0	8,3	10,1	6,7	4,8	7,6	5,6	6,2
6L8	1	5,8	4,1	3,9	2,9	4,2	2,7	4,3	3,7	3,0	3,4	10,5	6,2	6,8	10,3	8,5	14,3	9,4	10,2	7,7	10,4
	2	3,3	3,4	3,4	4,2	3,6	3,7	3,7	3,0	4,9	3,8	8,4	7,6	11,0	7,4	8,6	5,4	6,0	6,1	10,2	6,7
	3	3,4	3,8	3,6	4,1	3,7	4,0	3,0	3,0	3,7	3,4	8,3	12,3	12,7	8,2	10,4	6,1	5,4	5,1	12,2	7,2
	4	4,1	3,8	4,2	3,7	4,0	4,0	3,7	4,0	4,0	3,9	8,5	9,0	11,3	9,5	9,6	6,5	6,1	5,0	8,2	6,5
	5	4,3	5,1	4,9	4,2	4,6	4,0	3,7	4,3	3,7	3,9	12,3	12,3	12,5	9,0	11,5	4,9	7,4	5,1	10,9	7,1
6Q1	1	5,9	6,5	5,0	6,1	5,9	6,0	6,3	6,0	6,0	6,1	7,3	6,7	6,5	7,0	6,9	11,8	13,8	11,1	13,0	12,4
	2	5,9	6,3	6,6	6,6	6,4	6,3	6,0	6,3	6,1	6,2	8,1	7,0	8,1	7,9	7,8	10,2	13,5	11,4	12,2	11,8
	3	7,1	6,0	7,2	6,1	6,6	6,3	6,3	6,3	6,1	6,3	7,0	8,1	8,1	9,3	8,1	14,7	10,3	12,7	9,4	11,8
	4	9,0	6,3	5,7	5,4	6,6	6,3	6,0	5,6	6,1	6,0	8,4	7,3	9,8	7,9	8,4	16,1	12,7	9,0	9,7	11,9
	5	5,4	5,8	5,3	6,2	5,7	5,6	5,6	6,0	6,5	5,9	8,6	10,4	10,0	9,5	9,6	9,9	8,6	7,5	8,6	8,7

APPENDIX 11 (continued) EXCHANGEABLE & WATER SOLUBLE CATIONS TOPSOILS

TRIAL NO.	TREAT -MENT	S VALUE (me/100g)					C.E.C. (me/100g)					E.P.P. (me/100g)					$\frac{Ca + Mg}{K}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	7,4	6,8	7,7	6,4	7,1	7,3	7,3	7,7	6,9	7,3	11,0	8,5	7,4	9,0	9,0	7,9	9,8	12,2	9,0	9,7
	2	7,3	7,3	6,9	6,7	7,1	7,3	7,3	7,3	6,5	7,1	8,8	8,1	8,1	7,7	8,2	10,0	11,2	10,4	12,1	10,9
	3	6,3	6,4	7,2	6,5	6,6	6,9	6,5	6,9	6,8	6,8	8,0	9,8	10,0	8,7	9,1	9,9	8,8	9,3	9,8	9,5
	4	7,2	6,4	7,6	5,5	6,7	7,6	7,3	7,3	7,3	7,4	9,1	10,1	8,8	9,0	9,3	8.8	7,6	10,7	7,2	8,6
	5	6,7	6,6	7,2	5,7	6,6	7,3	6,9	7,3	7,3	7,2	8,8	8,6	8,8	10,0	9,1	9,1	10,3	10,4	6,7	9,1
3M11	1	9,0	9,1	9,7	8,3	9,0	8,5	8,5	9,0	8,5	8,6	4,9	5,2	3,9	4,9	4,7	20,3	18,6	25,5	18,3	20,7
	2	8,2	8,8	9,6	9,0	8,9	8,5	8,5	10,0	9,5	9,1	4,6	5,6	3,5	3,3	4,3	19,7	17,1	26,1	26,9	22,5
	3	8,4	9,5	8,8	8,8	8,9	8,2	8,5	8,2	9,5	8,6	4,8	4,6	4,5	5,1	4,8	20,0	22,4	24,1	16,7	20,8
	4	9,2	9,6	8,9	8,6	9,0	8,5	8,2	8,5	8,5	8,4	7,3	7,3	4,4	6,6	6,4	13,5	14,2	22,0	13,9	15,9
	5	9,4	9,0	8,5	10,3	9,3	9,0	9,5	8,5	9,5	9,1	6,2	6,5	6,6	6,3	6,4	14,9	13,3	13,7	15,3	14,3
OSBLOK	1	3,9	3,9	4,1	4,2	4,0	3,2	2,8	4,0	4,7	3,7	6,6	6,1	4,8	3,2	5,2	16,5	21,2	19,6	24,9	20,6
	2	3,3	3,5	4,4	3,7	3,7	2,8	1,9	4,0	4,0	3,2	7,5	9,5	3,0	3,8	6,0	14,3	17,8	33,3	22,2	21,9
	3	4,0	3,7	3,9	4,3	4,0	3,2	3,5	4,0	4,0	3,7	5,3	4,9	5,3	3,0	4,6	21,2	19,6	16,5	32,8	22,5
	4	3,9	4,1	3,7	4,2	4,0	3,5	4,0	4,0	3,6	3,8	4,9	3,8	5,8	5,8	5,1	21,2	24,9	13,9	17,8	19,5
	5	3,0	4,1	4,0	4,6	3,9	2,8	4,0	4,0	4,0	3,7	12,9	5,3	4,3	3,0	6,4	7,0	17,1	21,2	32,8	19,5
SKAAP BLOK	1	5,1	4,3	4,4	5,0	4,7	4,4	3,9	3,9	4,1	4,1	3,9	4,4	4,1	4,1	4,1	25,9	22,4	23,4	25,9	24,4
	2	5,1	4,4	4,7	5,0	4,8	4,1	3,5	4,4	4,4	4,1	5,9	4,9	5,5	5,5	5,5	18,6	22,7	17,3	17,2	19,0
	3	4,7	4,1	5,3	5,9	5,0	3,9	3,9	4,1	4,1	4,0	9,5	6,2	6,5	5,8	7,0	10,8	14,8	16,8	22,2	16,2
	4	4,6	4,3	4,9	5,2	4,8	4,4	3,8	4,1	4,4	4,2	7,5	8,7	4,8	6,1	6,8	12,1	10,9	21,7	16,6	15,3
	5	4,8	4,6	4,7	5,1	4,8	4,1	4,1	3,9	4,1	4,1	12,2	6,8	6,2	6,5	7,9	8,0	14,3	16,9	16,6	14,0

APPENDIX 11 (continued) EXCHANGEABLE & WATER SOLUBLE CATIONS (me/100g) TOPSOILS

TRIAL NO.	TREAT -MENT	S VALUE (me/100g)					C.E.C. (me/100g)					E.P.P. (me/100g)					$\frac{Ca + Mg}{K}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	3,7	4,1	3,5	3,8	3,8	4,0	4,0	3,9	4,0	4,0	8,3	6,8	6,4	6,8	7,1	9,5	13,6	12,6	12,6	12,1
	2	3,8	3,7	4,0	3,8	3,8	4,4	3,3	4,0	4,0	3,9	7,0	9,4	6,3	5,8	7,1	10,5	10,3	14,2	11,8	12,5
	3	3,9	4,2	3,9	3,8	4,0	4,0	3,9	3,3	4,0	3,8	8,3	9,7	9,4	6,8	8,6	10,3	9,5	11,2	12,6	10,9
	4	3,9	3,5	3,8	4,0	3,8	4,0	3,9	4,0	4,0	4,0	8,3	7,9	8,8	7,0	8,0	10,1	9,7	9,3	12,6	10,4
	5	4,4	3,3	4,0	3,7	3,9	3,9	4,0	3,3	3,9	3,8	11,8	8,8	13,9	7,9	10,6	8,1	7,8	7,1	10,1	8,3
24D10	1	4,0	3,6	3,8	4,7	4,0	4,3	5,5	5,0	5,0	5,0	7,7	5,9	6,6	6,4	6,7	11,3	10,4	10,5	13,8	11,5
	2	4,0	3,6	4,0	3,8	3,9	5,8	5,5	4,7	5,5	5,4	6,4	6,0	6,9	5,9	6,3	9,9	9,9	11,7	11,0	10,6
	3	4,0	3,8	3,7	3,8	3,8	5,0	5,5	4,7	5,5	5,2	7,4	7,3	7,7	6,0	7,1	9,9	8,5	9,5	10,3	9,5
	4	4,1	3,7	4,1	4,0	4,0	5,5	5,0	4,3	4,7	4,9	6,8	9,0	8,7	6,9	7,9	9,9	7,3	9,9	11,5	9,7
	5	4,3	3,6	4,2	4,3	4,1	5,5	4,7	5,0	4,7	5,0	8,6	10,5	6,6	9,0	8,7	8,1	8,4	11,7	9,2	8,9
5C5	1	3,5	4,2	3,9	4,0	3,9	3,2	3,9	3,5	3,5	3,5	5,6	4,4	4,0	4,9	4,7	17,8	22,4	25,7	21,5	21,9
	2	3,7	3,6	4,1	2,9	3,6	3,5	3,5	1,5	3,7	3,1	6,0	3,7	1,1	3,5	3,6	15,9	25,6	21,9	20,5	21,0
	3	3,7	4,0	3,6	2,7	3,5	3,5	3,9	3,5	4,3	3,8	3,7	4,4	6,0	4,4	4,6	25,6	21,2	15,2	12,3	18,6
	4	3,6	3,8	3,9	3,0	3,6	3,2	3,2	3,9	4,3	3,7	5,6	5,3	5,4	4,0	5,1	18,2	20,4	16,8	15,6	17,8
	5	3,7	3,8	3,2	3,2	3,5	3,9	3,5	3,5	3,7	3,7	4,4	5,1	6,0	3,5	4,8	19,6	19,2	13,7	22,5	18,8

APPENDIX 12 WATER SOLUBLE AND EXCHANGEABLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT -MENT	S VALUE (me/100g)					C.E.C. (me/100g)					E.P.P. (me/100g)					$\frac{Ca + Mg}{K}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	5,4	5,3	5,3	4,9	5,2	4,8	5,1	5,7	5,1	5,2	6,0	4,1	4,4	5,3	5,0	16,8	23,5	18,3	16,6	18,8
	2	4,6	4,8	4,6	5,4	4,9	4,8	4,8	5,7	5,1	5,1	4,8	5,2	4,7	4,9	4,9	18,1	16,8	15,3	18,9	17,3
	3	5,0	4,5	5,2	5,0	4,9	4,8	5,7	4,8	5,7	5,3	5,2	4,7	4,4	4,7	4,8	18,3	15,1	22,6	16,9	18,2
	4	5,2	4,8	4,3	5,2	4,9	5,1	5,1	4,8	4,8	5,0	4,1	4,9	6,9	6,7	5,7	23,0	17,1	11,5	14,3	16,5
	5	5,0	4,7	5,0	5,0	4,9	4,8	5,7	4,8	5,1	5,1	6,0	6,7	4,0	6,3	5,8	15,2	10,9	24,1	14,0	16,1
1R1	1	3,8	2,1	4,2	3,8	3,5	3,6	4,0	3,9	4,1	3,9	7,2	6,0	7,7	8,0	7,2	12,3	8,6	12,9	10,5	11,1
	2	4,4	3,0	3,8	4,1	3,6	4,3	4,4	4,5	4,5	4,4	7,0	7,0	5,8	7,3	6,8	11,1	8,4	13,3	10,9	10,9
	3	3,2	3,0	4,0	3,6	3,5	3,3	4,4	4,5	4,8	4,3	8,5	8,9	7,3	7,7	8,1	10,0	6,7	10,9	8,3	9,0
	4	3,8	2,9	4,3	3,7	3,7	3,9	4,0	4,5	4,5	4,2	8,7	8,3	7,3	9,5	8,5	9,5	7,7	11,7	7,3	9,0
	5	2,9	2,5	3,6	3,6	3,2	4,0	4,7	4,5	4,5	4,4	9,3	7,0	9,6	8,2	8,5	6,5	6,1	7,1	7,9	6,9
2A5	1	4,4	4,8	5,4	4,9	4,9	8,0	6,5	7,7	8,3	7,6	1,1	2,1	3,4	3,0	2,4	48.9	31,9	19,0	17,3	29,3
	2	4,7	4,7	3,5	4,9	4,5	6,5	7,9	6,0	9,3	7,4	1,4	1,8	2,0	1,5	1,7	49,7	31,7	30,6	33,4	36,4
	3	4,2	4,4	4,8	4,9	4,6	7,3	7,3	8,7	8,7	8,0	1,2	2,5	2,0	2,0	1,9	46,7	23,2	25,5	25,5	30,2
	4	4,6	4,3	4,9	4,9	4,7	6,7	6,5	9,0	9,0	7,8	2,5	2,1	1,9	1,9	2,1	26,3	30,0	24,7	26,2	26,8
	5	4,8	4,4	5,1	5,5	5,0	8,5	5,2	8,7	9,0	7,9	2,0	3,3	1,4	1,3	2,0	27,5	24,7	38,9	43,9	33,8
3K9	1	3,2	3,0	3,4	3,3	3,2	3,6	2,7	2,7	2,7	2,9	6,7	2,9	8,9	14,1	12,9	12,0	4,0	13,3	7,4	9,2
	2	3,0	3,2	3,2	2,3	2,9	2,7	2,7	2,7	2,7	2,6	10,4	11,5	10,4	12,7	11,3	9,0	9,0	9,8	7,4	8,8
	3	3,0	3,1	2,8	3,4	3,1	2,7	3,6	2,2	3,6	3,0	21,9	17,8	15,0	8,6	15,8	3,8	3,5	7,1	9,7	6,0
	4	2,8	3,1	3,3	3,0	3,1	2,2	2,7	2,2	2,7	2,5	21,4	10,4	17,3	13,0	15,5	4,8	10,7	7,4	8,4	7,8
	5	3,0	3,3	2,8	3,3	3,1	3,6	3,6	2,7	3,6	3,4	10,6	7,8	10,4	9,7	9,6	6,3	10,3	8,6	8,0	8,3

APPENDIX 12 (continued) WATER SOLUBLE AND EXCHANGEABLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT -MENT	S VALUE (me/100g)					C.E.C. (me/100g)					E.P.P. (me/100g)					$\frac{Ca + Mg}{K}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	3,8	3,0	2,9	3,4	3,3	4,5	3,3	3,3	3,7	3,7	5,7	4,2	6,3	4,9	5,3	13,1	21,2	13,3	18,5	16,5
	2	4,0	3,6	2,9	2,9	3,4	4,2	3,7	3,3	3,7	3,7	9,3	5,7	5,1	4,9	6,1	8,7	16,5	16,5	15,2	14,2
	3	3,4	3,1	3,0	2,9	3,1	3,7	3,3	3,3	3,3	3,4	5,6	6,9	6,6	6,6	6,4	15,9	12,9	12,7	12,5	13,5
	4	3,4	2,9	2,9	3,3	3,1	3,7	3,3	3,3	3,7	3,5	6,3	6,6	8,1	6,0	6,8	15,1	12,7	10,2	15,1	13,3
	5	3,3	2,7	3,6	3,2	3,2	3,3	3,3	3,3	3,7	3,4	8,1	5,4	6,6	6,3	6,6	11,7	14,4	15,5	13,2	13,7
4C5	1	1,5	2,0	2,6	3,8	2,5	3,3	3,3	3,3	3,2	3,3	3,0	3,0	1,8	3,4	2,8	12,0	18,0	46,7	32,7	27,4
	2	2,8	3,1	2,8	3,9	3,2	2,9	3,3	3,3	3,2	3,2	4,5	1,8	1,8	4,1	3,1	20,0	50,5	46,7	27,2	36,1
	3	2,0	3,3	3,9	3,5	3,2	3,3	3,7	3,2	2,0	3,1	3,9	1,6	2,5	4,0	3,0	12,8	57,8	45,8	41,6	39,5
	4	1,3	3,2	3,7	3,4	2,9	3,3	3,0	2,7	2,7	2,9	3,9	2,0	6,3	4,1	4,1	7,7	52,8	20,4	27,8	27,2
	5	1,9	2,8	3,8	4,1	3,2	2,9	3,3	3,2	3,2	3,2	4,5	1,8	3,4	2,5	3,1	12,8	65,7	34,5	50,8	41,0
6L8	1	3,3	3,6	4,0	3,2	3,5	3,7	3,0	3,3	3,0	3,3	4,4	6,0	4,8	8,0	5,8	18,4	18,2	22,9	11,7	17,8
	2	3,5	3,6	3,4	3,9	3,6	3,3	3,0	3,3	3,7	3,3	4,2	6,0	7,8	5,4	5,9	23,4	18,2	11,3	17,4	17,6
	3	3,8	3,4	4,2	3,6	3,8	3,7	3,0	3,7	3,0	3,4	4,9	4,7	5,5	6,7	5,5	19,3	22,4	20,7	16,4	19,7
	4	3,9	3,6	3,7	3,1	3,6	3,3	3,7	3,3	3,0	3,3	7,2	4,4	5,4	7,7	6,2	14,5	20,8	18,5	12,8	16,7
	5	3,6	5,1	3,3	3,4	3,9	3,3	3,7	3,0	3,0	3,3	6,0	5,4	8,0	8,0	6,9	16,4	23,7	12,3	12,8	16,3
6Q1	1	6,1	6,3	6,4	8,8	6,9	6,8	6,8	6,5	7,9	7,0	7,1	5,6	6,9	4,8	6,1	11,1	14,7	12,4	21,6	15,0
	2	6,0	6,4	5,9	6,8	6,3	6,5	6,8	7,2	8,3	7,2	5,8	5,3	7,1	5,2	5,9	14,0	16,3	9,5	14,3	13,5
	3	6,8	6,6	6,6	6,4	6,6	7,2	7,6	7,2	7,2	7,3	4,7	5,7	6,0	6,3	5,7	18,4	13,5	13,8	12,6	14,6
	4	5,9	6,2	7,1	6,8	6,5	6,8	7,2	7,2	6,8	7,0	4,7	4,7	6,7	6,3	5,6	16,7	16,5	13,3	14,3	15,2
	5	5,8	6,7	7,6	12,0	8,0	6,8	6,8	7,9	7,2	7,2	5,6	6,3	5,2	7,4	6,1	13,7	14,1	16,9	21,4	16,5

APPENDIX 12 (continued) WATER SOLUBLE AND EXCHANGEABLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT -MENT	S VALUE (me/100g)					C.E.C. (me/100g)					E.P.P. (me/100g)					$\frac{Ca + Mg}{K}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	6,7	6,5	9,2	7,0	7,4	8,4	8,8	10,7	10,0	9,5	8,5	7,7	5,2	6,3	6,9	8,3	8,3	15,1	10,1	10,5
	2	6,8	4,8	8,0	7,1	6,7	9,2	10,0	10,4	10,0	9,9	5,8	4,9	6,8	5,8	5,8	11,9	8,7	10,2	11,2	10,5
	3	6,6	6,3	7,2	5,8	6,5	8,8	9,5	10,4	9,5	9,6	5,6	6,6	7,0	6,1	6,3	12,1	9,0	9,7	9,0	9,7
	4	7,0	6,0	7,4	7,7	7,0	9,5	10,0	10,0	9,5	9,8	5,2	7,1	5,6	5,9	6,0	13,1	7,3	12,5	12,7	11,4
	5	5,8	7,5	6,7	7,0	6,8	7,7	9,2	10,7	10,7	9,4	7,8	5,5	4,8	5,3	5,9	8,3	13,8	12,4	12,5	11,8
3M11	1	11,5	12,8	18,0	15,0	14,3	11,1	12,2	16,3	13,7	13,1	3,3	3,9	2,0	3,2	3,1	30,1	26,7	54,3	35,9	36,8
	2	11,9	13,1	17,4	16,4	14,7	11,1	13,2	15,3	15,3	13,7	3,1	4,1	2,3	1,9	2,9	32,4	25,1	47,4	55,6	40,1
	3	10,3	16,9	16,2	16,2	14,9	10,0	15,3	13,7	13,7	13,2	5,0	2,2	3,6	3,3	3,5	19,6	51,7	31,1	33,8	34,1
	4	11,7	15,0	15,4	15,0	14,3	11,1	13,2	13,2	12,7	12,6	3,5	4,1	3,4	3,6	3,7	30,1	26,9	33,0	32,0	30,5
	5	13,2	15,0	16,0	18,4	15,7	13,2	13,2	14,2	15,3	14,0	3,3	3,0	3,3	2,1	2,9	30,1	37,0	32,9	55,8	39,0
OSBLOK	1	4,3	5,1	4,5	3,7	4,4	3,6	4,0	4,3	3,6	3,9	4,2	3,0	2,8	4,4	3,6	25,3	37,9	32,8	20,8	29,2
	2	4,3	4,5	3,9	3,7	4,1	3,6	3,6	3,6	4,0	3,7	4,7	4,2	3,1	3,3	3,8	22,4	27,1	32,7	25,6	27,0
	3	4,2	4,4	3,8	4,3	4,2	4,0	4,0	4,0	4,3	4,1	3,0	2,8	4,0	3,0	3,2	31,7	35,8	21,7	30,3	29,9
	4	4,0	3,6	4,2	4,2	4,0	4,0	3,6	4,3	4,3	4,1	3,8	3,3	3,7	3,0	3,5	24,0	34,4	24,6	22,1	26,3
	5	4,1	4,2	4,2	4,2	4,2	4,0	3,6	4,0	3,6	3,8	4,8	3,3	3,5	3,6	3,8	18,9	31,1	27,6	22,1	24,9
SKAAP BLOK	1	5,1	4,2	4,9	4,3	4,6	5,1	4,4	4,1	4,1	4,4	3,1	4,7	5,6	5,6	4,8	19,1	18,1	19,4	16,5	20,8
	2	5,6	4,1	4,1	4,3	4,5	5,7	4,1	3,7	3,7	4,3	3,0	5,1	7,8	5,7	5,4	28,2	17,8	12,4	18,1	19,1
	3	5,6	4,5	4,0	4,5	4,7	5,1	4,1	3,7	3,2	4,0	4,3	6,1	5,7	7,2	5,8	22,4	16,2	17,4	17,7	18,4
	4	5,6	3,7	3,8	4,7	4,5	5,1	4,1	3,7	3,7	4,2	3,9	6,1	7,8	5,7	5,9	26,0	12,8	11,3	20,3	17,6
	5	4,5	4,8	4,3	4,3	4,5	4,1	4,4	4,1	4,1	4,2	6,1	5,7	6,1	6,6	6,1	16,2	17,3	15,2	14,1	15,7

APPENDIX 12 (continued) WATER SOLUBLE AND EXCHANGEABLE CATIONS (me/100g) SUBSOILS

TRIAL NO.	TREAT -MENT	S VALUE (me/100g)					C.E.C. (me/100g)					E.P.P. (me/100g)					$\frac{Ca + Mg}{K}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	4,5	4,0	4,1	4,2	4,2	4,0	4,1	4,8	4,8	4,4	9,8	11,0	8,1	10,0	9,7	9,9	7,7	9,4	7,6	8,7
	2	4,0	3,6	3,9	3,9	3,9	4,0	4,5	4,5	4,5	4,4	8,3	10,7	9,1	9,1	9,3	10,5	6,4	8,4	8,4	8,4
	3	3,9	4,2	4,1	4,4	4,2	3,9	4,5	3,9	4,5	4,2	8,5	11,1	10,5	10,7	10,2	10,1	7,2	8,8	6,8	8,2
	4	4,1	4,1	4,1	4,2	4,1	3,3	4,5	4,5	4,8	4,3	11,5	10,0	9,6	9,4	10,1	9,1	8,0	8,4	8,1	8,4
	5	4,4	4,1	3,9	4,0	4,1	4,8	5,1	4,1	4,5	4,6	10,0	8,4	12,9	10,0	10,3	8,1	8,4	6,3	7,7	7,6
24D10	1	4,6	4,2	4,0	4,0	4,2	4,7	4,7	4,7	4,7	4,7	6,9	4,0	5,5	4,0	5,1	13,6	21,1	14,6	19,6	17,2
	2	4,4	4,0	4,3	4,2	4,2	4,3	5,0	4,0	4,0	4,3	6,8	6,0	6,0	4,3	5,8	14,7	11,3	16,7	23,5	16,6
	3	4,7	4,0	3,4	4,0	4,0	3,9	5,0	5,3	4,7	4,7	5,9	6,0	4,2	3,6	4,9	20,3	12,0	14,3	21,9	17,1
	4	4,7	4,3	4,0	3,6	4,2	4,3	4,7	4,7	4,7	4,6	5,9	3,6	4,0	5,5	4,8	18,7	23,9	19,6	12,1	18,6
	5	4,7	3,3	4,3	4,2	4,1	5,3	4,7	4,7	4,7	4,9	4,5	6,0	3,6	5,5	4,9	19,7	10,0	23,9	14,6	17,1
5C5	1	2,8	4,4	2,9	4,8	3,7	3,7	3,7	3,7	3,7	3,7	2,2	2,2	1,6	2,2	2,1	32,5	52,5	45,5	57,9	47,1
	2	2,8	2,9	3,1	5,3	3,5	3,7	3,3	3,0	3,3	3,3	3,2	2,4	4,0	1,8	2,9	21,7	34,1	23,8	86,7	41,6
	3	2,9	4,8	2,9	4,6	3,8	4,0	4,3	3,7	4,0	4,0	2,0	1,9	3,2	2,5	2,4	32,5	58,8	22,8	44,0	39,5
	4	2,8	2,9	4,6	4,3	3,7	3,7	3,7	3,7	3,7	3,7	2,2	2,2	2,2	1,6	2,1	31,6	34,1	55,0	70,0	47,7
	5	3,7	2,9	2,9	3,0	3,1	3,3	3,7	3,7	3,3	3,5	2,4	2,2	2,7	2,4	2,4	44,1	33,3	27,3	35,8	35,1

APPENDIX 13

POTASSIUM ABSORPTION RATIO FOR TOPSOILS $\frac{K}{\sqrt{\frac{Ca + Mg}{2}}}$ (me/l)

TRIAL NO.	TREAT -MENT	1	2	3	4	AVE	PLOT NO.	TREAT -MENT	1	2	3	4	AVE
1B2	1	0,62	0,37	0,57	0,53	0,53	4C5	1	0,55	0,30	0,26	0,36	0,37
	2	0,60	0,59	0,89	0,86	0,74		2	0,68	0,38	0,49	0,42	0,49
	3	0,80	0,84	0,85	0,91	0,85		3	0,42	0,46	0,49	0,55	0,46
	4	0,60	0,87	1,13	0,73	0,83		4	1,00	0,78	0,92	0,41	0,78
	5	1,23	0,82	1,41	0,58	1,01		5	1,23	1,95	0,73	1,01	1,23
1R1	1	0,38	0,28	0,44	0,34	0,36	6L8	1	0,49	0,34	0,45	0,68	0,49
	2	0,53	0,58	0,53	0,61	0,56		2	0,55	0,62	0,78	0,74	0,67
	3	0,67	0,83	0,61	0,70	0,70		3	0,82	1,15	1,13	0,77	0,97
	4	0,69	0,72	0,96	0,72	0,77		4	0,85	0,74	1,35	1,29	1,06
	5	1,79	0,61	0,81	0,71	0,98		5	1,70	1,33	1,66	0,64	1,33
2A5	1	0,34	0,40	0,37	0,35	0,37	6Q1	1	0,38	0,29	0,34	0,31	0,33
	2	0,28	0,37	0,40	0,36	0,35		2	0,42	0,33	0,44	0,38	0,39
	3	0,58	0,48	0,47	0,47	0,50		3	0,31	0,49	0,42	0,52	0,44
	4	0,65	0,61	0,59	0,47	0,58		4	0,48	0,42	0,56	0,46	0,48
	5	0,60	0,61	0,54	0,81	0,64		5	0,54	0,63	0,78	0,64	0,65
3K9	1	0,60	0,72	0,62	0,50	0,61	7Q1	1	0,75	0,79	0,37	0,73	0,66
	2	0,55	0,57	0,46	0,72	0,58		2	0,63	0,59	0,63	0,66	0,63
	3	1,18	1,14	0,69	0,52	0,88		3	0,61	1,11	0,77	0,50	0,75
	4	1,05	0,72	0,73	1,42	0,98		4	0,71	1,02	0,65	0,49	0,72
	5	0,98	0,86	0,40	1,28	0,88		5	0,71	0,68	0,65	0,64	0,67

APPENDIX 13 (continued) POTASSIUM ABSORPTION RATIO FOR TOPSOILS $\sqrt{\frac{Ca + Mg}{2}}$ (me/l)

TRIAL NO.	TREAT -MENT	1	2	3	4	AVE
4B4	1	0,24	0,21	0,31	0,43	0,30
	2	0,46	0,41	0,32	0,41	0,40
	3	0,37	0,52	0,40	0,82	0,53
	4	0,49	1,10	0,82	0,46	0,72
	5	1,24	0,47	0,98	0,62	0,83
3M11	1	0,21	0,22	0,16	0,23	0,21
	2	0,34	0,29	0,13	0,14	0,23
	3	0,32	0,19	0,25	0,26	0,26
	4	0,59	0,36	0,32	0,43	0,43
	5	0,35	0,40	0,33	0,36	0,36
OSBLOK	1	0,27	0,16	0,26	0,18	0,22
	2	0,36	0,18	0,11	0,15	0,20
	3	0,17	0,21	0,32	0,10	0,20
	4	0,18	0,15	0,35	0,31	0,25
	5	0,88	0,29	0,16	0,12	0,36
SKAAP BLOK	1	0,21	0,18	0,16	0,18	0,18
	2	0,25	0,22	0,28	0,22	0,24
	3	0,58	0,34	0,26	0,25	0,36
	4	0,47	0,60	0,22	0,35	0,41
	5	1,21	0,50	0,30	0,31	0,58

PLOT NO.	TREAT -MENT	1	2	3	4	AVE
4Q4	1	0,58	0,43	0,42	0,39	0,46
	2	0,52	0,62	0,44	0,33	0,48
	3	0,67	0,76	0,52	0,51	0,62
	4	0,65	0,62	0,77	0,51	0,64
	5	1,21	0,77	1,33	0,66	0,99
24D10	1	0,46	0,44	0,46	0,38	0,44
	2	0,62	0,49	0,39	0,45	0,49
	3	0,64	0,68	0,59	0,43	0,59
	4	0,63	0,84	0,70	0,50	0,67
	5	0,79	1,04	0,50	0,73	0,77
5C5	1	0,26	0,26	0,21	0,25	0,25
	2	0,37	0,18	0,25	1,44	0,56
	3	0,16	0,28	0,36	0,41	0,30
	4	0,37	0,30	0,34	0,18	0,30
	5	0,28	0,33	0,33	0,28	0,31

APPENDIX 14

PHOSPHATE, ZINC, COPPER AND ORGANIC MATERIAL CONTENTS OF TOPSOILS

TRIAL NO.	TREAT -MENT	P mg/Kg					Zn mg/Kg					Cu mg/Kg					ORG. mat. %				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	17	18	27	32	24	2,5	3,0	1,6	3,7	2,7	7,2	3,6	2,8	4,0	4,4	0,53	0,60	0,55	0,60	0,57
	2	19	21	27	29	24	2,0	3,5	2,6	3,1	2,8	1,4	8,4	6,6	6,2	5,7	0,53	0,60	0,62	0,57	0,58
	3	19	23	23	20	21	1,8	2,3	3,7	2,8	2,7	2,0	4,8	8,4	7,8	5,8	0,53	0,60	0,60	0,57	0,58
	4	21	16	27	27	23	3,2	2,1	3,6	2,7	2,9	6,0	3,0	6,0	5,6	5,2	0,69	0,50	0,60	0,37	0,54
	5	16	26	21	26	22	2,6	3,2	2,8	3,1	2,9	6,0	7,8	4,0	9,0	6,7	0,52	0,62	0,60	0,37	0,53
1R1	1	15	19	15	20	17	1,3	0,9	1,3	1,4	1,2	1,9	0,6	1,9	1,9	1,6	0,4	0,5	0,4	0,5	0,4
	2	23	13	14	16	17	1,2	1,3	1,2	2,0	1,4	1,2	1,9	1,9	2,5	1,9	0,5	0,3	0,5	0,4	0,4
	3	20	18	13	15	17	1,1	1,1	2,0	1,7	1,5	1,2	1,2	1,2	1,9	1,4	0,4	0,6	0,4	0,5	0,5
	4	27	13	17	20	19	2,5	1,1	1,5	1,6	1,7	1,9	1,9	1,9	1,9	1,9	0,6	0,2	0,6	0,5	0,5
	5	15	16	11	11	13	1,7	1,5	1,1	1,6	1,5	1,2	1,2	1,9	1,2	1,4	0,5	0,6	0,4	0,4	0,5
2A5	1	13	10	4	4	8	2,4	1,2	3,1	3,3	2,5	2,6	2,0	5,0	5,0	3,7	0,48	0,52	0,62	0,22	0,46
	2	6	12	7	5	8	1,6	1,1	2,9	3,2	2,2	4,6	2,0	5,0	5,8	4,4	0,48	0,45	0,58	0,36	0,47
	3	10	13	4	6	8	1,8	1,5	2,9	2,4	2,2	4,0	2,6	6,6	6,2	4,9	0,55	0,45	0,43	0,31	0,44
	4	15	13	9	13	13	1,7	2,0	3,2	2,9	2,5	2,6	4,0	7,6	4,0	4,6	0,41	0,60	0,45	0,60	0,52
	5	14	4	5	13	9	1,2	3,7	3,2	6,5	3,7	3,6	6,2	6,2	5,8	5,5	0,48	0,74	0,62	0,45	0,57
3K9	1	19	26	19	27	23	3,5	3,6	1,9	3,9	3,2	1,2	3,2	3,0	5,2	3,2	0,4	0,4	0,4	0,6	0,5
	2	21	23	19	27	23	2,1	2,2	2,8	1,8	2,2	3,6	2,6	3,2	4,4	3,5	0,5	0,5	0,4	0,6	0,5
	3	26	21	21	28	24	2,3	2,1	2,4	1,6	2,1	2,4	3,2	2,4	5,2	3,3	0,4	0,5	0,4	0,2	0,4
	4	28	20	24	31	26	2,3	2,9	1,3	1,4	2,0	1,6	2,4	2,0	3,0	2,3	0,5	0,4	0,4	0,6	0,5
	5	19	21	20	26	22	2,7	2,5	1,8	2,1	2,3	2,0	3,6	3,6	4,4	3,4	0,5	0,5	0,5	0,5	0,5

APPENDIX 14 (continued) PHOSPHATE, ZINC, COPPER AND ORGANIC MATERIAL CONTENTS OF TOPSOILS

TRIAL NO.	TREAT-MENT	P mg/Kg					Zn mg/Kg					Cu mg/Kg					ORG. MAT. %				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	9	14	9	15	12	1,6	2,9	1,3	2,6	2,1	4,4	6,6	4,6	4,4	5,0	0,3	0,3	0,3	0,3	0,3
	2	13	10	14	16	13	2,1	2,2	2,1	2,0	2,1	3,8	4,6	5,4	3,8	4,4	0,2	0,3	0,3	0,3	0,3
	3	9	11	13	11	11	2,6	2,6	1,5	2,3	2,3	5,0	5,0	3,8	5,4	4,8	0,3	0,3	0,3	0,3	0,3
	4	19	10	13	23	16	5,1	2,2	2,3	2,2	3,0	5,4	3,8	3,2	5,2	4,4	0,3	0,3	0,3	0,3	0,3
	5	10	10	13	14	12	3,0	2,7	2,6	1,8	2,5	4,4	4,4	4,4	5,0	4,6	0,3	0,3	0,3	0,3	0,3
4C5	1	5	7	5	2	5	1,5	1,8	1,3	0,7	1,3	6,2	2,4	1,7	1,7	3,0	0,4	0,5	0,5	0,5	0,5
	2	6	2	4	3	4	1,7	2,3	2,0	4,6	2,7	8,8	2,4	2,4	1,7	3,8	0,5	0,4	0,5	0,4	0,5
	3	2	3	5	6	4	3,8	1,0	0,8	0,6	1,6	2,0	1,7	2,0	1,7	1,9	0,5	0,4	0,5	0,5	0,5
	4	3	3	4	3	3	0,9	1,8	1,9	1,3	1,5	1,7	1,7	1,4	2,0	1,7	0,4	0,5	0,4	0,3	0,4
	5	4	4	3	2	3	0,6	1,3	1,2	1,3	1,1	2,0	1,4	1,7	1,4	1,6	0,5	0,4	0,4	0,5	0,5
6L8	1	19	17	20	16	18	1,5	1,1	1,3	1,5	1,4	2,6	2,2	1,8	2,2	2,2	0,7	0,6	0,6	0,4	0,6
	2	23	20	18	14	19	1,8	1,3	1,6	1,8	1,6	3,0	3,0	2,2	7,4	3,9	0,6	0,5	0,6	0,6	0,6
	3	23	19	19	15	19	1,8	1,0	1,1	2,6	1,6	4,2	1,8	2,6	8,2	4,2	0,6	0,6	0,7	0,6	0,6
	4	10	19	14	19	16	1,5	1,1	1,7	7,2	2,9	3,0	3,0	3,4	6,6	4,0	0,6	0,6	0,6	0,6	0,6
	5	20	20	18	23	20	1,3	0,9	1,8	3,1	1,8	2,2	2,2	2,6	5,8	3,2	0,7	0,5	0,5	0,6	0,6
6Q1	1	6	5	10	15	9	2,8	1,7	1,4	3,6	2,4	2,8	2,4	2,4	5,0	3,2	0,5	0,4	0,5	0,5	0,5
	2	6	6	4	3	5	2,2	2,9	1,8	2,0	2,2	4,6	5,6	4,0	2,8	4,3	0,5	0,5	0,5	0,4	0,5
	3	6	3	4	7	5	2,8	1,6	2,5	1,4	2,1	5,0	3,2	4,6	3,2	4,0	0,4	0,5	0,4	0,5	0,5
	4	13	6	8	3	8	1,5	1,5	2,4	2,1	1,9	3,2	3,6	4,6	4,6	4,0	0,4	0,4	0,4	0,4	0,4
	5	7	5	9	8	7	3,6	1,7	1,6	1,1	2,0	3,6	6,4	2,4	2,8	3,8	0,4	0,4	0,5	0,5	0,5

APPENDIX 14 (continued) PHOSPHATE, ZINC, COPPER AND ORGANIC MATERIAL CONTENTS OF TOPSOILS

TRIAL NO.	TREAT -MENT	P mg/Kg					Zn mg/Kg					Cu mg/Kg					ORG. MAT. %				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	21	17	5	6	12	1,5	5,8	1,4	3,8	3,1	3,0	4,2	3,8	3,8	3,7	0,6	0,5	0,5	0,5	0,5
	2	15	6	6	16	11	1,6	1,4	1,6	3,3	2,0	3,0	4,2	4,2	11,6	5,8	0,5	0,5	0,6	0,5	0,5
	3	6	8	9	10	8	1,4	1,3	4,8	2,8	2,6	3,4	3,8	2,6	12,0	5,5	0,5	0,5	0,5	0,5	0,5
	4	9	14	6	8	9	1,5	2,1	1,3	1,2	1,5	3,4	3,4	4,2	7,2	4,6	0,5	0,5	0,5	0,5	0,5
	5	11	5	11	6	8	2,8	1,3	1,2	1,4	1,7	3,4	4,2	3,0	7,2	4,4	0,6	0,5	0,5	0,5	0,5
3M11	1	12	14	13	10	12	3,2	2,1	2,8	2,1	2,6	5,6	3,2	6,0	5,6	5,1	0,7	0,8	0,7	0,7	0,7
	2	16	14	22	9	15	2,9	2,1	2,3	2,5	2,5	4,0	3,8	3,8	4,6	4,1	0,8	0,6	0,7	0,8	0,7
	3	10	14	10	7	10	2,6	2,0	2,0	2,6	2,3	4,6	3,8	3,6	5,0	4,3	0,8	0,7	0,8	0,7	0,8
	4	16	14	14	15	15	2,8	3,8	3,9	3,6	3,5	4,6	9,0	4,6	4,6	5,7	0,7	0,6	0,7	0,8	0,7
	5	13	16	12	7	12	3,2	2,9	4,0	2,3	3,1	5,0	4,6	8,6	3,8	5,5	0,7	0,7	1,2	0,8	0,9
OSBLOK	1	12	20	20	20	18	6,0	1,1	1,1	2,1	2,6	2,0	1,6	4,4	4,4	3,1	0,4	0,4	0,4	0,4	0,4
	2	16	11	22	19	17	1,5	1,4	1,1	1,3	1,3	2,6	2,6	3,4	3,8	3,1	0,6	0,4	0,4	0,3	0,4
	3	18	10	30	20	20	1,8	2,6	1,0	0,7	1,5	2,6	3,6	3,6	3,4	3,3	0,4	0,4	0,4	0,5	0,4
	4	10	17	24	20	18	2,0	1,7	1,4	1,0	1,5	3,0	4,2	4,8	3,8	4,0	0,5	0,4	0,4	0,4	0,4
	5	16	22	19	17	19	1,4	1,2	0,9	1,0	1,1	3,0	3,4	4,0	2,4	3,2	0,5	0,4	0,3	0,4	0,4
SKAAP BLOK	1	24	40	43	40	38	1,5	1,0	2,0	1,7	1,6	4,0	4,4	4,8	4,8	4,5	0,4	0,4	0,2	0,3	0,3
	2	26	44	51	30	38	1,1	1,4	1,2	0,7	1,1	3,0	4,8	6,6	3,8	4,6	0,4	0,3	0,2	0,3	0,3
	3	31	44	29	30	34	4,1	1,1	1,1	1,4	1,9	5,6	4,2	4,2	5,0	4,3	0,3	0,3	0,3	0,3	0,3
	4	31	43	43	29	37	1,3	1,4	0,9	1,2	1,2	2,6	4,0	3,6	3,2	3,4	0,3	0,5	0,3	0,3	0,4
	5	32	42	39	36	38	1,6	0,9	1,1	1,3	1,2	5,6	4,8	4,0	4,4	4,7	0,3	0,3	0,3	0,3	0,3

APPENDIX 14 (continued) PHOSPHATE, ZINC, COPPER AND ORGANIC MATERIAL CONTENTS OF TOPSOILS

TRIAL NO.	TREAT -MENT	P mg/Kg					Zn mg/Kg					Cu mg/Kg					ORG. MAT. %				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	13	15	17	18	16	1,4	2,6	1,5	3,2	2,2	2,2	6,0	2,0	4,4	3,7	0,4	0,4	0,4	0,4	0,4
	2	13	14	14	15	14	2,2	2,1	2,1	2,4	2,2	2,2	2,2	6,0	3,4	3,5	0,3	0,3	0,3	0,3	0,3
	3	16	8	9	17	13	5,0	2,0	2,5	3,5	3,3	6,6	3,4	3,6	4,4	4,5	0,5	0,3	0,3	0,4	0,4
	4	13	13	16	22	16	2,6	3,6	2,6	2,9	2,9	4,6	5,0	3,6	5,0	4,6	0,3	0,3	0,4	0,4	0,4
	5	10	14	14	16	14	1,6	1,9	2,6	2,3	2,1	3,8	2,8	3,6	3,8	3,5	0,3	0,5	0,3	0,3	0,4
24D10	1	14	14	15	11	14	2,3	1,5	2,1	2,0	2,0	5,4	2,4	4,8	6,0	4,7	0,6	0,4	0,3	0,4	0,4
	2	15	15	7	17	14	2,7	1,3	1,1	3,1	2,1	5,0	4,0	2,0	6,4	4,4	0,3	0,4	0,4	0,5	0,4
	3	12	16	12	17	14	1,5	1,3	1,4	1,9	1,5	4,8	4,0	3,8	3,4	4,0	0,4	0,4	0,4	0,4	0,4
	4	15	14	10	15	14	2,8	1,9	1,9	1,4	2,0	7,4	4,4	4,4	3,4	4,9	0,4	0,4	0,4	0,4	0,4
	5	17	19	20	16	18	2,4	1,6	3,7	2,8	2,6	5,6	3,4	4,0	6,0	4,8	0,4	0,4	0,4	0,3	0,4
5C5	1	11	6	1	2	5	2,5	3,1	2,2	3,4	2,8	2,2	3,2	3,8	1,4	2,7	0,3	0,4	0,3	0,4	0,4
	2	13	6	6	5	8	3,8	1,6	1,8	2,3	2,4	2,4	2,2	2,2	2,0	2,2	0,4	0,3	0,4	0,3	0,4
	3	13	8	3	7	8	3,1	2,5	1,6	1,2	2,1	2,4	4,8	0,8	2,6	2,7	0,2	0,4	0,4	0,4	0,4
	4	9	15	3	3	8	1,6	1,9	1,5	1,6	1,7	1,0	0,8	2,2	2,6	1,7	0,3	0,3	0,4	0,4	0,4
	5	10	6	6	4	7	3,4	2,0	2,2	1,9	2,4	2,8	2,4	1,4	3,6	2,6	0,3	0,4	0,4	0,5	0,4

APPENDIX 15 PHOSPHATE, ZINC, COPPER AND ORGANIC MATERIAL CONTENTS OF SUBSOILS

TRIAL NO.	TREAT -MENT	P mg/Kg					Zn mg/Kg					Cu mg/Kg					ORG. MAT. %				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	6	7	9	8	8	1,6	1,2	1,9	1,7	5,2	8,2	9,6	8,4	7,9	0,2	0,2	0,2	0,2	0,3	0,2
	2	8	13	8	34	16	1,8	0,9	2,0	1,0	1,4	4,6	6,6	5,6	4,6	5,4	0,3	0,2	0,3	0,2	0,3
	3	27	7	8	5	12	1,6	1,2	2,3	2,9	2,0	10,8	9,8	7,2	9,2	9,3	0,3	0,2	0,3	0,2	0,3
	4	8	3	7	7	6	3,2	1,6	2,3	1,3	2,1	12,0	4,6	7,8	10,6	8,8	0,2	0,1	0,2	0,2	0,2
	5	9	8	5	7	7	2,2	1,2	4,6	2,1	2,5	6,2	6,4	9,2	8,2	7,5	0,2	0,2	0,3	0,3	0,3
1R1	1	1	3	6	5	4	1,5	1,0	1,8	1,7	1,5	0,6	7,2	2,8	2,4	3,3	0,3	0,4	0,3	0,3	0,3
	2	25	1	4	4	9	1,1	2,0	2,0	1,3	1,6	1,2	8,4	3,8	3,8	4,3	0,3	0,2	0,3	0,3	0,3
	3	2	9	4	7	6	3,2	1,2	1,8	2,2	2,1	1,9	6,6	3,6	5,0	4,3	0,3	0,3	0,3	0,3	0,3
	4	2	13	3	1	5	3,3	2,6	1,8	2,0	2,4	0,6	7,2	3,6	4,4	4,0	0,3	0,4	0,3	0,2	0,3
	5	4	3	4	3	4	1,8	3,3	2,6	1,8	2,4	6,0	7,2	4,4	4,4	5,5	0,4	0,4	0,3	0,2	0,3
2A5	1	0	0	0	3	1	3,5	1,8	2,5	1,0	2,2	7,6	6,2	5,4	2,8	5,5	0,2	0,2	0,3	0,3	0,3
	2	0	0	7	4	3	2,4	1,8	1,9	1,1	1,8	6,6	4,4	3,6	2,4	4,3	0,2	0,4	0,3	0,3	0,3
	3	0	0	15	2	4	1,3	3,0	1,3	1,2	1,7	3,6	9,6	2,4	1,6	4,3	0,3	0,1	0,3	0,3	0,3
	4	0	0	6	3	2	2,0	1,8	1,2	1.6	1,7	5,0	4,0	2,0	2,0	3,3	0,3	0,3	0,3	0,3	0,3
	5	0	0	2	15	4	1,5	1,9	2,0	2,3	1,9	5,8	5,03	3,6	2,8	4,3	0,3	0,3	0,3	0,3	0,3
3K9	1	3	7	4	9	6	1,6	1,4	1,1	1,1	1,3	6,6	3,4	2,6	4,8	4,4	0,2	0,2	0,2	0,2	0,2
	2	11	9	1	14	9	1,1	1,6	1,1	1,4	1,3	3,4	3,4	3,0	4,0	3,5	0,2	0,2	0,2	0,2	0,2
	3	10	11	4	28	13	1,9	1,1	3,1	1,9	2,0	5,2	2,6	7,8	2,6	4,6	0,2	0,2	0,2	0,5	0,5
	4	6	25	4	25	15	1,4	1,3	0,7	1,9	1,3	5,4	2,6	2,6	4,0	3,7	0,2	0,2	0,2	0,2	0,2
	5	9	9	1	7	7	1,5	1,6	2,0	1,6	1,7	5,2	3,0	7,0	4,0	4,8	0,3	0,2	0,2	0,3	0,3

APPENDIX 15 (continued) PHOSPHATE, ZINC, COPPER AND ORGANIC MATERIAL CONTENTS OF SUBSOILS

TRIAL NO.	TREAT -MENT	P mg/Kg					Zn mg/Kg					Cu mg/Kg					ORG. MAT. %				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	4	3	3	4	4	1,5	2,8	4,3	3,7	3,1	3,0	6,0	8,0	6,0	6,0	0,2	0,2	0,2	0,2	0,2
	2	4	6	4	5	5	2,7	2,6	2,4	2,8	2,6	4,4	7,0	7,0	6,6	6,0	0,2	0,2	0,2	0,2	0,2
	3	4	5	3	4	4	1,7	3,3	2,1	1,6	2,2	4,2	7,6	5,0	4,4	5,3	0,2	0,2	0,2	0,2	0,2
	4	12	4	2	8	7	2,7	1,4	1,9	1,6	1,9	6,0	5,4	5,4	4,4	5,3	0,2	0,2	0,2	0,2	0,2
	5	3	3	4	3	3	2,8	1,7	1,2	3,8	2,4	6,6	4,6	5,4	7,0	5,9	0,2	0,2	0,2	0,2	0,2
4C5	1	0	19	2	0	5	1,1	1,5	2,0	1,4	1,5	1,4	1,7	5,2	2,2	2,6	0,2	0,2	0,2	0,2	0,2
	2	0	3	4	1	2	1,0	2,7	2,1	1,8	1,9	1,4	6,0	6,6	2,8	4,2	0,2	0,2	0,2	0,2	0,2
	3	0	3	0	1	1	4,0	1,9	1,3	1,3	2,1	2,4	5,0	2,8	2,2	3,1	0,2	0,2	0,2	0,2	0,2
	4	3	2	3	4	3	1,9	2,2	1,9	1,8	2,0	1,7	6,0	4,8	2,4	3,7	0,2	0,2	0,2	0,2	0,2
	5	3	2	0	0	1	1,3	2,1	1,0	0,9	1,3	1,4	6,0	2,4	1,8	2,9	0,2	0,2	0,2	0,2	0,2
6L8	1	2	0	5	0	2	1,7	1,1	1,1	1,3	1,3	8,2	6,6	9,0	6,6	7,6	0,4	0,2	0,3	0,4	0,3
	2	3	7	2	0	3	1,5	2,0	1,0	1,6	1,5	3,8	7,0	4,2	8,2	5,8	0,3	0,4	0,4	0,4	0,4
	3	4	2	14	7	7	0,9	1,7	0,9	1,3	1,2	5,8	5,8	4,2	3,8	4,9	0,3	0,4	0,3	0,3	0,3
	4	5	4	1	20	8	1,4	1,9	1,1	2,4	1,7	6,2	4,6	7,8	6,6	6,3	0,3	0,3	0,2	0,2	0,3
	5	8	5	1	12	7	1,6	2,5	1,1	1,5	1,7	4,2	6,2	7,0	5,8	5,8	0,3	0,2	0,5	0,4	0,4
6Q1	1	0	0	2	0	0,5	1,4	1,9	0,7	1,7	1,4	3,2	7,4	4,6	3,2	4,6	0,3	0,3	0,3	0,3	0,3
	2	0	7	0	0	2	1,2	1,7	1,6	1,9	1,6	4,6	8,6	6,8	6,8	6,7	0,3	0,3	0,3	0,3	0,3
	3	8	0	1	1	3	3,6	1,5	2,8	1,6	2,4	7,8	3,8	5,8	5,8	5,8	0,3	0,3	0,3	0,3	0,3
	4	7	2	1	0	3	2,6	2,0	1,4	0,9	1,7	5,0	5,0	4,6	3,6	4,6	0,3	0,3	0,3	0,3	0,3
	5	3	5	1	14	6	2,3	0,7	2,2	4,6	2,5	6,6	4,0	6,8	7,2	6,2	0,3	0,3	0,3	0,3	0,3

APPENDIX 15 (continued) PHOSPHATE, ZINC, COPPER AND ORGANIC MATERIAL CONTENTS OF SUBSOILS

TRIAL NO.	TREAT -MENT	P mg/Kg					Zn mg/Kg					Cu mg/Kg					ORG. MAT. %				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	3	3	1	2	2	1,1	1,4	1,2	1,0	1,2	5,6	8,2	9,2	5,0	7,0	0,3	0,4	0,3	0,4	0,4
	2	5	3	2	5	4	2,1	1,2	3,8	0,8	2,0	10,2	6,2	11,4	8,8	9,2	0,3	0,4	0,4	0,4	0,4
	3	1	2	2	1	2	1,3	1,6	1,0	1,4	1,3	7,2	10,8	8,8	10,2	0,3	0,4	0,4	0,3	0,4	0,4
	4	1	2	1	3	2	1,1	1,5	1,0	1,6	1,3	8,8	7,2	9,8	7,8	8,4	0,4	0,4	0,4	0,3	0,4
	5	3	5	2	2	3	5,1	1,6	1,4	1,5	2,4	7,8	8,8	8,8	11,4	9,2	0,4	0,4	0,4	0,4	0,4
3m11	1	5	16	2	1	6	4,7	1,6	1,3	1,6	2,3	7,0	5,0	5,6	5,6	5,8	0,5	0,5	0,5	0,4	0,5
	2	3	2	42	37	21	3,3	1,4	2,1	2,6	2,4	6,4	4,6	6,0	6,0	5,8	0,6	0,5	0,6	0,5	0,6
	3	7	3	13	1	6	2,4	1,9	1,8	1,2	1,8	6,0	5,6	5,6	3,6	5,2	0,4	0,4	0,5	0,5	0,5
	4	22	4	1	13	10	2,7	2,8	1,9	3,4	2,7	4,6	7,6	7,0	5,0	6,1	0,5	0,5	0,5	0,5	0,5
	5	1	3	2	47	13	1,9	1,4	1,8	2,4	1,9	5,0	4,6	5,6	6,6	5,5	0,4	0,5	0,5	0,5	0,5
OSBLOK	1	14	20	13	7	14	1,1	0,6	0,9	3,1	1,4	2,6	3,0	3,2	2,6	2,9	0,2	0,2	0,2	0,3	0,2
	2	15	16	13	3	12	1,6	1,3	0,9	1,8	1,4	4,0	4,0	3,0	2,4	3,4	0,3	0,3	0,3	0,2	0,3
	3	16	12	7	7	11	2,0	1,0	1,1	1,7	1,5	4,6	2,6	2,2	3,2	3,2	0,2	0,1	0,3	0,2	0,3
	4	13	8	8	10	10	0,9	1,2	1,0	1,1	1,1	3,8	3,6	1,4	2,2	2,8	0,4	0,3	0,3	0,3	0,3
	5	21	17	10	5	13	1,6	0,7	1,6	1,7	1,4	5,2	3,0	2,4	2,2	3,2	0,4	0,3	0,2	0,2	0,3
SKAAP BLOK	1	13	16	12	10	13	0,7	1,1	1,5	1,6	1,2	3,0	2,6	1,6	3,0	2,6	0,3	0,3	0,2	0,3	0,3
	2	10	13	6	5	9	0,8	1,9	1,3	0,8	1,2	3,0	3,6	3,6	3,0	3,3	0,3	0,2	0,2	0,3	0,3
	3	29	14	7	9	15	1,6	2,2	1,4	1,1	1,6	4,8	3,0	3,0	3,6	3,6	0,3	0,2	0,3	0,3	0,3
	4	67	13	7	6	23	1,9	0,8	1,1	1,5	1,3	4,8	1,6	1,0	3,6	2,8	0,3	0,2	0,2	0,3	0,3
	5	7	15	7	9	10	2,2	1,4	1,1	1,0	1,4	2,6	3,0	3,6	3,0	3,1	0,3	0,3	0,3	0,2	0,3

APPENDIX 15 (continued) PHOSPHATE, ZINC, COPPER AND ORGANIC MATERIAL CONTENTS OF SUBSOILS

TRIAL NO.	TREAT -MENT	P mg/Kg					Zn mg/Kg					Cu mg/Kg					ORG. MAT. %				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	1	60	10	6	19	2,2	1,9	1,9	1,9	2,0	5,0	3,8	4,4	3,8	4,3	0,2	0,2	0,2	0,2	0,2
	2	3	15	7	6	8	2,0	1,4	2,9	2,5	2,2	3,4	1,6	2,8	6,0	3,5	0,1	0,2	0,2	0,2	0,2
	3	1	13	10	4	7	3,2	1,8	2,4	2,6	2,5	4,4	2,8	4,2	4,4	4,0	0,2	0,2	0,2	0,3	0,3
	4	1	10	7	9	7	2,6	1,9	2,4	2,3	2,3	4,4	3,8	4,4	6,0	4,7	0,2	0,2	0,3	0,2	0,2
	5	60	8	8	5	20	3,0	2,2	3,8	2,8	3,0	6,0	3,0	6,6	4,4	5,0	0,2	0,2	0,2	0,2	0,2
24D10	1	4	7	11	8	8	1,0	0,7	3,3	2,2	1,8	4,0	2,2	10,2	2,8	4,8	0,2	0,2	0,2	0,2	0,2
	2	10	5	4	6	6	1,9	1,5	2,4	4,2	2,5	6,0	4,6	5,2	6,8	5,7	0,2	0,2	0,2	0,2	0,2
	3	8	8	4	19	10	2,2	1,1	1,8	4,6	2,4	7,0	4,6	4,6	12,6	7,2	0,2	0,2	0,2	0,2	0,2
	4	6	3	4	4	4	0,8	2,1	2,3	2,1	1,8	3,4	6,8	8,0	6,2	6,1	0,2	0,2	0,2	0,2	0,2
	5	49	4	28	4	21	2,3	1,5	2,8	2,0	2,2	6,8	2,8	5,8	7,4	5,7	0,2	0,2	0,2	0,2	0,2
5C5	1	7	2	1	1	3	1,4	1,4	1,7	1,8	1,6	4,6	4,0	3,6	4,0	4,1	0,2	0,3	0,1	0,3	0,2
	2	18	3	1	2	6	2,3	1,9	1,8	2,3	2,1	5,0	5,0	4,0	4,0	4,5	0,2	0,1	0,1	0,3	0,2
	3	3	1	1	4	2	2,0	1,4	1,7	1,9	1,8	3,6	2,6	4,6	4,6	3,9	0,3	0,3	0,1	0,2	0,2
	4	3	3	3	4	3	1,3	1,5	1,7	1,9	1,6	3,6	3,6	4,6	4,0	4,0	0,1	0,2	0,3	0,1	0,2
	5	3	5	4	2	4	1,7	2,4	2,5	1,2	2,0	3,6	4,6	4,6	3,0	4,0	0,1	0,1	0,2	0,1	0,1

APPENDIX 16

S.A.R., CONDUCTIVITY, pH AND SATURATION PERCENTAGE FOR TOPSOILS

TRIAL NO.	TREAT -MENT	S.A.R. me/l					CONDUCTIVITY mS/m 25°C					pH $CaCl_2$					SATURATION PERCENTAGE				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	1,83	1,50	1,98	1,30	1,78	38	33	31	29	33	5,8	5,9	5,8	5,7	5,8	27,5	27,5	27,1	27,1	27,4
	2	1,90	1,96	2,36	1,91	2,03	26	26	28	26	27	5,8	5,9	5,8	5,7	5,8	26,6	27,2	27,0	28,0	27,2
	3	1,93	2,04	1,64	2,60	2,05	36	29	34	24	31	6,1	5,8	5,8	5,8	5,9	27,8	27,2	28,2	28,2	27,9
	4	1,82	2,01	2,10	1,66	1,90	33	27	38	30	32	6,0	5,9	5,7	5,6	5,8	28,8	27,0	27,3	25,5	27,2
	5	2,32	2,37	2,74	1,27	2,18	30	32	32	32	32	6,0	5,8	5,7	5,6	5,3	27,5	27,0	28,2	24,0	26,7
1R1	1	1,10	0,96	1,15	1,23	1,11	43	86	36	50	54	6,4	5,6	5,8	5,8	5,9	23,5	25,0	22,0	25,0	23,9
	2	1,06	1,16	1,06	3,10	1,60	73	50	43	50	54	6,1	5,6	5,8	5,8	5,8	25,0	35,0	22,0	23,0	23,8
	3	1,31	1,40	1,22	1,38	1,33	50	58	35	46	47	6,0	5,6	5,8	5,8	5,8	24,0	23,0	22,0	25,0	23,5
	4	0,81	1,64	1,33	1,15	1,23	73	33	46	58	53	5,9	5,7	5,7	5,7	5,8	24,5	23,0	23,0	23,5	23,5
	5	1,39	1,33	1,52	1,39	1,41	51	53	34	36	44	5,8	5,7	5,7	5,8	5,8	22,0	22,0	24,0	23,5	22,9
2A5	1	0,63	0,92	1,07	1,07	0,92	42	28	39	38	37	6,6	6,4	5,8	5,8	6,2	29,0	28,3	25,2	25,8	27,1
	2	0,79	0,77	1,13	1,12	0,95	26	20	36	46	32	6,6	6,4	5,8	5,9	6,2	28,1	28,6	23,4	22,7	26,7
	3	0,72	0,84	1,23	1,23	1,01	18	26	40	50	34	6,5	6,4	5,8	5,8	6,1	27,7	28,4	23,4	21,1	25,2
	4	0,66	1,19	1,05	0,93	0,96	24	49	59	66	50	6,4	6,0	5,8	5,8	6,0	28,0	22,1	28,2	24,0	25,6
	5	0,44	0,92	1,10	0,81	0,82	30	45	41	91	52	6,5	5,9	5,8	5,6	6,0	28,6	21,5	22,0	23,0	23,8
3K9	1	0,42	0,82	0,57	0,35	0,54	35	38	32	41	37	6,0	5,9	5,9	6,0	6,0	23,5	24,0	23,0	23,0	23,4
	2	0,63	0,53	0,58	0,68	0,61	74	36	29	55	49	6,0	5,9	6,0	5,7	5,9	23,0	24,0	24,0	22,5	23,4
	3	0,53	0,93	0,64	0,67	0,69	71	36	34	142	71	6,0	5,9	6,0	5,9	6,0	23,5	24,0	24,0	23,0	23,6
	4	0,68	0,56	0,73	0,41	0,60	53	33	43	63	48	5,8	5,9	6,0	5,9	5,9	23,5	25,0	24,0	22,5	23,8
	5	0,90	0,52	0,37	0,99	0,70	28	51	54	65	50	5,9	5,7	6,0	5,9	5,9	24,0	23,0	24,0	22,5	23,4

APPENDIX 16 (continued) S.A.R., CONDUCTIVITY, pH AND SATURATION PERCENTAGE FOR TOPSOILS

TRIAL NO.	TREAT -MENT	S.A.R. me/l					CONDUCTIVITY mS/m 25°C					pH CaCl$_2$					SATURATION PERCENTAGE				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	1,80	1,16	1,43	1,39	1,27	65	106	36	33	60	7,6	6,8	6,4	6,2	6,8	27,0	26,2	25,0	29,0	26,8
	2	1,43	1,61	1,52	1,03	1,40	50	53	74	56	58	7,2	6,7	6,3	6,2	6,6	26,1	28,0	25,4	28,5	27,0
	3	1,38	1,29	0,89	1,29	1,21	73	45	58	74	63	7,1	6,5	6,3	5,9	6,5	25,6	26,0	25,1	29,0	26,4
	4	1,58	1,23	1,10	1,05	1,24	41	70	126	156	98	7,0	6,4	6,0	5,9	6,3	26,0	27,5	28,0	26,0	26,9
	5	1,54	1,29	1,14	1,05	1,26	77	40	100	110	82	6,7	6,4	6,0	5,8	6,2	25,3	25,5	28,5	29,4	27,2
4C5	1	1,36	0,98	1,03	0,92	1,07	43	40	36	33	38	6,3	5,6	5,6	5,6	5,8	23,5	22,5	23,0	23,0	23,0
	2	1,15	1,21	1,00	1,16	1,13	53	38	33	34	40	6,3	5,5	5,5	5,6	5,7	22,0	22,5	23,0	23,0	22,6
	3	1,35	0,91	1,06	1,07	1,10	42	46	46	51	46	5,8	5,5	5,6	5,5	5,6	23,0	23,0	23,0	23,0	23,0
	4	1,04	1,22	1,28	1,04	1,15	44	36	45	32	39	5,6	5,5	5,5	5,6	5,6	23,0	23,0	23,0	23,0	23,0
	5	1,53	1,53	1,05	1,24	1,34	38	48	47	69	51	5,5	5,5	5,5	,56	5,5	22,5	23,0	23,0	24,0	23,1
6L8	1	1,35	0,56	1,21	0,88	1,00	45	69	50	42	52	6,3	6,3	6,2	6,1	6,2	23,7	24,8	24,7	27,2	25,1
	2	0,63	1,03	1,25	0,53	0,86	61	45	48	17	43	6,3	6,3	6,1	5,8	6,1	25,4	22,0	22,8	24,5	23,7
	3	0,58	1,18	0,80	0,49	0,83	39	38	73	22	43	6,1	6,2	6,0	5,8	6,0	27,0	24,2	23,2	25,0	24,9
	4	1,27	1,15	1,09	0,49	1,00	42	40	48	26	39	6,3	6,2	6,0	5,7	6,1	26,0	24,2	23,4	25,0	24,7
	5	1,44	0,94	1,05	0,70	1,03	40	58	49	24	43	6,3	6,1	6,0	5,8	6,1	28,2	24,4	23,5	25,2	25,3
6Q1	1	1,26	1,18	1,23	0,94	1,15	36	33	30	73	43	5,9	6,0	6,0	6,0	6,0	24,0	23,0	23,0	24,0	23,5
	2	1,17	1,25	1,31	1,03	1,19	50	40	32	28	38	5,9	6,0	6,0	6,7	6,2	24,0	23,0	23,0	24,0	23,5
	3	0,99	1,28	1,26	0,95	1,12	36	33	36	40	36	5,9	6,0	6,0	6,0	6,1	24,0	23,5	23,0	24,0	23,6
	4	0,86	1,28	1,28	1,13	1,14	112	29	43	33	54	5,9	6,0	6,0	6,7	6,2	24,5	23,0	23,5	24,0	23,8
	5	1,47	1,14	1,60	0,96	1,29	41	41	33	36	38	5,9	6,0	6,0	6,7	6,2	23,5	23,5	23,5	25,0	23,9

APPENDIX 16 (continued) S.A.R., CONDUCTIVITY, pH AND SATURATION PERCENTAGE FOR TOPSOILS

TRIAL NO.	TREAT -MENT	S.A.R. me/l					CONDUCTIVITY mS/m 25°C					pH $CaCl_2$					SATURATION PERCENTAGE				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	0,77	1,17	0,93	0,61	0,87	49	112	86	139	97	6,0	6,0	5,7	5,6	5,8	22,5	23,0	24,5	22,5	23,2
	2	0,74	0,66	0,98	0,80	0,80	62	155	116	86	105	6,1	5,8	5,7	5,9	5,9	23,5	24,0	24,0	26,0	24,4
	3	1,02	0,84	1,02	0,80	0,92	34	162	116	66	95	6,2	5,7	5,7	5,9	5,9	21,0	23,0	23,0	29,5	24,1
	4	1,07	0,65	0,88	0,87	0,87	41	149	129	73	98	6,1	5,7	5,6	5,9	5,8	22,5	23,0	23,0	25,5	23,5
	5	1,36	0,68	0,84	0,90	0,95	65	178	198	77	130	6,1	5,6	5,6	5,9	5,8	22,5	23,0	23,0	25,0	23,4
3M11	1	1,03	1,06	1,49	0,95	1,13	141	45	40	69	74	6,7	6,7	6,8	6,5	6,7	25,0	26,0	25,5	24,5	25,3
	2	1,21	1,08	0,95	1,19	1,11	92	106	141	35	94	6,6	6,5	6,6	6,5	6,6	24,0	25,0	25,0	24,5	24,6
	3	1,00	1,08	1,19	1,39	1,17	99	57	38	50	61	6,5	6,6	6,6	6,6	6,6	23,0	26,0	24,0	25,0	24,5
	4	1,08	0,85	0,93	1,06	0,98	66	43	66	59	59	6,5	6,6	6,6	6,5	6,6	24,0	25,5	24,0	25,0	24,6
	5	1,06	1,17	1,00	1,36	1,15	86	96	78	67	82	6,6	6,7	6,6	6,5	6,6	27,0	25,5	24,5	25,0	25,5
OSBLOK	1	1,28	1,01	0,79	0,71	0,95	43	59	50	45	49	5,7	5,5	5,2	5,3	5,4	24,0	24,0	37,1	26,3	25,4
	2	1,28	1,22	0,87	0,80	1,04	55	53	43	48	50	5,4	5,5	5,2	5,3	5,4	24,0	24,0	25,8	25,9	24,9
	3	1,91	1,56	0,54	0,71	1,18	40	28	73	37	45	5,7	5,5	5,1	5,4	5,4	24,0	24,0	25,9	25,7	24,9
	4	1,48	0,99	0,76	0,77	1,00	50	55	43	57	51	5,7	5,0	5,2	5,3	5,3	23,5	25,7	26,3	26,5	25,5
	5	1,56	0,80	0,91	0,72	0,99	59	54	45	43	50	5,4	5,2	5,3	5,4	5,3	24,0	26,2	25,9	26,4	25,6
SKAAP BLOK	1	1,47	1,14	1,08	0,85	1,14	26	28	28	23	26	6,1	6,0	5,5	5,7	5,8	24,5	25,0	22,5	25,0	24,3
	2	1,21	1,25	1,24	1,36	1,24	29	26	40	20	29	6,1	5,7	5,5	5,8	5,8	24,5	24,0	23,0	23,0	23,6
	3	1,51	1,22	1,16	1,08	1,24	24	34	45	25	32	6,0	5,7	5,6	5,8	5,8	25,0	24,0	25,0	24,0	24,5
	4	1,30	1,30	0,94	1,08	1,16	25	36	40	23	31	6,0	5,6	5,6	5,9	5,8	24,5	25,0	25,5	24,5	24,9
	5	2,17	1,62	1,16	1,17	1,53	30	21	30	26	27	6,0	5,7	5,6	5,9	5,8	24,0	25,0	24,0	23,5	24,1

APPENDIX 16 (continued)

S.A.R., CONDUCTIVITY, pH AND SATURATION PERCENTAGE FOR TOPSOILS

TRIAL NO.	TREAT -MENT	S.A.R. me/l					CONDUCTIVITY mS/m 25°C					pH $CaCl_2$					SATURATION PERCENTAGE				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	1,06	0,98	1,02	1,09	1,04	38	53	44	43	45	5,5	5,5	5,7	5,6	5,6	24,0	24,0	24,0	24,0	24,0
	2	1,04	1,10	1,11	1,23	1,12	41	48	33	35	39	5,5	5,5	5,7	5,6	5,6	24,0	24,0	24,0	24,0	24,0
	3	1,13	1,15	1,11	1,12	1,13	43	42	41	50	44	5,5	5,6	5,7	5,5	5,6	24,0	24,0	24,0	24,0	24,0
	4	1,16	1,08	1,03	1,15	1,11	36	36	43	41	39	5,6	5,7	5,6	5,5	5,6	24,0	24,0	24,0	24,0	24,0
	5	1,46	0,97	1,39	1,51	1,33	34	43	35	34	37	5,5	5,6	5,5	5,5	5,5	24,0	24,0	24,0	24,0	24,0
24D10	1	0,61	0,63	0,44	0,75	0,61	73	46	53	54	57	5,4	5,5	5,5	5,7	5,5	24,0	24,5	25,0	23,5	24,3
	2	0,56	0,52	0,71	0,36	0,54	59	42	82	61	61	5,5	5,5	5,6	5,6	5,6	24,0	24,5	24,0	25,0	24,4
	3	0,66	0,74	0,89	0,45	0,69	46	48	69	46	52	5,4	5,4	5,5	5,6	5,5	24,5	24,0	24,0	25,0	24,4
	4	0,69	0,70	0,78	0,36	0,63	46	46	40	40	43	5,5	5,5	5,5	5,7	5,6	24,5	26,0	24,0	24,5	24,8
	5	0,66	0,68	0,52	0,49	0,59	48	36	66	53	51	5,4	5,5	5,5	5,6	5,5	25,0	25,0	25,0	25,0	25,0
5C5	1	0,56	0,66	0,73	0,79	0,69	73	33	30	66	51	5,8	5,8	5,8	5,9	5,8	25,0	24,5	24,5	25,0	24,8
	2	0,74	0,76	0,70	1,35	0,89	36	30	30	77	43	5,8	5,8	5,9	5,9	5,9	24,5	24,0	24,5	25,6	24,7
	3	0,85	0,71	0,70	0,88	0,79	26	26	30	73	39	5,8	5,7	5,8	5,9	5,8	24,5	24,5	24,5	25,1	24,7
	4	0,82	0,73	0,69	0,78	0,76	28	43	33	36	35	5,8	5,8	5,8	5,9	5,8	25,0	25,0	24,5	24,3	24,7
	5	0,76	0,68	0,60	0,83	0,72	29	28	53	33	36	5,7	5,7	5,7	6,1	5,8	24,0	24,5	24,0	24,0	24,1

APPENDIX 17

S.A.R., CONDUCTIVITY, pH AND SATURATION PERCENTAGE FOR SUBSOILS

TRIAL NO.	TREAT -MENT	S.A.R. me/l					CONDUCTIVITY mS/m 25°C					pH $CaCl_2$					SATURATION PERCENTAGE				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	0,78	1,05	0,83	0,96	0,91	44	38	40	34	39	5,7	5,9	6,0	6,1	5,9	25,5	25,0	27,5	28,5	26,6
	2	1,15	1,04	1,30	0,63	1,03	19	38	21	12	48	5,7	6,0	6,0	6,1	6,0	27,0	28,5	26,5	28,5	27,6
	3	0,75	1,58	0,84	1,50	1,17	84	21	73	43	55	5,8	5,9	6,0	6,1	6,0	25,0	27,5	27,5	28,5	27,1
	4	1,08	1,08	1,14	1,36	1,17	32	30	30	30	31	5,8	6,0	6,1	6,1	6,0	28,5	25,5	27,0	25,5	26,6
	5	1,20	1,70	2,74	1,08	1,68	21	16	43	23	28	5,8	5,9	6,1	6,1	6,0	25,0	25,5	27,0	28,5	26,5
1R1	1	0,99	0,84	1,51	1,79	1,28	50	178	32	34	74	5,9	4,9	6,6	6,5	6,0	23,5	27,7	27,0	27,3	26,4
	2	0,99	1,94	1,39	5,00	2,33	48	40	28	66	46	5,9	5,4	6,6	6,6	6,1	25,0	27,1	27,0	27,3	26,6
	3	0,89	1,52	1,60	1,69	1,44	165	58	24	41	72	6,0	5,6	6,6	6,6	6,2	24,0	27,7	27,7	28,0	26,9
	4	0,81	2,27	1,80	1,93	1,70	118	36	26	40	55	5,9	5,7	6,5	7,7	6,5	24,5	26,7	27,1	25,0	25,8
	5	1,82	2,65	1,63	2,14	2,06	42	24	46	32	36	5,6	5,8	6,4	7,7	6,4	27,7	27,2	27,8	25,2	27,0
2A5	1	1,42	1,55	1,08	0,86	1,23	119	99	36	66	80	5,9	6,0	6,2	6,0	6,0	26,2	25,0	25,2	20,0	24,1
	2	1,54	2,95	1,24	0,95	1,67	70	198	139	122	132	5,9	6,0	6,2	6,1	6,1	25,7	25,5	23,4	25,6	25,1
	3	1,53	1,33	0,83	1,18	1,22	145	112	86	74	104	5,9	6,1	5,9	6,0	6,0	25,1	26,0	24,8	25,0	25,2
	4	1,34	1,38	1,43	1,09	1,31	86	99	34	54	68	6,0	6,1	6,0	6,0	6,0	22,3	26,0	22,1	25,0	23,9
	5	1,34	1,51	1,11	1,35	1,33	218	48	38	231	134	6,0	6,2	6,0	6,0	6,1	23,9	26,5	21,5	25,5	24,4
3K9	1	1,10	0,93	0,68	0,96	0,92	28	79	112	61	70	6,0	6,1	6,2	6,2	6,1	21,0	22,0	23,0	22,0	22,0
	2	1,46	0,84	0,96	1,33	1,15	44	44	34	102	56	6,0	6,2	6,2	6,2	6,2	22,0	21,0	22,0	22,5	21,9
	3	1,07	1,56	1,18	0,40	1,05	38	48	30	42	40	6,0	6,1	6,2	6,2	6,1	22,0	21,5	22,0	22,0	21,9
	4	0,93	0,69	1,02	0,40	0,78	75	178	77	185	129	6,0	6,2	6,2	6,2	6,2	21,5	23,5	23,0	23,5	22,9
	5	0,96	0,73	1,05	1,31	1,01	35	62	33	50	45	6,1	6,2	6,2	6,2	6,2	20,5	22,0	22,0	22,0	21,6

APPENDIX 17 (continued) S.A.R., CONDUCTIVITY, pH AND SATURATION PERCENTAGE FOR SUBSOILS

TRIAL NO.	TREAT -MENT	S.A.R. me/l					CONDUCTIVITY mS/m 25°C					pH $CaCl_2$					SATURATION PERCENTAGE				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	1,35	1,42	0,87	0,94	1,15	39	132	90	86	87	6,1	7,3	7,0	6,9	6,8	28,0	25,0	23,0	25,0	25,
	2	1,26	1,17	1,60	0,62	1,16	71	92	96	88	87	6,3	7,2	7,0	7,0	6,9	25,5	24,5	24,0	24,0	24,
	3	1,80	1,16	1,27	0,99	1,31	88	95	90	96	92	7,5	7,1	7,0	7,0	7,2	24,5	25,0	23,0	23,0	24,
	4	1,06	0,70	1,00	1,12	0,97	158	90	89	152	122	7,4	7,1	6,8	7,0	7,1	24,0	24,0	24,0	25,0	24,
	5	2,17	0,89	0,79	1,50	1,34	132	73	76	99	95	7,2	7,1	7,0	6,8	7,0	24,5	24,0	25,5	25,0	24,
4C5	1	1,19	0,78	1,13	0,92	1,01	59	125	53	86	81	5,8	6,0	6,9	5,7	6,1	23,5	24,0	25,0	25,0	24,
	2	1,15	1,08	0,92	0,76	0,98	116	57	50	28	63	5,9	7,0	6,9	6,0	6,5	23,0	24,0	23,0	24,0	23,
	3	1,12	1,32	1,04	0,69	1,04	59	158	77	64	90	5,9	7,0	5,7	6,0	6,2	23,0	24,5	25,0	25,0	24,
	4	1,13	1,25	0,96	1,06	1,10	45	54	92	23	54	5,9	6,8	5,8	6,0	6,1	23,5	25,0	25,0	23,0	24,
	5	1,14	0,98	1,03	1,23	1,10	99	129	152	198	145	6,0	6,8	5,7	6,1	6,2	24,0	25,0	25,0	24,5	24,
6L8	1	0,76	0,81	0,75	0,83	0,79	33	39	37	26	34	5,9	6,1	6,2	6,3	6,1	23,6	23,5	24,5	22,5	23,
	2	0,66	0,59	0,75	1,07	0,77	55	23	21	15	29	5,9	6,1	6,2	6,3	6,1	24,2	22,7	23,2	22,2	23,
	3	0,73	1,02	0,47	0,52	0,69	40	23	149	59	68	6,0	6,1	6,3	6,3	6,2	23,3	23,3	24,0	24,5	23,
	4	0,80	0,57	0,66	0,35	0,60	53	33	42	139	67	6,0	6,2	6,3	6,3	6,2	22,8	27,5	22,5	23,5	24,
	5	0,70	0,99	0,73	0,61	0,76	55	67	32	53	52	6,1	6,2	6,3	6,3	6,2	24,0	23,0	24,0	24,4	23,
6Q1	1	0,81	0,68	0,30	0,70	0,62	32	29	29	42	33	6,6	6,4	6,1	6,2	6,3	26,5	26,0	24,5	27,0	26,
	2	0,95	0,75	0,88	0,66	0,81	33	53	30	41	39	6,6	6,4	6,1	6,3	6,4	24,5	26,5	24,5	29,0	26,
	3	0,74	0,66	0,89	0,70	0,75	51	28	33	33	36	6,5	6,0	6,2	6,2	6,2	26,0	27,5	24,5	26,0	26,
	4	0,80	0,73	0,73	0,73	0,75	46	30	36	24	34	6,5	6,1	6,2	6,3	6,3	26,5	26,0	27,0	25,0	26,
	5	0,98	0,56	0,82	0,52	0,72	36	46	42	58	46	6,4	6,1	6,2	6,3	6,3	26,5	26,5	29,0	27,0	27,

APPENDIX 17 (continued) S.A.R., CONDUCTIVITY, pH AND SATURATION PERCENTAGE FOR SUBSOILS

TRIAL NO.	TREAT -MENT	S.A.R. me/l					CONDUCTIVITY mS/m 25°C					pH $CaCl_2$					SATURATION PERCENTAGE				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	1,28	1,17	1,41	1,31	1,29	109	106	119	132	117	6,0	6,2	6,4	6,4	6,3	27,0	28,0	32,0	3,0	29,3
	2	1,33	1,34	1,42	1,14	1,31	158	165	152	145	155	6,1	6,2	6,4	6,4	6,3	29,5	28,0	31,5	32,0	30,3
	3	1,20	1,32	1,32	1,17	1,25	92	165	125	185	142	6,2	6,2	6,4	6,4	6,3	28,5	28,0	31,5	29,5	29,4
	4	1,19	1,16	1,23	1,40	1,25	32	145	224	165	167	6,1	6,3	6,4	6,4	6,3	29,5	29,5	32,0	30,0	30,3
	5	1,04	1,24	1,37	1,31	1,24	61	231	264	231	197	6,1	6,3	6,4	6,4	6,3	28,5	29,0	30,0	30,0	29,4
3M11	1	1,79	1,54	2,26	1,59	1,79	251	231	330	198	253	6,6	6,6	6,7	6,7	6,7	28,0	28,5	33,0	31,4	30,2
	2	1,60	1,75	1,70	1,28	1,58	135	462	257	211	266	6,7	6,5	6,8	6,9	6,7	28,0	30,0	31,0	31,0	30,0
	3	1,53	1,88	1,46	1,78	1,66	191	409	116	132	212	6,6	6,4	6,7	6,9	6,7	26,0	30,5	33,0	30,8	30,1
	4	1,68	1,20	1,95	1,17	1,50	297	198	277	165	234	6,6	6,6	6,7	6,8	6,7	28,0	30,5	30,0	31,6	30,0
	5	1,35	1,78	1,91	2,10	1,79	257	330	257	277	280	6,8	6,6	6,6	6,9	6,7	28,5	29,8	31,6	30,3	30,1
OSBLOK	1	1,16	1,36	1,39	1,81	1,43	46	46	61	43	49	5,5	5,7	5,7	5,6	5,6	24,9	26,1	26,2	24,0	25,3
	2	1,31	1,19	0,89	1,53	1,23	53	55	50	43	50	5,5	5,6	5,7	5,8	5,7	25,6	27,0	25,7	24,0	25,6
	3	1,11	0,93	1,32	1,62	1,25	58	53	73	40	56	5,6	5,7	5,8	5,7	5,7	26,0	26,6	24,0	23,0	24,9
	4	0,90	0,96	1,71	1,56	1,28	39	50	73	53	54	5,6	5,7	5,8	5,7	5,7	25,6	26,3	24,0	24,0	25,0
	5	1,15	0,97	1,46	1,61	1,30	46	51	58	46	50	5,6	5,7	5,7	5,6	5,7	27,9	25,6	24,0	24,0	25,4
SKAAP BOLK	1	1,57	2,12	1,63	1,86	1,80	29	22	28	26	26	5,9	5,7	5,7	5,7	5,8	23,0	22,5	23,0	22,5	22,8
	2	3,10	2,04	1,80	2,06	2,25	21	24	27	24	24	6,0	5,5	5,7	5,7	5,7	25,0	22,5	22,5	22,0	23,0
	3	1,46	1,41	1,17	2,02	1,52	55	36	33	21	36	6,0	5,6	5,7	5,7	5,8	24,0	23,0	22,5	22,5	23,0
	4	0,94	1,59	1,78	1,73	1,51	86	28	26	18	40	6,0	5,8	5,6	5,7	5,8	25,0	24,5	22,5	22,5	23,6
	5	2,41	1,49	1,70	1,83	1,86	36	48	29	21	34	5,7	5,8	5,6	5,7	5,7	22,5	23,0	23,5	22,0	22,8

APPENDIX 17 (continued) S.A.R., CONDUCTIVITY, pH AND SATURATION PERCENTAGE FOR SUBSOILS

TRIAL NO.	TREAT -MENT	S.A.R. me/l					CONDUCTIVITY mS/m 25°C					pH $CaCl_2$					SATURATION PERCENTAGE				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	1,56	1,83	1,58	1,83	1,70	30	23	17	24	24	5,6	7,1	6,8	6,6	6,5	24,0	25,5	27,7	27,0	26,1
	2	1,89	1,59	1,42	1,74	1,51	26	30	25	16	24	5,8	6,9	6,7	6,6	6,5	24,0	26,0	27,2	27,0	26,1
	3	1,23	1,67	1,69	1,31	1,48	32	25	29	25	28	5,8	6,9	6,7	6,6	6,5	24,0	26,9	27,0	27,7	26,4
	4	1,49	1,67	1,58	1,96	1,68	29	24	19	17	22	5,7	6,8	6,7	6,6	6,5	24,0	26,0	26,6	27,1	25,9
	5	2,26	1,31	1,52	2,06	1,79	23	26	20	18	22	7,2	6,8	6,6	6,5	6,8	26,3	26,8	27,0	27,8	26,9
24D10	1	0,70	0,91	1,06	1,96	1,16	95	172	165	158	148	6,0	7,2	6,9	6,8	6,7	24,0	24,7	24,5	24,5	24,4
	2	0,95	0,72	1,06	1,45	1,05	139	125	162	165	148	6,1	7,1	6,9	6,8	6,7	25,0	25,0	23,5	25,5	24,8
	3	0,88	0,95	0,92	1,27	1,01	178	88	106	106	120	6,1	7,0	6,9	6,8	6,7	24,0	24,5	25,5	25,5	24,6
	4	1,04	0,98	1,02	1,21	1,06	175	142	122	45	121	6,2	7,0	6,9	6,8	6,7	24,0	24,5	24,5	25,5	24,6
	5	1,12	0,84	1,12	1,81	1,22	224	48	172	125	142	7,2	6,9	6,8	6,7	6,9	24,0	24,0	24,5	25,0	24,4
5C5	1	0,93	0,81	0,96	2,12	1,21	43	75	73	178	92	6,0	6,2	6,3	6,6	6,3	25,2	25,4	26,8	25,1	25,6
	2	0,78	0,78	0,61	2,72	1,22	50	62	99	231	111	6,1	6,2	6,5	6,5	6,3	24,6	25,0	24,1	24,8	24,9
	3	0,73	0,85	0,54	0,98	0,78	38	99	78	158	93	6,1	6,2	6,5	6,5	6,3	26,0	25,1	25,3	22,0	24,6
	4	0,79	0,82	1,54	1,20	1,09	28	81	132	132	93	6,2	6,3	6,5	6,6	6,4	25,4	25,0	25,2	25,2	25,2
	5	0,63	0,83	0,65	1,23	0,84	52	73	87	158	93	6,1	6,3	6,5	6,6	6,4	24,0	25,7	25,3	23,2	24,6

APPENDIX 18 CATION CONTENTS OF LEAVES (me/100g)

TRIAL NO.	TREAT -MENT	Na^+					K^+					Ca^{++}					Mg^{++}				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	13,05	16,51	9,77	7,01	11,59	29,95	25,73	25,48	34,01	28,79	299,52	300,21	233,52	297,56	262,70	128,36	154,39	93,41	95,22	117,85
	2	14,98	10,98	12,94	9,96	12,22	30,39	25,84	25,88	34,66	29,19	230,09	233,96	301,98	346,55	275.65	108,53	100,35	103,54	116,96	107,35
	3	9,67	8,64	10,75	7,35	9,10	28,79	32,91	29,51	33,62	31,21	217,99	226,28	236,05	226,95	226,82	92,13	92,16	105,38	92,04	95,43
	4	12,22	9,42	7,11	7,18	8,98	25,28	25,12	38,79	33,77	30,74	219,06	221,90	301,67	232,19	243,71	92,26	92,11	96,54	88,23	92,29
	5	8,99	7,22	9,88	6,76	8,21	29,95	38,24	25,23	32,77	31,55	213,95	233,71	231,27	208,93	221,97	87,29	99,01	92,51	91,76	92,64
1R1	1	3,16	3,20	2,76	3,96	3,27	42,17	51,27	42,39	41,73	44,39	210,82	183,71	182,29	212,81	197,41	88,13	73,48	81,82	85,12	82,14
	2	2,80	2,58	2,71	3,21	2,83	43,11	38,65	33,30	38,56	38,41	176,74	158,88	166,52	222,77	181,23	78,89	58,83	71,61	78,40	71,93
	3	2,96	2,73	3,20	3,38	3,07	42,26	42,83	42,61	38,01	41,43	88,75	166,00	183,24	211,16	162,29	74,80	62,86	77,99	79,40	73,76
	4	3,20	2,57	2,78	3,16	2,93	42,60	42,76	38,46	42,15	41,49	200,24	162,50	299,16	252,88	228,70	77,97	60,30	73,51	83,87	73,91
	5	2,97	2,58	2,71	2,96	2,81	50,97	38,65	41,69	33,88	41,30	203,90	158,90	175,10	190,58	182,12	73,06	58,83	65,45	72,84	67,55
2A5	1	5,18	4,50	4,72	3,57	4,49	17,26	12,87	17,15	20,98	17,07	198,46	171,58	814,58	197,25	345,47	81,11	69,49	137,19	74,28	90,52
	2	4,70	3,61	4,68	4,08	4,27	21,38	17,00	21,27	17,18	19,21	188,12	170,00	182,91	180,42	180,36	78,24	68,85	71,04	76,03	73,54
	3	3,86	3,85	4,08	4,07	3,97	17,15	17,12	17,16	17,13	17,14	158,62	179,78	210,21	899,20	361,95	69,45	67,20	80,65	137.02	88,58
	4	3,99	4,68	4,28	3,79	4,19	25,21	17,01	21,41	21,07	21,18	193,28	170,10	192,68	189,59	186,41	74,38	71,02	78,36	85,95	77,43
	5	4,08	3,87	4,48	4,90	4,33	25,78	34,39	21,33	21,31	25,70	171,86	180,56	191,98	554,00	274,60	71,75	67,49	80,20	97,59	79,26
3K9	1	2,29	1,86	2,10	2,07	2,08	58,24	66,27	58,87	62,22	61,40	137,29	136,69	164,00	161,77	149,94	40,77	36,45	45,42	51,02	43,42
	2	2,04	1,89	2,50	2,49	2,23	57,14	67,19	58,35	58,12	60,20	126,53	146,97	162,55	170,22	151,57	35,51	46,61	39,59	46,08	41,95
	3	1,87	1,88	2,09	2,51	2,09	66,58	66,93	58,54	58,51	62,64	124,83	133,85	150,53	183,90	148,28	35,37	43,50	42,33	55,59	44,17
	4	2,09	1,88	2,29	2,11	2,09	58,51	66,70	62,37	67,67	63,83	138,06	150,08	166,31	160,72	153,79	42,26	43,36	41,99	42,72	42,58
	5	1,81	2,11	2,30	2,27	2,12	64,52	58,95	66,87	57,86	62,05	129,04	160,00	162,99	173,59	156,41	40,73	40,00	46,39	45,88	43,25

APPENDIX 18 (continued) CATION CONTENTS OF LEAVES (me/100g)

TRIAL NO.	TREAT -MENT	Na^+					K^+					Ca^{++}					Mg^{++}				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	7,89	8,82	7,76	9,45	8,48	34,11	33,60	37,75	37,80	35,82	255,81	294,01	226,50	231,01	251,83	93,37	91,98	78,86	74,34	84,64
	2	6,81	7,22	7,60	7,01	7,16	42,55	38,20	37,98	34,00	38,18	234,02	254,70	253,20	229,52	242,86	95,31	77,68	74,69	73,11	80,20
	3	5,71	6,00	7,06	5,28	6,01	42,28	47,15	42,76	46,51	44,68	465,13	231,49	213,82	215,62	281,52	96,83	73,73	69,28	68,49	77,08
	4	4,62	4,78	7,53	4,23	5,29	46,33	45,68	41,84	46,49	45,06	546,31	211,78	221,78	228,23	302,03	89,93	67,27	74,06	70,58	75,46
	5	6,48	7,17	4,02	4,86	5,63	46,00	42,20	46,53	42,24	44,24	878,09	219,43	194,59	232,30	381,10	125,44	68,36	66,41	64,62	81,21
4C5	1	9,19	8,79	8,52	7,61	8,53	17,10	17,15	17,04	25,35	19,16	209,47	210,10	208,75	202,81	207,78	99,61	101,62	99,26	92,53	98,26
	2	6,40	7,66	7,48	6,81	7,09	25,59	21,29	20,77	29,78	24,36	204,69	204,35	207,72	221,24	209,50	89,12	91,10	93,06	93,18	91,62
	3	6,66	8,18	6,15	6,86	6,96	24,98	30,14	25,45	24,95	26,38	183,15	228,17	207,83	207,90	206,76	84,92	98,59	84,40	86,90	91,20
	4	7,40	5,99	6,13	5,52	6,26	34,83	25,67	33,84	21,22	26,26	213,34	205,39	211,51	186,71	204,24	93,17	87,29	84,18	72,99	84,41
	5	7,23	5,96	6,18	7,68	6,76	34,00	34,03	30,92	34,12	33,27	195,52	195,70	211,32	204,70	201,81	82,03	79,98	94,32	82,30	84,66
6L8	1	7,46	7,47	8,53	6,36	7,46	34,09	33,21	34,12	41,05	35,62	200,27	220,01	208,97	201,17	207,61	73,29	78,04	75,49	61,17	72,00
	2	7.61	6,06	6,43	7,74	6,96	33,84	37,62	33,20	38,71	35,84	215,72	200,63	211,63	227,94	213,98	79,52	69,80	73,45	76,12	74,72
	3	4,68	5,92	4,22	7,53	5,59	46,81	42,28	42,23	41,86	43,30	195,74	194,48	190,05	213,48	198,44	56,60	70,60	56,17	69,90	63,32
	4	3,98	6,92	5,66	4,59	5,29	50,31	24,42	40,44	41,77	39,24	192,87	215,73	181,99	200,50	197,77	78,41	78,56	58,64	57,23	68,21
	5	4,63	4,81	5,36	5,30	5,03	50,51	41,81	32,96	33,89	39,79	210,46	217,42	189,52	199,12	204,13	62,72	63,97	61,38	63,12	62,80
6Q1	1	6,32	6,61	6,35	4,25	5,88	33,73	42,67	38,09	38,26	38,19	206,58	183,48	190,47	187,07	191,90	81,37	71,26	86,35	84,61	80,90
	2	5,90	6,73	6,59	4,25	5,87	37,90	42,05	42,53	42,50	41,25	202,13	180,81	195,64	297,51	219,02	79,17	79,05	91,02	93,08	85,58
	3	6,29	6,33	5,95	3,78	5,59	37,75	37,94	38,26	42,05	39,00	192,96	193,89	225,32	222,86	208,76	78,86	74,61	82,05	74,43	77,49
	4	5,30	6,96	5,78	5,23	5,82	38,16	37,97	42,80	41,82	40,19	195,06	202,51	196,89	200,73	198,80	72,93	86,07	82,61	87,40	82,25
	5	5,33	5,96	5,97	4,62	5,47	34,14	42,58	38,39	41,98	39,27	196,31	195,85	170,64	214,07	194,22	78,10	71,10	78,07	89,83	79,28

APPENDIX 18 (continued) CATION CONTENTS OF LEAVES (me/100g)

TRIAL NO.	TREAT -MENT	Na^+					K^+					Ca^{++}					Mg^{++}				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	3,14	2,92	2,50	2,55	2,78	51,04	54,27	50,93	54,18	52,61	168,81	154,20	192,03	195,21	177,56	65,56	58,76	71,60	68,75	66,22
	2	3,20	2,78	2,54	2,76	2,82	47,97	59,18	55,19	59,95	55,57	171,88	179,84	181,77	195,29	182,20	68,75	73,65	72,71	73,02	72,02
	3	2,87	2,12	2,52	2,75	2,57	40.94	58,76	59,30	55,06	53,52	147,38	156,71	142,78	194,83	160,43	62,64	66,49	54,59	68,61	63,08
	4	6,33	2,91	2,54	2,51	3,57	42,20	54,26	45,96	124,91	67,01	164,58	204,02	181,78	179,68	182,52	64,57	67,45	70,60	63,93	66,64
	5	2,77	2,09	2,73	2,29	2,47	51,21	50,46	50,05	50,12	50,46	179,25	179,61	180,81	179,36	179,76	71,27	63,91	68,12	65,49	67,20
3M11	1	4,90	4,90	6,99	4,68	5,36	29,83	34,06	25,44	29,78	29,77	213,09	255,42	254,35	212,71	233,89	71,17	80,03	84,36	77,85	78,35
	2	4,50	4,01	7,06	6,31	5,47	29,99	29,55	29,06	21,05	27,41	257,07	211,06	290,55	210,46	242,29	73,69	74,72	86,75	77,03	78,05
	3	6,54	7,79	5,99	5,62	6,49	29,52	25,27	29,95	33,30	29,51	295,17	210,56	299,51	332,96	284,55	77,16	88,01	85,15	89,07	84,85
	4	4,61	4,72	4,22	3,96	4,38	33,53	24,62	25,30	33,35	29,20	251,50	246,24	210,85	250,14	239,68	76,71	75,10	72,53	73,79	74,53
	5	5,72	5,06	4,78	10,40	6,49	33,87	35,32	24,92	33,98	29,52	254,04	253,24	249,25	216,62	243,26	74,94	77,24	78,07	86,65	79,23
OS-BLOK	1	7,59	5,39	8,81	4,62	6,60	29,52	38,81	20,97	33,62	30,73	210,85	194,04	192,92	168,09	191,48	79,28	74,17	80,94	68,08	75,62
	2	6,53	8,30	4,85	4,65	6,08	33,68	25,52	37,98	42,26	34,86	176,83	199,94	194,13	177,51	187,10	70,31	88,91	72,59	74,81	76,66
	3	12,76	6,59	6,11	5,43	7,72	21,27	29,74	29,49	33,39	28,48	216,92	182,83	185,36	179,46	191,14	86,77	75,26	74,57	71,78	77,10
	4	6,00	5,05	4,00	5,06	5,03	38,57	37,86	37,86	33,73	37,01	201,41	180,80	176,68	189,70	187,17	71,56	68,15	83,71	72,51	73,98
	5	10,66	10,44	4,40	3,96	7,36	25,59	25,56	31,97	35,59	29,68	187,67	204,45	167,82	170,05	182,50	82,32	66,89	62,73	62,09	73,51
SKAAP BLOK	1	13,92	8,39	2,76	3,98	7,11	17,13	23,98	25,46	33,50	25,02	218,42	191,86	152,77	180,07	185,78	99,79	83,54	68,75	67,84	79,98
	2	11,48	4,66	5,22	5,91	6,82	17,00	21,16	25,07	33,75	24,25	195,54	182,01	158,75	244,70	195,25	88,84	72,80	80,63	86,07	82,09
	3	5,32	5,28	5,71	3,77	5,02	34,03	21,12	21,13	41,90	29,55	216,92	185,85	169,07	192,72	191,14	84,64	81,52	74,81	69,97	77,74
	4	8,43	6,13	5,28	6,15	6,50	25,30	16,91	29,57	25,45	24,31	210,82	181,84	181,66	220,55	198,72	94,45	84,12	81,54	86,52	86,66
	5	3,97	4,13	8,58	3,60	5,07	43,69	33,07	25,11	33,90	33,94	214,47	177,75	209,29	194,92	199,11	76,65	71,10	93,76	64,83	76,59

APPENDIX 18 (continued)

CATION CONTENTS OF LEAVES (me/100g)

TRIAL NO.	TREAT -MENT	Na^+					K^+					Ca^{++}					Mg^{++}				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	4,97	6,12	6,10	4,69	5,47	41,45	37,99	42,09	51,14	43,17	182,37	219,50	757,54	255,72	353,78	77,92	88,22	126,26	95,47	96,97
	2	5,30	4,65	7,08	4,44	5,37	42,40	42,23	41,63	42,27	42,13	203,51	202,70	183,19	190,21	194,90	90,73	84,04	84,93	86,23	86,48
	3	5,33	5,05	5,47	5,35	5,30	41,01	37,89	42,09	41,16	40,54	196,86	757,85	336,72	197,58	372,26	83,67	88,42	92,18	81,91	86,55
	4	5,28	6,42	5,91	5,25	5,72	42,28	42.82	54,84	46,17	46,53	207,16	385,40	210,93	180,47	245,99	84,13	98,49	88,17	85,62	89,10
	5	5,29	5,09	5,63	4,09	5,03	42,29	46,69	40,18	43,10	43,07	207,20	212,22	602,75	189,65	302,96	86,26	97,20	100,46	90,08	93,50
24D1	1	4,53	4,64	4,33	4,13	4,41	28,84	33,72	41,23	33,06	34,21	218,33	181,23	202,01	206,63	202,05	61,38	54,79	66,79	66,95	62,48
	2	3,39	2,78	3,84	4,45	3,62	33,88	34,23	42,65	33,81	36,16	186,35	171,17	853,10	232,84	360,87	47,01	49,21	93,41	61,39	62,76
	3	3,38	3,77	4,42	3,73	3,83	33,84	39,65	32,11	33,18	34,70	169,20	214,12	281,01	228,13	223,12	46,95	60,67	73,46	71,34	63,11
	4	5,88	5,49	3,72	3,54	4,66	33,58	38,02	37,15	37,45	36,55	209,89	211,22	193,99	216,39	207,87	74,30	70,55	63,15	60,34	67,09
	5	4,33	3,97	5,93	4,52	4,69	37,10	33,45	36,82	34,42	35,45	177,24	192,31	192,28	258,13	204,99	54,82	65,64	66,28	62,38	62,28
5C5	1	6,33	6,92	7,37	7,54	7,04	17,46	17,31	17,34	21,54	18,41	231,30	216,38	212,46	258,50	229,66	104,74	96,94	97,12	100,39	99,80
	2	7,23	8,28	6,66	8,46	7,66	25,52	12,74	17,18	21,70	19,28	340,32	255,10	386,60	234,37	296,60	114,86	123,17	87,63	95,05	105,18
	3	9,07	8,21	6,02	5,56	7,22	12,95	17,28	25,80	25,65	20,42	224,52	233,34	215,04	226,58	224,87	112,26	98,95	80,85	82,51	93,64
	4	6,51	6,70	6,05	8,14	6,85	17,35	17,28	25,92	21,41	20,49	225,59	228,98	228,99	231,26	228,71	108,46	100,67	88,14	107,06	101,08
	5	6,24	7,08	5,55	6,44	6,33	17,23	21,44	25,64	16,62	20,23	233,94	218,68	209,38	216,11	217,03	98,62	91,76	75,63	95,17	90,30

APPENDIX 19 NUTRIENT CONTENTS OF LEAVES (%) AVERAGE OF 4 REPLICATES

TRIAL NO.	TREAT -MENT	Na^{+}%	K^{+}%	Ca^{++}%	Mg^{++}%	P%	S=SO4%	N%
1B2	1	0,27	1,12	5,65	1,14	0,30	0,38	4,66
	2	0,28	1,14	5,51	1,29	0,31	0,38	4,95
	3	0,21	1,22	4,84	1,15	0,29	0,41	4,75
	4	0,21	1,19	4,87	1,11	0,29	0,46	4,80
	5	0,19	1,23	4,44	1,11	0,29	0,37	4,68
1R1	1	0,08	1,73	3,95	0,99	0,31	0,43	5,25
	2	0,07	1,50	3,63	0,86	0,30	0,37	5,02
	3	0,07	1,62	3,25	0,89	0,30	0,37	5,22
	4	0,07	1,62	4,57	0,89	0,28	0,40	5,03
	5	0,07	1,61	3,64	0,81	0,29	0,39	4,89
2A5	1	0,10	0,67	6,91	1,09	0,29	0,41	4,10
	2	0,10	0,75	3,61	0,88	0,28	0,35	4,44
	3	0,09	0,67	7,24	1,06	0,28	0,36	4,18
	4	0,10	0,83	3,74	0,93	0,28	0,34	4,44
	5	0,10	1,00	5,49	0,95	0,29	0,36	4,54
3K9	1	0,05	2,39	3,00	0,52	0,48	0,20	4,08
	2	0,05	2,35	3,03	0,50	0,45	0,21	4,09
	3	0,05	2,44	2,97	0,53	0,50	0,22	4,09
	4	0,05	2,49	3,08	0,51	0,47	0,22	4,29
	5	0,05	2,42	3,13	0,52	0,51	0,23	4,22

APPENDIX 19 (continued) NUTRIENT CONTENTS OF LEAVES (%) AVERAGE OF 4 REPLICATES

TRIAL NO.	TREAT -MENT	Na^+%	K^+%	Ca^{++}%	Mg^{++}%	P%	S=SO4%	N%
4B4	1	0,20	1,40	5,04	1,02	0,34	0,51	4,56
	2	0,17	1,49	4,86	0,96	0,35	0,52	4,60
	3	0,14	1,74	5,63	0,93	0,35	0,51	4,55
	4	0,12	1,76	6,04	0,91	0,34	0,47	4,67
	5	0,13	1,73	7,62	0,98	0,34	0,46	4,17
4C5	1	0,20	0,75	4,16	1,18	0,29	0,28	4,73
	2	0,16	0,95	4,19	1,10	0,26	0,29	4,72
	3	0,16	1,03	4,14	1,09	0,28	0,29	5,03
	4	0,14	1,02	4,09	1,01	0,28	0,33	4,96
	5	0,16	1,30	4,04	1,02	0,27	0,31	5,05
6L8	1	0,17	1,40	4,15	0,86	0,27	0,29	5,12
	2	0,16	1,40	4,28	0,90	0,27	0,29	5,10
	3	0,13	1,69	3,67	0,76	0,27	0,28	5,22
	4	0,12	1,53	3,76	0,82	0,29	0,33	5,17
	5	0,12	1,55	4,08	0,75	0,28	0,31	5,02
6Q1	1	0,14	1,49	3,84	0,97	0,28	0,29	4,92
	2	0,14	1,61	4,38	1,03	0,28	0,29	4,89
	3	0,13	1,52	4,18	0,93	0,27	0,28	4,84
	4	0,13	1,57	3,98	0,99	0,28	0,31	4,79
	5	0,13	1,53	3,88	0,95	0,28	0,30	4,93

APPENDIX 19 (continued) NUTRIENT CONTENTS OF LEAVES (%) AVERAGE OF 4 REPLICATES

TRIAL NO.	TREAT -MENT	Na^+%	K^+%	Ca^{++}%	Mg^{++}%	P%	S=SO4%	N%
7Q1	1	0,06	2,05	3,55	0,79	0,30	0,28	5,39
	2	0,07	2,17	3,64	0,86	0,29	0,28	4,97
	3	0,06	2,09	3,21	0,76	0,31	0,28	5,16
	4	0,08	2,61	3,65	0,80	0,28	0,28	5,07
	5	0,06	1,97	3,60	0,81	0,31	0,28	5,16
3M11	1	0,12	1,16	4,68	0,94	0,32	0,46	4,73
	2	0,13	1,07	4,85	0,94	0,30	0,43	4,42
	3	0,15	1,15	5,69	1,02	0,31	0,46	4,47
	4	0,10	1,14	4,79	0,89	0,33	0,46	4,45
	5	0,15	1,15	4,87	0,95	0,31	0,46	4,39
OSBLOK	1	0,15	1,20	3,83	0,91	0,37	0,42	3,88
	2	0,14	1,36	3,74	0,92	0,36	0,40	4,17
	3	0,18	1,11	3,82	0,93	0,37	0,39	4,04
	4	0,12	1,44	3,74	0,89	0,41	0,46	4,17
	5	0,17	1,16	3,65	0,88	0,37	0,39	4,18
SKAAP BLOK	1	0,16	0,98	3,72	0,96	0,29	0,40	4,05
	2	0,16	0,95	3,91	0,99	0,29	0,45	3,95
	3	0,12	1,15	3,82	0,93	0,35	0,42	4,16
	4	0,15	0,95	3,97	1,04	0,31	0,40	4,07
	5	0,12	1,32	3,98	0,92	0,31	0,46	4,01

APPENDIX 19 (continued) NUTRIENT CONTENTS OF LEAVES (%) AVERAGE OF 4 REPLICATES

TRIAL NO.	TREAT -MENT	Na^+%	K^+%	Ca^{++}%	Mg^{++}%	P%	S=SO4%	N%
4Q4	1	0,13	1,68	7,08	1,16	0,22	0,39	3,92
	2	0,12	1,64	3,99	1,04	0,23	0,39	3,74
	3	0,12	1,58	7,45	1,04	0,22	0,41	3,82
	4	0,13	1,82	4,92	1,07	0,25	0,39	3,89
	5	0,12	1,68	6,06	1,12	0,24	0,43	3,89
24D10	1	0,10	1,33	4,04	0,75	0,31	0,40	5,03
	2	0,08	1,41	7,22	0,75	0,33	0,34	4,97
	3	0,09	1,35	4,46	0,76	0,32	0,37	4,87
	4	0,11	1,43	4,16	0,81	0,31	0,43	4,63
	5	0,11	1,38	4,10	0,75	0,31	0,38	5,09
5C5	1	0,16	0,72	4,59	1,20	0,33	0,30	4,10
	2	0,18	0,75	5,93	1,26	0,34	0,33	4,14
	3	0,17	0,80	4,50	1,12	0,33	0,34	4,07
	4	0,16	0,80	4,57	1,21	0,32	0,33	3,99
	5	0,15	0,79	4,34	1,08	0,32	0,32	4,28

APPENDIX 20 PHOSPHATE AND SULPHUR CONTENTS OF LEAVES (me/100g)

TRIAL NO.	TREAT -MENT	P (mg/kg)					SO4$^{=}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	3102,95	3224,70	2819,73	2952,82	3052,05	81,30	72,05	80,67	85,87	79,97
	2	3198,01	3139,85	3112,03	3009,21	3114,78	68,59	76,66	87,14	87,50	79,97
	3	3045,53	2826,54	3088,95	2887,39	2962,10	69,10	90,51	94,42	89,94	85,99
	4	2845,93	2604,79	3585,88	2626,36	2915,74	82,57	72,85	94,81	87,81	84,51
	5	2841,79	3211,26	2712,29	2704,98	2867,58	71,89	102,83	709,89	55,71	77,58
1R1	1	3250,93	3212,34	2847,76	3121,62	3108,16	94,45	86,30	75,46	91,80	89,50
	2	2731,30	2884,49	2748,91	3499,19	2965,97	68,11	74,71	74,10	89,11	76,51
	3	2725,94	2906,15	3090,39	3223,78	2986,57	80,29	57,67	78,41	94,60	77,74
	4	2764,45	2921,55	2707,82	2943,87	2829,92	91,17	74,41	74,36	90,19	82,53
	5	3064,25	2606,22	2864,28	3184,46	2929,80	88,35	65,28	74,21	94,87	80,68
2A5	1	2964,13	3028,86	2863,59	2851,24	2926,96	87,15	62,63	98,61	89,81	84,55
	2	2627,28	2757,55	3133,42	2984,00	2800,56	64,99	67,15	80,82	74,74	71,93
	3	2699,83	2777,41	2783,51	2811,00	2767,94	58,30	62,49	91,80	89,06	75,41
	4	2726,28	2921,51	2974,39	2572,93	2798,78	89,92	55,28	86,49	54,77	71,62
	5	2886,14	3265,29	2816,00	2439,82	2852,06	72,12	53,31	88,74	83,53	74,43
3K9	1	4382,48	5296,16	4365,62	4987,02	4757,83	33,28	36,45	52,14	45,63	41,88
	2	4206,26	4808,15	4454,20	4373,52	4460,53	38,37	43,67	45,84	49,82	44,43
	3	4923,29	6066,80	4309,18	4562,42	4965,42	32,46	41,41	50,18	58,51	45,64
	4	3640,83	5330,41	4840,12	5004,28	4703,91	33,47	50,03	45,75	50,75	45,00
	5	5386,74	4596,22	5988,60	4574,78	5136,59	36,29	48,00	54,33	51,25	47,47

APPENDIX 20 (continued) PHOSPHATE AND SULPHUR CONTENTS OF LEAVES (me/100g)

TRIAL NO.	TREAT -MENT	P (mg/Kg)					SO4$^{=}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	3254,57	3526,88	3746,22	3126,15	3413,46	105,73	99,12	116,61	101,65	105,78
	2	3312,93	3629,23	3704,60	3471,66	3529,61	110,63	107.82	117,32	95,21	107,75
	3	3453,73	3730,49	3394,98	3453,28	3508,12	104,86	113,17	108,62	97,24	105,97
	4	3175,83	3486,81	3449,76	3484,49	3399,22	89,93	100,49	96,24	107,35	98,50
	5	3351,47	3253,50	3261,48	3740,01	3401,62	96,17	94,52	93,06	102,21	96,49
4C5	1	3132,80	2798,46	2813.05	2822,22	2891,63	55,57	60,03	62,20	57,46	58,82
	2	2441,41	2697,34	2587,06	2695,73	2592,89	57,99	48,53	67,30	68,93	60,69
	3	2621,46	3236,99	2671,11	2745,51	2818,77	47,45	65,44	68,71	58,21	59,95
	4	3390,06	2711,05	2825,45	2186,48	2778,26	59,21	65,04	80,37	68,74	68,34
	5	2790,32	2711,74	2577,07	2718,19	2699,33	59,51	57,86	72,16	67,38	64,23
6L8	1	2651,01	2709,38	2816,03	2616,82	2698,31	62,21	65,59	52,88	59,94	60,16
	2	2792,94	2600,34	2470,78	2905,50	2692,39	64,29	67,71	45,65	65,37	60,76
	3	2955,99	3049,81	2708,02	2508,31	2805,53	59,57	61,73	52,37	61,11	58,70
	4	3488,67	2330,35	2871,12	2726,27	2854,10	74,63	64,31	56,62	60,99	64,14
	5	3438,03	3095,93	2421,65	2231,49	2796,78	68,19	67,73	57,68	59,31	63,23
6Q1	1	2606,81	2670,97	3053,31	2726,17	2764,32	99,50	81,07	85,50	78,23	86,08
	2	2635,89	2680,23	2938,17	2757,68	2764,24	92,64	84,94	80,81	77,35	83,94
	3	2673,80	2783,23	2450,18	2888,83	2699,01	92,29	99,48	83,33	74,85	87,49
	4	2994,16	2657,05	2662,92	2873,06	2796,80	102,62	94,04	83,89	72,77	88,33
	5	2850,53	2648,81	2654,07	2883,78	2759,30	100,72	91,11	81,05	73,04	86,48

APPENDIX 20 (continued) PHOSPHATE AND SULPHUR CONTENTS OF LEAVES

TRIAL NO.	TREAT -MENT	P (mg/Kg)					SO4$^{=}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	2622,23	3435,88	3075,11	3028,93	3040,54	65,95	47,51	47,58	73,84	58,72
	2	2441,07	3203,29	2710,60	3240,81	2898,94	55,96	71,94	41,43	64,53	58,47
	3	2531,41	3184,56	3558,21	3184,71	3114,72	42,85	55,06	54,59	77,93	57,61
	4	2786,46	2638,06	3065,70	2759,13	2812,34	43,89	67,45	64,26	61,01	59,15
	5	3746,48	3029,14	2856,68	2706,49	3084,70	67,43	45,95	61,39	60,90	58,92
3M11	1	3090,64	3152,17	3300,65	3344,92	3222,10	86,09	110,68	97,50	91,04	96,33
	2	3009,04	3286,82	2819,94	2699,01	2953,70	81,41	99,62	95,47	82,50	89,75
	3	3041,76	2812,72	3266,21	3161,19	3070,47	92,77	99,38	100,98	89,07	95,55
	4	3551,72	2882,21	3283,39	3405,15	3280,62	106,47	104,24	90,24	84,21	96,29
	5	3102,78	3189,74	3201,57	3031,53	3131,41	111,78	90,32	93,02	88,35	95,87
OSBLOK	1	4152,52	3225,70	3361,45	3945,66	3671,33	90,24	89,69	82,20	87,41	87,39
	2	3310,41	3474,59	3608,19	3839,27	3558,12	46,31	78,27	113,95	94,67	83,30
	3	4285,71	3278,10	3633,91	3568,19	3691,48	83,36	64,63	94,37	81,80	81,04
	4	3336,60	4174,96	4078,16	4633,80	4055,88	89,13	96,76	101,80	96,96	96,16
	5	3646,66	3576,60	3812,78	3683,07	3679,78	64,83	71,56	103,89	88,59	82,22
SKAAP BLOK	1	1994,31	3203,76	2542,92	3676,24	2854,31	51,39	85,54	90,81	108,88	84,16
	2	2595,89	3021,05	2901,97	3091,74	2902,66	67,16	85,50	81,88	138,88	93,23
	3	2792,21	3143,69	3178,19	4765,33	3469,86	71,85	102,22	64,25	113,12	87,76
	4	2639,32	2953,76	3160,53	3820,44	3143,51	66,62	54,98	111,53	102,64	83,94
	5	2652,88	3187,13	2795,84	3849,14	3121,25	91,35	81,02	66,14	141,53	95,01

APPENDIX 20 (continued) PHOSPHATE AND SULPHUR CONTENTS OF LEAVES

TRIAL NO.	TREAT -MENT	P (mg/Kg)					$SO4^{=}$ (me/100g)				
		1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	2293,90	1901,14	2040,03	2602,77	2209,46	86,21	80,20	90,06	67,34	80,95
	2	1796,26	2659,45	2351,82	2355,41	2290,74	80,56	70,94	91,59	80,31	80,85
	3	1956,73	2089,06	2216,97	2403,70	2166,62	82,85	43,26	94,28	88,09	84,62
	4	1920,25	2353,56	2737,21	2771,33	2445,59	72,25	65,09	104,62	84,78	81,69
	5	2259,52	2494,90	2039,85	2632,14	2356,60	87,95	80,65	85,99	101,72	89,08
24D10	1	3097,39	3104,74	3241,49	2981,12	3106,19	75,80	90,19	69,26	66,95	82,30
	2	3184,46	3495,36	3353,79	3183,22	3304,21	68,61	67,61	78,48	71,12	71,46
	3	3293,62	3299,23	3095,03	3007,90	3173,95	73,60	91,20	71,46	72,17	77,11
	4	2819,99	3063,43	3119,24	3208,39	3052,74	89,83	109,83	71,82	84,06	88,89
	5	3177,90	3047,76	3044,92	3267,60	3134,55	75,84	89,47	68,73	79,16	78,30
5C5	1	3281,53	3666,82	3773,21	2400,92	3280,62	66,34	53,66	56,37	69,80	61,54
	2	3474,70	3793,28	3033,09	3114,34	3353,85	80,83	52,67	72,16	70,31	68,99
	3	3460,72	3331,52	3036,77	3296,02	3281,26	63,04	79,51	69,67	67,55	69,94
	4	3162,67	3133,09	3265,18	3138,83	3149,83	63,34	68,26	79,50	67,66	69,69
	5	3320,29	3371,47	3000,90	2934,55	3156,80	60,29	78,90	69,22	56,22	66,23

APPENDIX 21 NITROGEN CONTENT OF LEAVES (%N)

TRIAL NO.	TREAT -MENT	1	2	3	4	AVE	TRIAL NO.	TREAT -MENT	1	2	3	4	AVE
1B2	1	4,91	4,92	4,26	4,53	4,66	4B4	1	4,54	4,50	4,50	4,68	4,56
	2	5,12	4,64	5,10	4,95	4,95		2	4,50	4,49	4,90	4,50	4,60
	3	4,90	4,73	4,86	4,49	4,75		3	4,58	4,60	4,33	4,67	4,55
	4	4,80	4,30	5,52	4,58	4,80		4	4,75	4,66	4,46	4,81	4,67
	5	4,74	4,74	4,58	4,64	4,68		5	4,62	4,89	4,11	4,85	4,62
1R1	1	5,34	5,38	5,01	5,26	5,25	4C5	1	4,91	4,43	4,49	5,08	4,73
	2	5,22	5,01	4,84	5,01	5,02		2	4,89	4,52	4,89	4,57	4,72
	3	4,86	5,02	5,36	5,43	5,22		3	4,98	5,31	4,81	5,03	5,03
	4	5,15	4,68	4,81	5,49	5,03		4	5,50	4,85	4,85	4,64	4,96
	5	5,13	5,01	5,06	4,37	4,89		5	4,88	5,04	5,00	5,26	5,05
2A5	1	4,10	4,32	3,93	4,03	4,10	6L8	1	4,86	5,32	5,28	5,03	5,12
	2	4,35	4,23	4,41	4,76	4,44		2	5,02	5,06	5,09	5,21	5,10
	3	4,19	4,51	4,05	3,95	4,18		3	5,42	5,21	5,23	5,02	5,22
	4	4,34	4,79	4,09	4,53	4,44		4	5,01	5,15	5,32	5,20	5,17
	5	4,56	4,96	4,13	4,49	4,54		5	5,24	4,99	5,00	4,85	5,02
3K9	1	4,21	4,01	4,17	3,94	4,08	6Q1	1	4,93	5,04	4,86	4,86	4,92
	2	3,88	4,21	4,16	4,09	4,09		2	5,26	4,78	4,93	4,58	4,89
	3	3,81	4,10	4,17	4,28	4,09		3	4,95	4,72	5,08	4,60	4,84
	4	4,11	4,30	4,33	4,40	4,29		4	5,03	4,59	4,91	4,62	4,79
	5	4,42	3,95	4,27	4,23	4,22		5	4,82	5,21	5,02	4,68	4,93

APPENDIX 21 (continued) NITROGEN CONTENT OF LEAVES (%N)

TRIAL NO.	TREAT -MENT						TRIAL NO.	TREAT -MENT					
		1	2	3	4	AVE			1	2	3	4	AVE
7Q1	1	5,08	5,77	5,21	5,48	5,39	4Q4	1	4,25	3,40	3,81	4,23	3,92
	2	4,65	5,17	5,34	4,71	4,97		2	3,95	3,98	3,33	3,68	3,74
	3	4,64	5,16	5,65	5,18	5,16		3	3,61	3,47	3,78	4,41	3,82
	4	4,63	5,10	5,39	5,16	5,07		4	3,63	4,08	3,76	4,10	3,89
	5	4,89	5,10	5,37	5,29	5,16		5	3,82	4,17	3,65	3,90	3,89
3M11	1	4,18	4,37	5,91	4,46	4,73	24S10	1	4,93	5,02	5,23	4,94	5,03
	2	4,51	4,37	4,26	4,54	4,42		2	4,92	5,15	4,86	4,94	4,97
	3	4,54	4,47	4,29	4,57	4,47		3	5,16	4,99	4,83	4,51	4,87
	4	4,39	4,41	4,42	4,58	4,45		4	4,88	4,77	4,59	4,29	4,63
	5	4,20	4,65	4,19	4,53	4,39		5	5,35	5,08	4,89	5,02	5,09
OSBLOK	1	3,79	4,14	3,77	3,81	3,88	5C5	1	4,01	4,08	4,23	4,09	4,10
	2	4,20	4,24	4,18	4,06	4,17		2	4,09	3,83	4,04	4,59	4,14
	3	3,91	4,52	3,72	4,00	4,04		3	3,73	3,94	4,09	4,52	4,07
	4	4,84	4,04	3,96	3,83	4,17		4	3,91	3,95	4,26	3,83	3,99
	5	4,10	4,39	4,10	4,14	4,18		5	3,97	4,07	4,23	4,84	4,28
SKAAP BLOK	1	3,90	4,55	4,15	3,61	4,05							
	2	3,97	4,22	3,57	4,03	3,95							
	3	4,30	4,10	4,14	4,11	4,16							
	4	4,08	4,13	3,87	4,20	4,07							
	5	4,17	3,75	4,41	3,69	4,01							

APPENDIX 22

MICRONUTRIENT CONTENT OF LEAVES (mg/Kg)

TRIAL NO.	TREAT -MENT	Mn^{++}					Fe^{++}					Cu^{++}					Zn^{++}				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
1B2	1	91,99	109,36	106,15	87,14	98,66	85,58	111,51	63,69	125,10	96,47	23,53	21,44	16,98	21,25	20,80	25.46	33,02	21.87	19,34	24,92
	2	108,53	135,67	126,19	102,88	118,32	91,17	86,14	101,38	101,80	95,12	21,71	21,54	21,57	23,83	22,16	26,48	23,26	26,33	19,71	23,94
	3	102,83	110,06	114,86	86,16	103,48	115,16	82,28	105,34	84,05	96,72	20,57	20,57	21,08	23,12	21,34	26,32	22,22	23,18	19,75	22,87
	4	90,57	95,25	115,28	96,04	99,29	92,68	98,39	86,19	113,95	97,80	21,06	23,03	21,55	14,78	20,16	29,49	20,93	24,35	21,11	23,97
	5	85,58	106,23	105,12	104,06	100,35	89,86	110,48	84,10	69,64	88,52	23,52	27,62	14,72	14,34	20,05	24,60	25,71	23,55	21,10	18,47
1R1	1	198,18	311,87	131,42	139,79	195,31	99,09	93,99	84,79	87,63	91,38	16,87	25,63	19,08	16,69	19,57	29,94	25,85	21,83	19,19	24,20
	2	185,36	253,34	162,36	129,59	182,66	94,84	94,47	79,10	89,96	89,59	23,71	23.62	16,65	10,71	18,67	22,85	19,75	18,94	22,06	20,90
	3	160,59	213,09	158,74	141,48	168,48	88,75	87,83	93,75	92,91	90,81	19,02	20,88	19,18	16,89	18,99	20,71	22,38	23,01	22,38	22,12
	4	225,81	132,56	155,99	194,93	177,32	100,12	76,97	85,45	80,08	85,66	21,30	17,10	14,96	18,97	18,08	21,30	22,45	20,51	25,08	22,34
	5	219,82	154,60	187,61	108,00	167,51	135,93	85,89	79,21	80,47	101,91	23,36	17,18	18,76	16,94	19,06	19,54	21,47	20,43	24,78	21,56
2A5	1	80,90	80,43	73,95	70,30	76,40	81,97	100,80	115,76	109,12	101,91	12,94	19,30	21,44	12,59	16.57	21,79	26,17	27,01	20,57	23,89
	2	75,89	75,44	75,50	71,95	74,94	100,47	89,25	110,60	100,95	100,32	17,10	19,12	19,14	25,77	20,28	20,95	23,37	23,82	24,27	23,10
	3	65,38	78,12	78,29	73,86	73,91	85,74	115,57	107,25	107,05	103,90	17,15	14,98	15,01	14,99	15,53	23,58	22,69	22,09	26,55	23,73
	4	82,98	73,35	85,64	76,89	79,72	88,24	85,05	100,62	12,64	71,64	12,61	17,01	27,83	10,53	17,00	20,17	22,96	20,55	28,65	23,08
	5	74,11	80,61	77,86	71,38	75,99	85,93	101,03	110,92	93,75	97,91	23,63	17,20	21,33	12,78	18,74	22,77	24,07	24,96	26,85	24,66
3K9	1	71,76	56,95	64,13	61,18	63,51	70,72	70,42	71,49	74,66	71,82	14,56	10,36	14,72	14,52	13,54	19,55	19,88	25,65	18,87	20,99
	2	51,02	68,24	54,18	59,16	58,15	61,22	67,19	70,85	70,85	67,53	12,24	14,70	18,76	14,53	15,06	16,33	22,26	21,05	19,10	19,69
	3	63,45	50,19	61,68	83,59	64,73	66,58	87,84	79,45	83,59	79,37	12,48	18,82	14,64	12,54	14,62	18,52	22,16	22,58	20,90	21,04
	4	48,11	56,28	118,50	115,25	84,54	62,76	79,21	70,68	76,13	53,16	12,55	16,68	14,55	23,26	16,76	18,62	22,09	22,45	21,78	21,24
	5	109,89	70,53	65,82	67,16	78,35	68,55	71,58	71,05	70,26	70,36	12,10	14,74	18,81	14,47	15,03	20,16	24,21	21,94	21,70	22,00

APPENDIX 22 (continued) MICRONUTRIENT CONTENT OF LEAVES (mg/Kg)

TRIAL NO.	TREAT-MENT	Mn^{++}					Fe^{++}					Cu^{++}					Zn^{++}				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4B4	1	150,69	135,46	163,58	140,71	147,51	136,43	92,40	88,08	71,40	97,08	10,66	18,90	25,17	12,60	16,83	18,97	20,58	20,13	16,80	19,12
	2	144,67	126,29	109,72	153,01	133,42	68,08	80,65	80,18	89,26	79,54	19,15	19,10	21,10	12,75	18,03	15,53	18,46	20,68	17,43	18,03
	3	123,68	109,31	137,91	171,23	135,53	71,88	85,74	76,97	88,79	80,85	19,03	15,00	23,52	19,03	19,15	18,18	18,65	19,46	17,76	18,51
	4	191,21	154,68	126,58	213,44	171,48	109,26	74,74	98,33	67,62	87,49	14,71	22,84	14,65	12,68	16,22	21,01	20,76	17,16	16,91	18,96
	5	111,85	109,72	224,20	138,53	146,08	79,45	84,40	80,37	80,25	81,12	16,73	21,10	14,81	19,01	17,91	18,19	17,30	17,34	18,16	17,75
4C5	1	78,02	84,68	99,05	64,44	81,55	68,70	72,89	80,94	67,60	72,46	19,24	21,44	23,43	19,01	20,78	30,35	33,02	34,51	30,00	31,97
	2	101,28	91,53	136,27	96,79	106,47	76,76	59,60	70,63	76,58	75,92	21,32	19,16	18,70	21,27	20,11	28,57	29,37	33,24	31,06	30,56
	3	87,41	115,16	102,85	83,16	97,15	66,60	81,80	72,10	83,16	75,92	16,65	19,37	19,09	27,03	20,54	31,64	38,75	32,23	30,35	33,24
	4	113,20	114,46	109,98	73,20	102,71	121,91	658,95	80,37	55,16	229,10	21,77	17,12	21,15	23,24	20,85	30,48	41,93	31,73	24,30	39,67
	5	87,13	91,47	108,24	73,56	90,10	89,26	68,07	87,62	76,76	80,43	21,25	17,02	23,19	19,19	20,16	28,48	31,48	34,53	33,69	32,05
6L8	1	55,39	81,99	62,91	72,87	68,29	110,97	78,87	72,50	73,90	84,06	17,04	14,53	21,32	14,37	16,82	27,27	25,32	20,90	27,10	25,15
	2	62,39	101,36	49,80	72,04	71,40	109,97	98,22	70,54	94,62	93,34	19,03	20,90	16,60	21,50	19,51	28,34	29,26	21,79	24,73	26,03
	3	60,64	70,82	62,29	63,83	64,40	100,00	124,72	92,91	71,16	97,20	21,28	19,03	19,00	14,65	18,49	28,09	27,48	22,39	25,53	25,87
	4	61,84	68,18	57,63	69,97	64,41	104,81	89,55	95,04	71,01	90,11	23,06	18,32	18,20	14,62	18,55	30,61	23,00	22,24	23,39	24,81
	5	72,61	74,21	49,44	52,96	62,31	124,17	83,62	86,52	99,56	98,47	23,15	20,91	18,54	16,95	19,89	32,41	23,62	23,07	21,28	25,07
6Q1	1	205,53	499,24	222,21	119,04	261,51	139,13	140,81	143,91	114,70	134,66	23,19	19,20	16,93	14,88	18,55	22,77	18,56	19,89	19,56	20,20
	2	130,54	353,22	186,07	121,13	197,74	117,91	138,76	144,60	119,00	130,07	29,48	21,02	19,14	17,00	21,66	23,58	17,66	21,27	22,31	21,21
	3	156,26	223,40	366,68	117,74	216,02	134,23	124,34	136,04	134,56	132,29	16,78	25,29	21,66	29,43	23,29	21,60	21,08	23,38	26,07	23,03
	4	309,55	189,86	278,22	93,05	217,67	125,09	135,01	162,65	142,16	141,24	19,08	18,99	17,12	18,82	18,50	23,96	21,20	19,69	20,07	21,21
	5	142,97	425,76	314,62	142,72	256,52	136,57	136,24	136,51	146,91	139,06	19,02	17,03	23,46	16,79	19,12	23,90	22,35	19,62	20,99	21,72

APPENDIX 22 (continued) MICRONUTRIENT CONTENT OF LEAVES (mg/Kg)

TRIAL NO.	TREAT -MENT	Mn^{++}					Fe^{++}					Cu^{++}					Zn^{++}				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
7Q1	1	57,91	85,44	76,18	77,45	74,25	92,26	75,02	79,32	89,12	83,93	15,70	22,92	20,87	23,34	20,71	25,91	34,17	23,65	32,25	31,75
	2	58,96	84,57	70,81	79,60	73,49	83,94	89,92	84,55	84,91	85,83	51,96	21,41	23,25	19,10	28,93	27,98	31,69	35,51	28,44	30,90
	3	55,27	84,71	68,24	96,36	76,15	69,60	84,71	98,68	93,18	86,54	20,47	19,06	23,10	14,82	19,36	26,61	30,92	34,85	30,92	27,91
	4	74,90	75,99	102,52	87,75	85,29	118,16	79,11	164,87	91,93	113,52	18,99	18,74	25,36	18,80	20,47	22,79	30,40	31,71	26,74	27,91
	5	57,61	74,14	97,76	96,98	81,62	89,62	75,18	138,76	91,77	98,83	23,47	20,89	21,02	20,86	21,56	38,41	31,75	28,17	27,11	31,36
3M11	1	75,65	73,43	98,56	84,02	82,92	125,72	125,58	99,62	106,36	114,32	19,18	19,16	21,20	19,24	19,67	19,60	21,29	24,37	23,40	22,17
	2	87,83	83,37	96,50	84,18	87,97	130,38	124,53	122,44	84,18	115,38	27,85	16,89	22,83	21,05	22,16	20,14	23,22	26,98	21,68	23,01
	3	82,28	100,01	87,71	78,04	87,26	113,85	92,65	126,22	122,78	113,88	25,30	16,84	21,39	22,89	21,61	30,36	24,64	24,60	27,05	26,66
	4	101,65	96,18	105,42	82,34	96,40	197,01	160,06	109,64	122,98	147,42	23,05	20,52	18,98	25,01	21,89	23,05	21,55	22,14	21,89	22,16
	5	100,56	84,41	98,62	91,32	93,73	194,76	124,51	122,50	106,18	136,99	23,29	21,10	20,76	16,99	20,54	25,19	23,85	22,84	23,79	23,92
OS-BLOK	1	195,03	220,99	117,43	127,12	165,14	84,34	90,55	98,56	88,25	90,43	21,08	21,56	18,87	21,01	20,63	29,10	28,46	26,42	27,31	27,82
	2	153,68	186,11	257,44	131,02	182,06	71,58	76,57	118,17	109,89	94,05	21,05	23,40	21,10	21,13	21,67	25,68	28,08	26,59	25,57	26,48
	3	81,87	155,19	160,08	108,51	126,41	106,33	93,54	105,52	98,08	100,82	23,39	25,51	23,17	25,04	24,28	31,05	26,36	29,91	23,58	27,73
	4	151,05	146,20	151,44	107,50	139,05	107,13	88,35	113,58	105,39	103,61	23,57	16,83	25,24	25,29	22,73	28,28	26,50	30,71	30,77	29,07
	5	129,03	113,94	153,84	107,77	126,15	109,19	89,45	93,90	431,07	180,90	29,59	19,17	17,98	23,73	21,62	40,95	30,67	24,77	30,06	31,61
SKAAP BLOK	1	57,82	131,10	149,59	119,35	114,47	706,67	103,92	106,09	104,69	255,34	25,70	19,99	16,97	16,75	19,85	30,84	22,38	19,94	22,61	23,94
	2	45,70	118,52	108,62	100,20	93,26	85,02	114,28	116,97	113,91	107,55	23,38	25,40	16,71	21,09	16,37	20,83	23,91	24,86	30,38	24,99
	3	58,48	98,20	83,48	104,74	86,23	119,09	109,82	88,76	104,74	105,60	123,34	16,90	16,91	23,04	45,05	21,90	22,39	21,35	30,58	24,06
	4	56,92	86,69	120,41	77,40	85,36	105,41	80,35	114,07	110,27	102,53	21,08	16,91	16,90	21,21	19,03	22,35	21,36	25,14	26,72	23,89
	5	120,14	100,24	101,50	102,75	106,16	93,34	111,61	87,90	110,17	100,76	23,83	16,54	20,93	23,31	21,15	29,39	20,26	21,98	26,70	24,58

APPENDIX 22 (continued)

MICRONUTRIENT CONTENT OF LEAVES (mg/Kg)

TRIAL NO.	TREAT -MENT	Mn^{++}					Fe^{++}					Cu^{++}					Zn^{++}				
		1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE	1	2	3	4	AVE
4Q4	1	151,29	96,03	93,64	124,66	116,41	91,19	92,87	124,15	55,41	90,91	16,58	12,66	10,52	14,92	13,67	22,80	23,85	23,57	25,79	24,00
	2	152,63	107,68	197,76	96,16	138,56	76,32	114,02	126,98	63,40	95,18	14,48	21,11	8,23	12,68	14,24	20,35	25,13	25,40	25,15	24,01
	3	258,38	112,62	90,49	139,95	150,36	73,82	113,68	67,34	74,09	82,23	10,25	10,53	16,84	14,41	13,01	21,53	20,63	23,15	21,20	21,63
	4	100,41	103,84	138,37	83,94	106,64	71,87	81,36	84,37	71,35	77,24	14,80	12,85	12,66	10,49	12,70	19,45	22,70	32,48	21,19	23,96
	5	109,94	98,69	93,43	92,67	98,68	80,34	106,11	60,27	64,65	77,84	14,80	21,22	10,05	15,09	15,29	21,35	26,74	23,51	20,69	23,07
24D10	1	99,89	97,99	110,28	112,61	105,19	90.63	84,29	82,45	82,65	85,01	14,42	14,75	18,55	14,46	15,55	24,92	24,66	22,26	20,66	23,13
	2	98,47	99,50	103,44	123,83	106,31	88,94	85,59	85,31	71,97	82,95	14,82	10,70	10,19	16,93	13,16	22,23	23,11	19,62	24,77	22,43
	3	146,99	157,61	146,52	75,70	131,71	99,41	79,39	84,30	82,95	86,49	14,81	13,88	16,06	14,52	14,82	24,32	24,19	20,07	22,40	22,75
	4	147,97	223,89	93,90	73,86	134,91	88,15	99,27	74,29	191,42	113,28	14,69	14,79	14,45	16,65	15,15	23,09	24,77	21,88	20,81	22,89
	5	140,14	124,38	109,44	151,65	131,40	103,05	75,25	69,55	86,04	83,47	18,55	22,99	10,23	10,76	15,63	25,56	21,53	24,75	24,31	24,04
5C5	1	216,03	155,79	136,58	199,27	176,92	82,92	73,57	73,71	222,32	113,13	15,27	17,31	26,02	25,85	21,11	24,44	28,13	32,52	44,81	32,48
	2	293,53	126,35	122,42	189,88	183,05	89,34	80,70	68,73	78,12	79,22	19,14	25,48	19,33	15,19	19,79	22,55	31,00	25,56	25,39	26,13
	3	150,04	157,72	176,33	197,72	170,45	73,40	64,82	64,51	85,50	72,06	19,43	15,12	19,35	23,51	19,35	27,63	28,09	25,16	26,08	26,74
	4	197,39	183,62	150,14	187,36	179,63	73,75	69,13	77,77	68,52	72,29	15,18	23,76	21,60	25,70	21,56	24,29	23,33	27,65	27,41	25,67
	5	222,86	201,54	311,93	181,82	229,52	81,82	72,90	85,46	66,49	76,67	21,53	19,30	25,64	24,94	22,85	24,33	31,73	25,00	25,14	26,55

APPENDIX 23 MICRONUTRIENT CONTENT OF LEAVES (mg/kg) AVERAGE OF 4 REPLICATES

TRIAL NO.	TREAT -MENT	Mn^{++}	Fe^{++}	Cu^{++}	Zn^{++}	TRIAL NO.	TREAT -MENT	Mn^{++}	Fe^{++}	Cu^{++}	Zn^{++}
1B2	1	98,66	96,47	20,80	24,92	4B4	1	147,51	97,08	16,83	19,12
	2	118,32	95,12	22,16	23,94		2	133,42	79,54	18,03	18,03
	3	103,48	96,72	21,34	22,87		3	135,53	80,85	19,15	18,51
	4	99,29	97,80	20,16	23,97		4	171,48	87,49	16,22	18,96
	5	100,35	88,52	20,05	18,47		5	146,08	81,12	17,91	17,75
1R1	1	195,32	91,38	19,57	24,20	4C5	1	81,55	72,46	20,78	31,97
	2	182,66	89,59	18,67	20,90		2	106,47	75,92	20,11	30,56
	3	168,48	90,81	18,99	22,12		3	97,15	75,92	20,54	33,24
	4	177,32	85,66	18,08	22,34		4	102,71	229,10	20,85	39,67
	5	167,51	101,91	19,06	21,56		5	90,10	80,43	20,16	32,05
2A5	1	76,40	101,91	16,57	23,89	6L8	1	68,29	84,06	16,82	25,15
	2	74,70	100,32	20,28	23,10		2	71,40	93,34	19,51	26,03
	3	73,41	103,90	15,53	23,73		3	64,40	97,20	18,49	25,87
	4	79,72	71,64	17,00	23,08		4	64,41	90,11	18,55	24,81
	5	75,99	97,91	18,74	24,66		5	62,31	98,47	19,89	25,07
3K9	1	63,51	71,82	13,54	20,99	6Q1	1	261,51	134,66	18,55	20,20
	2	58,15	67,53	15,06	19,69		2	197,74	130.07	21,66	21,21
	3	64,73	79,37	14,62	21,04		3	216,02	132,29	23,29	23,03
	4	84,54	53,16	16,76	21,24		4	217,67	141,24	18,50	21,21
	5	78,35	70,36	15,03	22,00		5	256,52	139,06	19,12	21,72

APPENDIX 23 (continued) MICRONUTRIENT CONTENTS OF LEAVES (mg/Kg) AVERAGE OF 4 REPLICATES

TRIAL NO.	TREAT -MENT	Mn^{++}	Fe^{++}	Cu^{++}	Zn^{++}	TRIAL NO.	TREAT -MENT	Mn^{++}	Fe^{++}	Cu^{++}	Zn^{++}
7Q1	1	74,52	83,93	20,71	31,75	4Q4	1	116,41	90,91	13,67	24,00
	2	73,49	85,83	28,93	30,90		2	138,56	95,18	14,24	24,01
	3	76,15	86,54	19,36	27,91		3	150,36	82,23	13,01	21,63
	4	85,29	379,37	20,47	27,91		4	106,64	77,24	12,70	23,96
	5	81,62	98,83	21,56	31,36		5	98,68	77,84	15,29	23,07
3M11	1	82,92	114,32	19,67	22,17	24D10	1	105,19	85,01	15,55	23,13
	2	87,97	115,38	22,16	23,01		2	106,31	82,95	15,41	22,43
	3	87,26	113,88	21,61	26,66		3	131,71	86,49	14,82	22,75
	4	90,40	147,42	21.89	22,16		4	134,91	113,28	15,15	22,89
	5	93,73	136,99	20,54	23,92		5	131,40	83,47	15,63	24,04
OSBLOK	1	165,14	90,43	20,63	27,82	5C5	1	176,92	113,13	21,11	32,48
	2	182,06	94,05	21,67	26,48		2	183,05	79,22	19,79	26,13
	3	126,41	100,82	24,28	27,73		3	170,45	72,06	19,35	26,74
	4	139,05	103,61	22,73	29,07		4	179,63	72,29	21,56	25,67
	5	126,15	426,59	21,62	31,61		5	229,54	76,67	22,85	26,55
SKAAP BLOK	1	114,47	255,34	19,85	23,94						
	2	93,26	107,55	16,37	24,99						
	3	86,23	105,60	45,05	24,06						
	4	85,36	102,53	19,03	23,89						
	5	106,16	100,76	21,15	24,58						

APPENDIX 24 RATIO OF $\frac{Ca + Mg}{K}$ (me/100g) LEAVES

TRIAL NO.	TREAT -MENT	1	2	3	4	AVE	TRIAL NO.	TREAT -MENT	1	2	3	4	AVE
1B2	1	14,29	17,67	12,83	11,55	14,09	4B4	1	10,24	11,48	8,09	8,08	9.47
	2	11,14	12,55	15,67	13,37	13,18		2	7,74	8,70	8,63	8,90	8,49
	3	10,77	9,68	11,57	9,49	10,38		3	13,29	6,47	6,62	6,11	8,12
	4	12,32	12,50	10,27	9,49	11,15		4	13,76	6,11	7,07	6,43	8,34
	5	10,06	8,70	12,83	9,18	10,19		5	21,82	6,82	5,61	7,03	10,32
1R1	1	7,09	5,02	6,23	7,14	6,37	4C5	1	18,08	18,18	18,08	11,65	16,50
	2	5,93	5,63	7,15	7,81	6,63		2	11,48	13,88	14,48	10,56	12,60
	3	3,87	5,34	6,13	7,64	5,75		3	10,73	10,84	11,48	11,82	11,22
	4	6,53	5,21	9,69	7,99	7,36		4	8,80	11,40	8,74	12,24	10,30
	5	5,43	5,63	5,77	7,78	6,15		5	8,16	8,10	9,88	8,41	8,64
2A5	1	16,20	18,73	55,50	12,94	25,84	6L8	1	8,02	8,98	8,34	6,39	7,93
	2	12,45	14,05	11,94	14,93	13,34		2	8,72	7,19	8,52	7,85	8,09
	3	13,30	14,43	16,95	60,49	26,29		3	5,39	6,27	5,83	6,77	6,07
	4	10,62	14,18	12,76	13,08	12,66		4	5,39	12,05	5,95	6,17	7,39
	5	9,42	7,21	12,76	30,58	14,99		5	5,41	6,73	7,61	7,74	6,87
3K9	1	3,06	2,61	3,56	3,42	3,16	6Q1	1	8,54	5,97	7,27	7,10	7,22
	2	2,84	2,88	3,46	3,72	3,23		2	7,42	6,18	6,74	9,19	7,38
	3	2,41	2,65	3,29	4,09	3,11		3	7,20	7,08	8,03	7,07	7,35
	4	3,08	2,90	3,34	3,01	3,08		4	7,02	7,60	6,53	6,89	7,01
	5	2,63	3,39	3,13	3,79	3,24		5	8,04	6,27	6,48	7,24	7,01

APPENDIX 24 (continued) RATIO OF $\frac{Ca + Mg}{K}$ (me/100g) LEAVES

TRIAL NO.	TREAT -MENT	1	2	3	4	AVE	TRIAL NO.	TREAT -MENT	1	2	3	4	AVE
7Q1	1	4,59	3,93	4,86	5,18	4,64	4Q4	1	6,28	8,10	20,99	6,87	10,56
	2	5,02	4,28	4,61	4,48	4,60		2	6,94	6,79	6,44	6,54	6,68
	3	5,13	3,80	3,33	4,79	4,26		3	6,84	22,34	10,19	6,79	11,54
	4	5,43	4,94	5,49	1,95	4,45		4	6,89	11,30	5,46	5,76	7,35
	5	4,89	4,83	4,97	4,89	4,50		5	6,94	6,63	17,50	6,49	9,39
3M11	1	9,53	9,85	13,31	9,76	10,61	24D10	1	9,70	6,70	6,52	8,28	7,80
	2	11,03	9,67	12,98	13,66	11,84		2	6,89	6,44	22,19	8,69	11,05
	3	12,61	11,82	12,84	12,67	12,49		3	6,39	6,93	11,04	9,03	8,35
	4	9,79	13,05	11,20	9,71	10,94		4	8,46	7,41	6,92	7,39	7,55
	5	9,71	12,05	13,13	8,92	11,20		5	6,26	7,71	7,02	9,31	7,58
OSBLOK	1	9,83	6,91	13,06	7,03	9,21	5C5	1	19,25	18,10	17,85	16,66	17,97
	2	7,34	11,32	7,02	5,97	7,91		2	17,84	27,34	27,60	15,18	21,99
	3	14,28	8,67	8,81	7,52	9,82		3	26,01	19,23	11,47	12,05	17,19
	4	7,08	6,58	6,88	7,77	7,08		4	19,25	19,08	12,24	15,80	16,59
	5	10,55	11,40	7,21	6,52	8,92		5	18,72	14,48	11,12	18,73	15,76
SKAAP BLOK	1	18,58	11,49	8,70	6,59	11,34							
	2	16,73	12,04	9,55	9,80	12,03							
	3	8,86	12,66	11,54	6,27	9,83							
	4	12,07	15,73	8,90	12,07	12,19							
	5	6,66	7,53	12,06	7,66	8,48							

APPENDIX 25 YIELD (Kg/ha) SEED COTTON

TRIAL NO.	TREAT -MENT	1	2	3	4	AVE	TRIAL NO.	TREAT -MENT	1	2	3	4	AVE
1B2	1	3723	3479	2746	3235	3296	6Q1	1	2136	1831	2075	2563	2151
	2	3906	3296	3113	3225	3388		2	2502	1892	2258	1953	2151
	3	3601	3296	3357	3479	3433		3	2319	1892	2685	1953	2212
	4	3357	3296	3662	3052	3342		4	2380	2624	2441	2136	2395
	5	3601	3479	3662	3235	3494		5	2197	2136	2685	2075	2273
4B4	1	3113	3235	2746	2869	2991	OSBLOK	1	3357	3723	4089	3967	3784
	2	2930	2441	3540	2930	2960		2	3174	3113	3967	3418	3418
	3	2807	2991	2807	2624	2807		3	3479	3174	3052	3296	3250
	4	2685	2502	3235	1953	2594		4	3296	2930	3357	2869	3113
	5	3052	2746	2136	3296	2801		5	3967	3418	3723	3113	3555
4C5	1	2869	2563	2258	2685	2594	SKAAP BLOK	1	2624	1831	1770	1343	1892
	2	2624	2869	2746	2258	2624		2	2930	1526	1404	1465	1831
	3	2807	2441	2746	2563	2639		3	2502	2014	1587	977	1770
	4	2869	2624	2624	2624	2685		4	2930	2136	1404	1709	2045
	5	2807	2197	2563	2441	2502		5	2502	1587	2136	854	1770
6L8	1	2869	3296	3174	3052	3098	4Q4	1	1282	2501	2441	2380	2151
	2	3174	2930	3235	2807	3037		2	2075	2685	1038	3723	2380
	3	3113	3418	3235	3174	3235		3	1648	2319	2746	2258	2243
	4	3235	2624	2869	2197	2731		4	1770	2075	1282	3052	2045
	5	3479	3052	3418	2685	3159		5	2197	2075	1709	2746	2182

APPENDIX 25 (continued) YIELD (Kg/ha) SEED COTTON

TRIAL NO.	TREAT -MENT					
		1	2	3	4	AVE
24D10	1	2136	2075	1526	2197	1984
	2	2075	1770	1831	2014	1923
	3	2197	1953	1465	2136	1938
	4	1709	2075	1892	2075	1938
	5	1831	2014	1648	1770	1816
5C5	1	3784	3845	3418	4028	3769
	2	3845	3723	4211	3967	3937
	3	3357	4150	4089	3906	3876
	4	3906	4028	4089	3784	3952
	5	3540	3845	3845	3296	3632

APPENDIX 26

MICRONAIRE VALUE AND FIBRE PERCENTAGE

TRIAL NO.	TREAT -MENT	1st HARVEST MICRONAIRE	2nd HARVEST MICRONAIRE	1st HARVEST FIBRE %	2nd HARVEST FIBRE %	PLOT NO.	TREAT -MENT	1st HARVEST MICRONAIRE	2nd HARVEST MICRONAIRE	1st HARVEST FIBRE %	2nd HARVEST FIBRE %
1B2	1	4,5	2,9	38,2	36,7	6Q1	1	4,8	3,7	38,7	35,2
	2	4,2	3,1	37,9	37,0		2	4,5	3,8	38,6	35,1
	3	3,9	3,2	38,4	37,2		3	4,7	4,0	38,7	35,4
	4	4,1	3,1	37,9	36,7		4	4,5	3,7	37,8	34,9
	5	3,5	3,2	38,2	37,2		5	4,5	4,0	38,5	35,2
4B4	1	3,8	2,7	38,1	36,0	OSBLOK	1	4,2	3,6	36,1	35,9
	2	4,0	2,8	36,5	36,1		2	4,3	3,7	37,2	36,0
	3	3,9	3,1	36,9	35,6		3	4,0	3,7	36,4	35,7
	4	3,7	3,0	37,3	35,6		4	4,2	3,3	36,0	36,0
	5	3,8	2,8	37,4	35,2		5	4,2	3,8	35,8	36,6
4C5	1	3,6	2,5	37,6	36,6	SKAAP BLOK	1	4,2	3,8	37,4	36,6
	2	3,8	2,8	37,2	35,6		2	4,3	3,6	38,3	35,6
	3	3,9	2,7	37,6	36,2		3	4,3	3,7	37,3	35,6
	4	3,9	2,8	37,4	35,3		4	4,6	3,9	38,4	37,2
	5	3,7	2,8	37,9	35,3		5	4,3	3,7	37,7	36,2
6L8	1	2,5	3,4	35,3	36,6	4Q4	1	4,5	3,3	39,7	34,5
	2	2,6	3,5	35,3	36,0		2	4,4	3,4	39,4	35,2
	3	2,8	3,6	35,6	36,4		3	4,4	3,4	38,9	35,0
	4	2,5	3,4	35,2	36,9		4	4,2	3,3	39,5	35,0
	5	2,6	3,4	35,9	36,4		5	4,2	3,2	39,2	35,3

APPENDIX 26 (continued) MICRONAIRE VALUE AND FIBRE PERCENTAGE

TRIAL NO.	TREAT -MENT	1st HARVEST MICRONAIRE	2nd HARVEST MICRONAIRE	1st HARVEST FIBRE %	2nd HARVEST FIBRE %
24D10	1	3,1	2,4	34,6	33,2
	2	3,2	2,4	34,6	33,0
	3	3,1	2,5	34,7	33,1
	4	3,0	2,5	34,5	32,6
	5	2,9	2,6	33,6	32,9
5C5	1	2,8	3,9	36,2	36,7
	2	2,8	3,7	36,3	37,4
	3	2,7	3,8	36,0	36,9
	4	2,7	3,9	36,2	37,0
	5	2,7	3,9	36,5	37,4

APPENDIX 27

RELATIONSHIP BETWEEN LEAF - K CONTENT AND DIFFERENT PARAMETERS FOR GROUPED DATA

GROUPING	PARAMETER		r VALUE
8% Clay in topsoils	E.P.P.	subsoils	0,80966**
(10 experiments)	E.P.P.	topsoils	0,17053*
	Ca+Mg/K	subsoils	-0,52168**
	Ca+Mg/K	topsoils	-0,27352**
	Exch-K	topsoils	0,51143**
	P.A.R.	topsoils	0,39926**
	YIELD		-0,36538*
	NH_4Ac-K	topsoils	0,51976**
	Ca+Mg/K	leaves	-0,63683**
10% Clay in topsoils	E.P.P.	subsoils	0,41827**
(3 experiments)	E.P.P.	topsoils	0,42471**
	Ca+Mg/K	subsoils	-0,28324*
	Ca+Mg/K	topsoils	-0,01259
	Exch-K	topsoils	0,29604*
	P.A.R.	topsoils	0,22369
	YIELD		-0,41056**
	NH_4Ac-K	topsoils	0,31807*
	Ca+Mg/K	leaves	-0,84866**
12-16% Clay topsoils	E.P.P.	subsoils	0,71841**
(2 experiments)	E.P.P.	topsoils	0,71659**
(no yield data)	Ca+Mg/K	subsoils	-0,69492**
	Ca+Mg/K	topsoils	-0,66122**
	Exch-K	topsoils	0,58919**
	P.A.R.	topsoils	0,77173**
	YIELD		-
	NH_4Ac-K	topsoils	0,62786**
	Ca+Mg/K	leaves	-0,72301**
8% Clay in subsoils	E.P.P.	subsoils	0,80852**
(10 experiments)	E.P.P.	topsoils	0,20869**
	Ca+Mg/K	subsoils	-0,51937**
	Ca+Mg/K	topsoils	-0,32986**
	Exch-K	topsoils	0,54202**
	P.A.R.	topsoils	0,35364**
	YIELD		-0,29964**
	NH_4Ac-K	topsoils	0,54890**
	Ca+Mg/K	leaves	-0,64663**

Appendix 27 (continued)....

GROUPING	PARAMETERS		r VALUE
>8% Clay in subsoils (5 experiments)	E.P.P.	subsoils	0,55408**
	E.P.P.	topsoils	0,44228**
	Ca+Mg/K	subsoils	-0,53651**
	Ca+Mg/K	topsoils	-0,30785**
	Exch-K	topsoils	0,51316**
	P.A.R.	topsoils	0,31439**
	YIELD		-0,61549**
	NH_4Ac-K	topsoils	0,53338**
	Ca+Mg/K	leaves	-0,71171**
Ca+Mg/K topsoils >15 (10 experiments)	E.P.P.	subsoils	0,58680**
	E.P.P.	topsoils	0,75682**
	Ca+Mg/K	subsoils	-0,50356**
	Ca+Mg/K	topsoils	-0,39001**
	Exch-K	topsoils	0,46286**
	P.A.R.	topsoils	0,32201**
	YIELD		-0,30649**
	NH_4Ac-K	topsoils	0,47505**
	Ca+Mg/K	leaves	-0,60837**
Ca+Mg/K topsoils <15 (5 experiments)	E.P.P.	subsoils	0,66057**
	E.P.P.	topsoils	0,13966
	Ca+Mg/K	subsoils	-0,71637**
	Ca+Mg/K	topsoils	-0,57304**
	Exch-K	topsoils	0,29108**
	P.A.R.	topsoils	0,43636**
	YIELD		-0,63805**
	NH_4Ac-K	topsoils	0,31823**
	Ca+Mg/K	leaves	-0,80965**
NH_4Ac-K in topsoils < 0,20 me/100g (3 experiments)	E.P.P.	subsoils	0,61968**
	E.P.P.	topsoils	0,68155**
	Ca+Mg/K	subsoils	-0,44157**
	Ca+Mg/K	topsoils	-0,56307**
	Exch-K	topsoils	0,66020**
	P.A.R.	topsoils	0,46676**
	YIELD		-0,30693
	NH_4Ac-K	topsoils	0,66034**
	Ca+Mg/K	leaves	-0,82001**
NH_4Ac-K in topsoils 0,20 - 0,30 me/100g (6 experiments)	E.P.P.	subsoils	0,78055**
	E.P.P.	topsoils	0,50275**
	Ca+Mg/K	subsoils	-0,64931**
	Ca+Mg/K	topsoils	-0,50428**
	Exch-K	topsoils	0,33747**
	P.A.R.	topsoils	0,25854**
	YIELD		-0,08957
	NH_4Ac-K	topsoils	0,35023**
	Ca+Mg/K	leaves	-0,55111**

Appendix 27 (continued)....

GROUPING	PARAMETERS		r VALUE
NH$_4$Ac-K in topsoils 0,30-0,40 me/100g (2 experiments)	E.P.P.	subsoils	0,17912
	E.P.P.	topsoils	-0,12554
	Ca+Mg/K	subsoils	-0,25028
	Ca+Mg/K	topsoils	-0,04438
	Exch-K	topsoils	0,17520
	P.A.R.	topsoils	0,09653
	YIELD		-0,37946*
	NH$_4$Ac-K	topsoils	0,17575
	Ca+Mg/K	leaves	-0,34022*
NH$_4$Ac-K in topsoils >0,40 me/100g (4 experiments)	E.P.P.	subsoils	0,62513**
	E.P.P.	topsoils	0,10550
	Ca+Mg/K	subsoils	-0,70303**
	Ca+Mg/K	topsoils	-0,63324**
	Exch-K	topsoils	0,03616
	P.A.R.	topsoils	0,40290**
	YIELD		-0,34884**
	NH$_4$Ac-K	topsoils	0,08229
	Ca+Mg/K	leaves	-0,79833**
C.E.C. in topsoils 4-5 me/100g (3 experiments)	E.P.P.	subsoils	0,87067**
	E.P.P.	topsoils	0,78413**
	Ca+Mg/K	subsoils	-0,76212**
	Ca+Mg/K	topsoils	-0,88456**
	Exch-K	topsoils	0,81123**
	P.A.R.	topsoils	0,51647**
	YIELD		-0,80684**
	NH$_4$Ac-K	topsoils	0,80719**
	Ca+Mg/K	leaves	-0,83087**
C.E.C. in topsoils 5-6 me/100g (9 experiments)	E.P.P.	subsoils	0,77709**
	E.P.P.	topsoils	0,03083
	Ca+Mg/K	subsoils	-0,42886**
	Ca+Mg/K	topsoils	-0,10531
	Exch-K	topsoils	0,38161**
	P.A.R.	topsoils	0,32548**
	YIELD		-0,08280
	NH$_4$Ac-K	topsoils	0,34936**
	Ca+Mg/K	leaves	-0,59261**
C.E.C. in topsoils > 6 me/100g (3 experiments)	E.P.P.	subsoils	0,59441**
	E.P.P.	topsoils	0,57166**
	Ca+Mg/K	subsoils	-0,54999**
	Ca+Mg/K	topsoils	-0,35559**
	Exch-K	topsoils	0,63609**
	P.A.R.	topsoils	0,32308*
	YIELD		0,15448*
	NH$_4$Ac-K	topsoils	0,66347**
	Ca+Mg/K	leaves	-0,74207**

Appendix 27 (continued)....

GROUPING	PARAMETERS		r VALUE
E.P.P. in topsoils <4 (5 experiments)	E.P.P.	subsoils	0,62862**
	E.P.P.	topsoils	0,69123**
	Ca+Mg/K	subsoils	-0,31599**
	Ca+Mg/K	topsoils	-0,50138**
	Exch-K	topsoils	0,66534**
	P.A.R.	topsoils	0,49446**
	YIELD		-0,14546
	NH_4Ac-K	topsoils	0,67446**
	Ca+Mg/K	leaves	-0,86094**
E.P.P. in topsoils >4 (10 experiments)	E.P.P.	subsoils	0,67504**
	E.P.P.	topsoils	0,18038*
	Ca+Mg/K	subsoils	-0,65502**
	Ca+Mg/K	topsoils	-0,46193**
	Exch-K	topsoils	0,32556**
	P.A.R.	topsoils	0,37908**
	YIELD		-0,34121**
	NH_4Ac-K	topsoils	0,34659**
	Ca+Mg/K	leaves	-0,53764**

APPENDIX 28

RELATIONSHIP BETWEEN YIELD AND DIFFERENT PARAMETERS FOR GROUPED DATA

GROUPING	PARAMETER	r VALUE
8% Clay in topsoils (7 experiments)	E.P.P. subsoils	-0,49527**
	E.P.P. topsoils	-0,34202**
	Ca+Mg/K subsoils	0,55188**
	Ca+Mg/K topsoils	0,65814**
	K - LEAVES	-0,36538**
	Exch-K topsoils	-0,50964**
	P.A.R. topsoils	-0,23516**
	NH_4Ac-K topsoils	-0,49376**
	Ca+Mg/K leaves	0,37526**
10% Clay in topsoils (3 experiments)	E.P.P. subsoils	-0,20599
	E.P.P. topsoils	0,03888
	Ca+Mg/K subsoils	0,33331*
	Ca+Mg/K topsoils	-0,46023**
	K - LEAVES	-0,41056**
	Exch-K topsoils	-0,46816**
	P.A.R. topsoils	0,24497
	NH_4Ac-K topsoils	-0,44460**
	Ca+Mg/K leaves	0,47782**
8% Clay in subsoils (7 experiments)	E.P.P. subsoils	-0,41093**
	E.P.P. topsoils	-0,14582
	Ca+Mg/K subsoils	0,51402**
	Ca+Mg/K topsoils	0,55742**
	K - LEAVES	-0,29964**
	Exch-K topsoils	-0,32099**
	P.A.R. topsoils	0,03959
	NH_4Ac-K topsoils	-0,30269**
	Ca+Mg/K leaves	0,39013**
10% Clay in subsoil (2 experiments)	E.P.P. subsoils	0,00529
	E.P.P. topsoils	0,03361
	Ca+Mg/K subsoils	0,10996
	Ca+Mg/K topsoils	0,05589
	K - LEAVES	-0,06606
	Exch-K topsoils	0,01029
	P.A.R. topsoils	0,10069
	NH_4Ac-K topsoils	0,02047
	Ca+Mg/K leaves	0,04529

Appendix 28 (continued)....

GROUPING	PARAMETERS		r VALUE
0,30 - 0,40 me/100g K in topsoils (3 experiments)	E.P.P.	subsoils	-0,59689**
	E.P.P.	topsoils	-0,43012**
	Ca+Mg/K	subsoils	0,70209**
	Ca+Mg/K	topsoils	0,70090**
	K - LEAVES		-0,45624**
	Exch-K	topsoils	-0,65327**
	P.A.R.	topsoils	-0,56522**
	NH_4Ac-K	topsoils	-0,66055**
	Ca+Mg/K	leaves	0,10864
C.E.C. 4-5 me/100g in topsoils (2 experiments)	E.P.P.	subsoils	-0,74821**
	E.P.P.	topsoils	-0,69843**
	Ca+Mg/K	subsoils	0,66196**
	Ca+Mg/K	topsoils	0,67309**
	K - LEAVES		-0,80686**
	Exch-K	topsoils	-0,70445**
	P.A.R.	topsoils	-0,33409*
	NH_4Ac-K	topsoils	-0,69984**
	Ca+Mg/K	leaves	0,62802**
C.E.C. 5-6 me/100g in topsoils (7 experiments)	E.P.P.	subsoils	-0,37575**
	E.P.P.	topsoils	-0,00159
	Ca+Mg/K	subsoils	0,38670**
	Ca+Mg/K	topsoils	0,40616**
	K - LEAVES		-0,13219
	Exch-K	topsoils	-0,08895
	P.A.R.	topsoils	0,12970
	NH_4Ac-K	topsoils	-0,07984
	Ca+Mg/K	leaves	0,08876
C.E.C. in topsoils > 6 me/100g (1 experiment)	E.P.P.	subsoils	0,05301
	E.P.P.	topsoils	-0,03644
	Ca+Mg/K	subsoils	0,17359
	Ca+Mg/K	topsoils	0,10533
	K - LEAVES		-0,31129
	Exch-K	topsoils	0,00999
	P.A.R.	topsoils	-0,01473
	NH_4Ac-K	topsoils	0,00660
	Ca+Mg/K	leaves	0,13883
E.P.P. < 4 in topsoils (5 experiments)	E.P.P.	subsoils	-0,38376**
	E.P.P.	topsoils	-0,04034
	Ca+Mg/K	subsoils	0,47559**
	Ca+Mg/K	topsoils	0,67230**
	K - LEAVES		-0,14546
	Exch-K	topsoils	0,05456
	P.A.R.	topsoils	0,09750
	NH_4Ac-K	topsoils	0,05409
	Ca+Mg/K	leaves	0,38399**

Appendix 28 (continued)....

GROUPING	PARAMETERS	r VALUES
14% Clay in subsoils (1 experiment)	E.P.P. subsoils	-0,28815
	E.P.P. topsoils	0,17100
	Ca+Mg/K subsoils	0,24495
	Ca+Mg/K topsoils	-0,00067
	K - LEAVES	-0,34884
	Exch-K topsoils	0,16000
	P.A.R. topsoils	0,22685
	NH_4Ac-K topsoils	0,15650
	Ca+Mg/K leaves	0,08610
Ca+Mg/K in topsoils >15 (8 experiments)	E.P.P. subsoils	-0,39206**
	E.P.P. topsoils	-0,12140
	Ca+Mg/K subsoils	0,46393**
	Ca+Mg/K topsoils	0,49223**
	K - LEAVES	-0,30649**
	Exch-K topsoils	0,14010
	P.A.R. topsoils	0,07349
	NH_4Ac-K topsoils	-0,13700
	Ca+Mg/K leaves	0,38437**
Ca+Mg/K in topsoils <15 (2 experiments)	E.P.P. subsoils	-0,77466**
	E.P.P. topsoils	-0,49195**
	Ca+Mg/K subsoils	0,76518**
	Ca+Mg/K topsoils	0,62140**
	K - LEAVES	-0,63805**
	Exch-K topsoils	-0,80601**
	P.A.R. topsoils	-0,43659**
	NH_4Ac-K topsoils	-0,80267**
	Ca+Mg/K leaves	0,40932*
NH_4Ac-K in topsoils < 0,20 me/100g K in topsoils (3 experiments)	E.P.P. subsoils	-0,66481**
	E.P.P. topsoils	-0,07708
	Ca+Mg/K subsoils	0,71925**
	Ca+Mg/K topsoils	0,75602**
	K - LEAVES	-0,30693*
	Exch-K topsoils	0,01301
	P.A.R. topsoils	0,26074*
	NH_4Ac-K topsoils	0,01323
	Ca+Mg/K leaves	0,52333**
0,20 - 0,30 me/100g K in topsoils (4 experiments)	E.P.P. subsoils	-0,29729**
	E.P.P. topsoils	0,02276
	Ca+Mg/K subsoils	0,03808
	Ca+Mg/K topsoils	-0,16801
	K - LEAVES	-0,08957
	Exch-K topsoils	-0,03171
	P.A.R. topsoils	0,09227
	NH_4Ac-K topsoils	-0,00481
	Ca+Mg/K leaves	-0,05758

Appendix 28 (continued)....

GROUPING	PARAMETERS		r VALUE
E.P.P. > 4 in topsoils (5 experiments)	E.P.P.	subsoils	-0,36861**
	E.P.P.	topsoils	-0,36961**
	Ca+Mg/K	subsoils	0,50226**
	Ca+Mg/K	topsoils	0,52654**
	K - LEAVES		-0,34121**
	Exch-K	topsoils	-0,55990**
	P.A.R.	topsoils	-0,42601**
	NH_4Ac-K	topsoils	-0,55314
	Ca+Mg/K	leaves	0,08805