NEW ZEALAND GRASSLAND ASSOCIATION.

TECHNIQUE OF TOPDRESSING EXPERIMENTS.

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Perhaps the most important development in New Zealand Agriculture during the last quarter of a century has been the spectacular increase in pastoral products, Rapid as advancement in this direction has been, it is claimed that the set limit of production for New Zealand's *grass* lands is not yet even in sight, and the potential value of grass as a crop is so far only dimly appreciated. .

Just how far this increase in production has been due to a growing appreciation of the value of artificial fertilisers, and how much is due to other factors such as improved seeds and better management, it would be hard to say; but this much is certain, any future increase in production must be closely associated with the use of ever increasing quantities of artificial fertilisers, The agricultural history of New Zealand is relatively a *short one*, and 'its pioneers found a virgin land,, rich with the accumulated plant food of centuries. Under the drain of a heavy export trade in milk products, meat and wool, the natural food reserves are being quickly expended. Even if production is 'to be maintained only at the present level, the national bill for fertilisers must certainly be increased.

This increasing burden can be very materially lessen -ed by an improved knowledge of the behaviour of the different fertilisers under varying conditions of soil and climate; and when it is realised that by improving the efficiency of a farmer' s topdressing by even 10%, the total production of the topdressing *area* is increased by a like figure, it is evident that the experimentalist can give help of real financial value. The fact that observations *suggest* scope for improvement far in excess of 10% on many farms, serves to emphasise the value

of intensified effort toward still further improvement of experimental technique, If the experimenter is to educate the farmer in the proper use of fertilisers, he too must continue to add to his knowledge, and must strive to attain a still higher standard of cxactitudo in the assessing of manurial responses.

Under the searching probe of modern science, additions aro being made to the known list of possible soil deficiencies. Cobalt and boron have recently been shown to play an unsuspected part in the economy of the plant, and it is probable that dther elements essential for the full and healthy development of plants and grazing livestock may yet be added to the list.

Whatever the future may have' in store however, the role of the Instructor is at present mainly confined to the assessing and measuring of crop responses to added phosphates, lime, potash and nitrogen.

Contrary to the widespread belief of many of the farming community, the chemist can in the meantime promise little further help in the detecting of soil deficiencies. An application of 1 cwt.. of superphosphate per acre will increase the phosphatic content by an infinitesimal percentage which only a plant is capable of detecting, In actual practice it has been found that the most reliable guide to the requirements Of any particular soil is provided by a carefully organised field trial.

The farmer has in the past received much help from the chemist and now another valuable ally has appeared in the pedologist with whose co-operation the laying down of trials and the charting of responses can now be placed on an organised and scientific basis which should lead to a better understanding of results obtained ,and which offers some prospects of ultimately finalising manurial experiments on the recognised soil types.

Types of manurial experiment: Two distinct methods of experimenting have been adopted as standard practice for New Zealand conditions. -

(a) Alternate mowing and grazing experiments.

(b) L.P.K. Trials.

Although both these methods of investigation have yielded much excellent and valuable information, experience has shown that both have certain defects which greatly detract from their value.

Mowing and Grazing Experiments: In experiments of this type two duplicate enclosures are manured to provide a number of replications of each of the treatments under investigation. The herbage from these treatments is mown and weighed periodically, the swards being kept in good condition by alternately grazing them with sheep.

In general) the results obtained from such experiments can be said to be highly conservative, and they are commonly in no way comparable with those obtained in normal farm practice-, Such a trial carried out on the Ruakura Farm showed percentage increases over “no manure” as follows: Lime 11%; Super 5%; super plus lime 15%; Phosphate plus potash 5%; phosphate plus potash plus lime 17%. Yet the results on a field scale on a similar soil type are clearly visible for superphosphate alone.

It seems probable that the explanation of such comparatively small manurial responses lies in the fact that fertility is constantly being transferred by sheep from the manured to the unmanured areas, with the result that the "no manure” plots merely lag slightly behind the manured plots. That the effect of the transferring of herbage is very pronounced, and swift in action, is shown by a trial at present in progress at Ruakura. In this, two area A and B are mown. periodically, the clippings from A being returned and those from B being rejected. Within a few months of the first mowing

plot A was noticeably superior to plot B, the difference amounting to about 25 par, cent. in production.

It may be mentioned that this experiment has now been continued since October in which period the plots have been periodically mown and no recourse has been made to stock grazing, Contrary to traditional belief) the sward of A has not deteriorated under the constant mowing and now compares favourably with that in an adjoining enclosure which has been periodically grazed by sheep without mowing. It has also been noted that the returned herbage quickly decays and the quantity collected by the machine at the next mowing is insig nif i cant. Considering that t he employment of grazing stock makes mowing experiments expensive and difficult to conduct in practice, besides introducing additional complexities in the interpretation of results, skillful advocacy is required to justify the continued retention of this system.

In view of the importance of transferred fertility as affecting the reliability of small scale plot experiments, a somewhat elaborate and comprehensive experiment has recently been evolved and is now in progress at Ruakura. In this, a system of "single-treatment" paddocks surrounds an enclosure containing all the treatments laid out in a series of plots, It is hoped that this will enable the extent of transference of fertility to be accurately measured so that its importance can be properly assessed for future guidance and for the better interpretation of past experimental work.

Ordinary L.P.K. Trials: Whereas the type of trail outlined above can only be used in restricted areas because of the labour and equipment entailed in their operation, the L.P.K. observational trial is ideally suited for general field work under a very wide range of conditions. The general layout, which has been standardised, comprises a series of 10 plots each 25 links by 20 links, and affords comparisons of phosphate plus potash alone, and, in combination, and with and without lime. A control strip 20 links wide, surrounds' the plots

to facilitate comparisons with "No manure".

In the system of pointing at present employed, marks are awarded by visual observation to indicate the differences of the treated plots from "No manure."

0 = No visible difference from "No manure."
? = Doubtful difference from "No manure."
1 = Slight dif ference from "No manure."
2 = Pair difference from "No manure",
3 = Good difference f rom "No manure."
4 = Very good difference from "No manure."
5 = Excellent difference from "No manure."

No specific directions have been laid down and each observer is free to mark according to his own conception of what constitutes A"difference from ' No manure' ". The result over a wide range of districts involving numerous observers who seldom make personal contact, is a wide disparity in the standard of marking practised. A study of a number of reports sent in by different instructors showed that some appeared to attach major importance to clover increase, some to colour and some to stock preferences.

This lack of uniformity may be regarded as a very serious defect, in that it at present affects the authenticity of experimental reports and must greatly retard future progress.

Manurial trials have absorbed the time and energy of instructors since the very early days of Agricultural advisory work. In that period an infinity of trials, many of them needless, have been laid down on practically every cultivated soil type in the Dominion. Much information has been gained by individuals, but it is certain that both the amount of knowledge extracted and that actually recorded and made available would have been considerably greater had all observers used a uniform and systematic method of making and recording their observations.

It may be contended that the only hope of real

progress and of ultimate finality in manurial experimental work lies in the accurate mapping of responses on identified soil types. This implies close co-operation with tho pedologist and a high&y accurate system of marking all visible reactions to applied fertilisers. If needless repetition is to be avoided, the methods employed throughout the country must be uniform, so that all experimental results on similar soil types are scientifically comparable. In addition, the system must be so designed that no significant response is in danger of being overlooked.

Since each experiment should be regarded as one of a comprehensive and carefully organised series, the results should be so recorded as to show in a simple form both the degree and the nature of the responses. Not only is this desirable from an educative point of view, it is vitally important in the summarising and classifying of the final results, so that information obtained can be readily made available to any officer of the Department without the necessity of his digesting a vast amount of irrelevant, sometimes, inacurate, and often useless information.

Properly conducted, an L.P.K. observational trial can become a very formidible competitor of the mowing experiment. It has been found that changes in the composition of the sward may prove a more sensitive barometer than a mere increase in production, and if correctly interpreted they may often be regarded as providing more significant responses. Subterranean clover may be slowly in process of replacement by white clover or fog, and cocksfoot by ryegrass. In a mowing trial these changes are reflected by an increased yield; in an L.P.K. trial they are readily detected by observation. Qualitative changes in a sward are frequently more easily detected by eye than quantitative changes, and moreover they may be accompanied by only slight production changes, which, in a mowing trial, where the emphasis is necessarily quantitative

might wrongly be regarded as of little significance.

It is suggested that in marking a plot, attention should be paid only to reactions which can be actually seen and the value of which can be assessed with some degree of accuracy. It will be found in practice that although much could be written in reporting on a trial, there are five points only which really matter, and if these are adequately dealt with no material response can be overlooked.

The essential points for observation are:

Change in clover content or species.
Change in species other than clover,
Change in vigour of growth.
Change in density,
Indications of preferential grazing by stock.

Although each of these points may serve to indicate a response, they are not equally important, and it is desirable that each should be considered separately and its relative significance properly assessed. The following is suggested as a scale of mximum values:-

Change in clover content or species	10
Change in species other than clovers	10
Change in vigour	10
Change in density	5
Indications of preferential grazing	15.

Change in Clover content: This may properly be regarded as a very valuable and reliable indicator of changes in soil, fertility. Although clover growth is affected also by manage ment factors, they may be discounted as the comparison is made with an adjacent "No manure" plot. It will be found that clovers are particularly sensitive to any deficiency of lime phosphate or potash, and the response to either of these fertilisers is frequently first seen as an increase in clover content or a change in clover species.

It should be noted that any improvement in the species of clover is as important as, an increase of clover, and regardless of whether the result is an improvement in the value of the pasture, it should be marked up., Every response , indicates a corresponding deficiency, and the basic object of the experiment is to indicate deficiencies. Pasture improvement in this sense is quite unimportant.

In view of the importance of clovers as indicators of manurial deficiencies, trials are now being conducted at Ruakura on specially sown pure clover swards, and. it is possible that such trials may play an important part in future investigations.

Change in other species.:, Although in the main possibly more tolerant of soil deficiencies than clovers, the grass components of the sward quickly, reflect any change. in, soil fertility. Over „a period of time , a rise in. the. fertility of a soil carrying a third' rate pasture will be accompanied by a corresponding progressive increase in. the proportions of the better grasses present , and it is frequently possible to judge the fertility of a soil by the sward alone. Similarly, any discontinuity of the manurial programme on a good pasture quickly results in the increase of species responding to descending scales of fertility. Such changes are very clearly visible, and viewed as indicators are often of much greater value than the knowledge of any resulting changes in production.

ChAnge in vigour: On inferior pastures this is frequently a transitional stage between (1) and (2). Although an important factor, its measurement presents some difficulty and is best accomplished by judging the increased height and size of the plants. Vigour is often associated with colour changes, but these are at times very difficult to interpret, and it is doubtful whether they should be taken

into account,

Change in density: This is commonly an important factor as affecting production. X-ii is sometimes very difficult to judge however, as it is often associated with the presence of certain clovers or of inferior grasses, and may be more apparent than real. It should be noted that if the increase in density has been gained purely. by grass at the expense of clover or vice versa, it has been fully accredited under (1) and (2). It is because of these difficulties that this rather important factor has been assessed at only five marks.

Indications of preferential grazing: In studying the probelm presented by preferential grazing, it is often exceedingly hard to distinguish cause from effect, If a plot contains particularly succulent feed, it is quickly singled out and eaten down; at this stage cause and effect are clear. The plot is now kept short; clovers increase because of this preferential grazing" and the effect is continued preferential grazing,

Whether or not mineral content is a contributing factor is a matter of uncertainty? Analysis of manuring trials at Ruakura clearly shows that there may be an appreciable increase in the Ca and P205 contents after these fertilisers have been applied to plots?' provided that the "No manure" plots show marked deficiencies. It is well known that animals are very sensitive to body requirements, and experiments have shown that, given facilities, pigs will balance their own ration, This tendency to balance the diet may well apply to grazing stock, a belief which is reinforced by numerous cases on record in which cows have suffered from a debased appetite resulting from a dcf icioncy of phosphates,

Whatever be the cause , whether lack of minerals or the condition of the sward, it is evident that preferential grazing indicates a response and hence a soil deficiency tc be taken into account,

Again, the fact remains that certain plots may be so eaten down and damaged as to show to extreme disadvantage, and the effect of this severe grazing may under certain conditions result in a permanent handicap. If no points are awarded for preference, a response may be ignored; by giving points this risk of ponalising is to some extent eliminated.

Just what marks should be allocated under this heading it is difficult to determine, but considering that because of selective grazing a plot may be severely marked down in (2) and (3) and (4), I would suggest a maximum of 15 marks, but high marks to be awarded under this heading only after very careful consideration.

It will be noticed that in the system of pointing plots outlined, the relative effects of the fertilisers used are denoted by figures and written description is omitted. In effect, fiva questions are set and marks are awarded according to the answers.

In justification it is claimed:-

a. Figures express a result more accurately *and* more concisely than words.

b. A uniform technique involves a standard basis for marking. This can only be expressed in figures,

c. The final summary of results is more easily prepared from figures than from written statements.

Laying down of trials: A surprisingly high degree of accuracy can be attained and relatively small responses can be detected by an experienced observer working on systematic lines. Much however depends on the site selected for a trial, and many trials have failed through being laid down on an unsuitable sward.

As has been mentioned, qualitative changes are often more apparent than quantitive changes, and this implies that the pasture should be a poor one capable of being improved, so that all manured plots may have a chance to respond by herbag changes in *an* upward direction. If the sward at the

commencement of a trial is good, the time lag for deterioration may be a long one, partly through fertility being transferred in from the field and partly because there is only the one unmanured plot likely to deteriorate. It has been noticed that on mowing and grazing trials, visual changes are often relatively slight and slow, partly because of the fertiliser applied in establishing the pasture, and partly because the mixture sowncommences growth with a full sward of good grasses and clovers. The only possible changes are downwards. 'The ideal site for an observational trial is a third rate pasture originally 'put down with a 'shotgun' mixture; fertility is obviously low and capable of great improvement, and a sufficient *number* of species *are present* to permit of rapid and easily visible changes in the swar'd components.

EXAMPLE OF SUGGESTED SYSTEM OF RECORDING OBSERVATIONS

Field Report on Pasture Topdressing Expt.

Name of Farmer: Experiment No.

Address: Date of Laying Down: 20/8/37

Date of Visit: 9/2/38

Remarks on "No manure": (B/A/W ratio - 20/40/40).

Class of pasture: 4.

Change		Maximum points, clover content 10	Other species 10	vigour 10	density 5	stock preference 5	Total, 40	Total to date 120
Super	A	8	5	5	2	0	20	30
	B	3						
Potash	A	5	4	4	1	0	14	47
Super & potash	B	7	5	5	2	0	19	60
	B	5	3	3	1	0	12	36
Lime	A	3	2	4	2	0	11	14
			2	3		0	9	10
Lime & super	A	8	6	6	2	0	23	33
	A	4	5	9	1	0	13	19
Lime & Potash	A	8	6	5	2	0	21	66
	B	0	0	0	0	0	0	5
Lime & Potash & super	A	9	7	7	3	0	26	77
	B	6	5	5	1	0	17	62

Fields Superintendent's initials: Date:

Signature

SYSTEM AT PRESENT IN USE l?OR RECORDING OBSERVATIONS.

Progress report on pasture topdressing expt.

Name of farmer: Date: Expt. No. 16/

Address: Date of Inspection: 14/1/38

1. General condition of paddock: Grazed by dairy cows, recent showers have freshened up growth especially paspalum growth l-2".

2, Species on "No manure" plot etc.,; Dom. Paspalum, S.D. cocksfoot, much lotus hispidus, Tarweed and moss. Class: poor.

3. Outstanding feature of experiment:

4. Special points:

EFFECT OF LIME AND FERTILIZERS.

Treatment	A	Difference from "No manure." and remarks on nature of differences.	B	
Super	1½	Slight increase clover, growth and density	2.	More marked than in A
Potash	1½	Increase-in clover vigour and density	½	Only slight improvements
sup plus potash	2	Increase clover growth & density	2	As in A.
Lime	2	Similar to super plus pot. more clover than sup.alone	1½	Mot as marked as in A
Lime plus 2 super	2	Sim. to sup. alone	1½	Similar to super alone.
Lime plus potash	2	Similar to lime alone	1½	Similar to lime alone.
Lime plus sup.plus pot.	3	Increase in clover, vigour and density	2½	Not quite as marked as in A,

Approximate date of next report._____

Fields Superintendent's initials: Signature of Instructor

DISCUSSION

E.B. Levy:

Mr. Syme has opened up a very controversial hardy annual. I view very largely the technique of pasture work as a growing child and contributions such as Mr. Syme's are very valuable in adding to the stature of that work. In regard to this discussion which we will throw open, you will bear in mind that Mr. Smallfield's paper dealing with experimental technique also comes up for general discussion in regard to this matter. If I may voice any opinion just on these papers and if I had any criticism to offer it would be along the lines of that transference of fertility by stock and as far as I can see the L.P.K. trials we have conducted and to some extent the mowing and grazing trials give transference of fertility by stock. In any topdressing experiments there are two types of responses, one is what we call primary response which is generally clover response due to the application of phosphate, then there is a secondary response due to the animal eating the clover and depositing its nitrogen on the sward, the effect of which is grass growth rather than clover growth. In L.P.K. trials on third class and not on high fertility country I feel that we regard clover dominance as the major of our responses. It will measure that primary response all right but in not having a grass associate with that clover we will loose only the secondary response of the stock transference of fertility which to my mind, is the accumulated effect of topdressing and very largely the important effect of topdressing.

J.W. Woodcock:

I would like to congratulate Mr. Syme and Mr. Smallfield for their contribution to the subject, particularly because I am interested naturally in both these papers and both Mr. Syme and Mr. Smallfield have shown some of the difficulties which grassland workers are generally called upon to face in trying to assess responses on pasture. Mow our work so far has met with a great deal of criticism by certain people - people who maintain that we should measure response not by means of herbage production but by means of stock, that is to s=y we should take into consideration the actual quality of herbage as well as the quantity of herbage produced. As Mr. Smallfield pointed out yesterday there is really need for experiments in which the livestock products are the final criteria of production, but as he also pointed out those kinds of experiments can only be conducted on State Farms or Agricultural colleges, such as Lincoln and Massey Colleges. If some of you realise what is involved in each of these trials you will also realise that such trials would be impossible in the wide spread manner as with these L.P.K. trials, and I would like to emphasise that these L.P.K. trials have one purpose in view and that is to find the major soil deficiencies throughout the Dominion. We are not particularly concerned with slight differences but we are out to find major differences. We have found that there are major fertiliser responses by means of those L.P.K. plots. We have, for instance, a strip of country round Waihi which responds to potash, the whole of Canterbury responds to lime and Westland responds to limo. We have found that certain areas in the Manawatu respond to potash and so on throughout the whole Dominion. I would like to compliment both these speakers on the papers they have given.

H.E. Annett:

I am naturally interested in this subject, first I would like to congratulate Mr. Syme because he has put in a great deal of thought into that paper, and it is almost unfair to make a few casual observations just now. Mr. Woodcock put the case pretty well and looking through this paper and Mr. Syme's ideas of L.P.K. plots I think that one has expected too much of the powers of observation of the average man you have to observe the plots, There is not one man in a thousand who' can use the scale. You obviously get transference of fertility. There is one observation of clover and Mr. Levy will possibly put me right there. I have sown down No. 1 white clover and my experience of it is that unless it receives really good treatment, until you get highly fertile conditions,, it will not maintain its qualities. It would seem that white clover increases the fertility on those particular pastures. You have got to have very high fertility conditions. When fertility of these pastures was brought up to a high degree you can see most magnificent white clover,

R. McGillivray:

I have been very interested, Mr. Chairman, in Mr. Syme's paper. I do not wish to take up much time but on page 2 he makes reference there to "soil deficiencies". Now I think I do not know actually what is known about soil deficiency affecting the results of experiments but I believe that soil deficiencies alter the results of experiments tremendously: In the Ashburton country we have got a very 'definite soil map for that country and on looking up those different soil types there appears to be a certain place with certain deficiencies, and yet you cannot get some results of experiments laid down on that same soil, You might go for 10 miles on the one type of soil but you do not get the same results from definite experiments laid down on that type of soil, The question of boron deficiency is, I think, quite well known. On the West Coast of the South Island the effect of the application of boron certainly controls brown heart in swedes and turnips, also it has the effect of increasing the value of the fertilisers, We had for a 'time ashes controlling brown hear-i; quite effectively but how it has lost its effect. More, further work requires to be done I think in co-nnection with this matter on the control of brown heart, - this is almost 100 per cent, on the West Coast - and in the fact that the remedying of these soil deficiencies in this increasing the efficiency of the fertiliser.

J.M. Smith:

With reference to the necessity of grazing trials. There are three types of trials outlined by Mr. Smallfield this -morning, the grazing trials , the mowing and grazing trials and L.P.K. observational trials. I have always been a believer in observational trials but my faith has been shaken in the last few years. Mr. Woodcock mentioned that they were planned for a certain reason - to get major responses - but what is the position *where you do not get major responses? In other pap ers emphasis has been made on tine necessity for furthering our topdressing programme. We topdress for certa5.r purposes, to increase production and I feel that the only way to register the results of that work is to register: in production figures. In a district with impoverished soil you get major responses here. It indicates to the farmer that topdressing gives a response and it is payable. In the South responses are very small and you cannot see them at times. There is a

farm in the South where the farmer is using superphosphate and he is increasing his production and yet our L.P.K. plots on his property show no'response at all. The Instructor and the farmer know that manuring is paying.

G.H. Holford:

Mr. Smith has indicated that these plots are likely to plot against the farmer. At one time we had L.P.K.N. plots, nom the 'N' has been dropped. That brings up this question of using clover alone; after all clover is an essential plant. I ask Mr. Smallfield how he is going to get over marking the species, giving 10 to clover-s and 10 to grasses. He has valued the grasses the same as the clovers. How do you reconcile these two facts? I would like to quote from'a paper which I have recently received on work in Germany - "It has been found that by taking cuts even when grazing is simulated by frequent cutting and subsequent rolling no reliable picture can be obtained of the actual performance of the pasture. The only method of making a correct judgment of a pasture and a special form of management is one which employs the grazing animal". I do, however, think that manurial response trials have been of value and also I think they may be continued, perhaps extended but is it possible to do these animal grazing trials which may be of greater value? We know that the animal plays an enormous factor in altering the sward. I think it has been shown that it is possible to measure degrees of difference but not the amount of difference and there are special institutions where you can do these grazing trials and get that factor defined. What are you going to do about standardising the observer?

Mr. Mazengarb:

I enjoyed Mr. Symds paper particularly much and I also feel that the words of the last few speakers have been on very definite lines. My experience has been that as Mr. Smith knows. One sees the cash results and the carrying of additional stock where these L.P.K. trials have shown any response, After all it is not the acid test and I think more concentration could be placed on the grazing trials. It is difficult to tell by observation Just what that particular grazing plot is doing. It is the cash results that the farmer is definitely interested in. I feel sure that the Department is on definite lines.

R.B. Tennent:

It seems to me that the discussion and argument as to the value of L.P.K.'s V. grazing manurial plots -- I want to say right here everybody must immediately realise that any measurement by the grazing animal is superior to eye measurement, I would not like at this Conference to give the impression that L.P.K. plots are of no value. I want to say L.P.K. plots undoubtedly prove wonderful value to the instructional service of the Department in giving advice to farmers. These L.E.K. plots have segregated the major differences in manurial responses and that is all they are intended to do. Also we have not reached the ideal experimental work, but they have in a small way contributed to the information of the instructors and the farming community very valuable material. Mr. Holford quoted from a German bulletin but he did not quote all - "A few experiments cannot however give sufficient reliable answers to questions such as manuring because it is necessary to study such questions on a sufficient number of farms in varying conditions of soil, climate etc." - that is the whole crux of L.P.K. plots because by their mere simplicity we were able to put them on 600 - 700 farms in New Zealand.

W. Alexander :

On page 2 he states "contrary to the widespread belief of many of the farming community, the chemist can in *the meantime promise little further help in* detecting of *soil* deficiencies, " I wonder whether that is quite correct. Is not the chemist not capable of detecting deficiencies? I think the statement condemning the chemist is a little far reaching. If soil analyses means anything at all it should be able to assist in the detection of these outstanding deficiencies and possibly make the L.P.K. trials of a good deal *more* information than they are at present,

R.E.R. Grimmett:

I-think that the Soil Chemist can answer that question, There are major deficiencies. Soil analyses does show major deficiencies in lime, phosphate, potash. You go to those areas and analyses show reasonable content of those elements and yet in actual practice you find very great differences in response. In recent years the position has been rather changed largely through the realisation particularly with regard to phosphate and potash. I would like to mention that Dr. Davies who has recently returned from the Soil Experimental Station in Aberdeen has recently been carrying out some co-operative work with Mr. Woodcock in the Manawatu district on about 20 L.P.K. plots there to see how far the results of soil analyses for available nutrients would go with the points given by the Fields Instructors, So far the analyses have been of soils from the "no manure" plots. and they have used. three different methods the old citric acid method, There is a much more rapid method with acetic extractor that gives just about the same results as the citric acid method, There is another method using a solution that can be combined with a method. of measuring soil fixation. I think it is found that in every- 16 out of 20 the interpretation is similar to actual pointing. Accordingly the main deficiency is shown in the analyses and you get similar results in 16 out of' 20 cases. It remains ve t to be seen how Far the pasture analyses will need to go, but that part of the work. is going to be published in the forthcoming Journal of Science, Although we obvicusly cannot give you as good a result as animal trials it may be a useful adjunct. It is a very rapid method end very simple 3.s you can run off 100 analyses in a few weeks.

P.S. Syme:

Gentlemen, first of all with regard to the degree of accuracy which can be obtained with L.P.K. plots, I would like to suggest that the. degree of accuracy is very much higher than we would suppose. Dr. Annett suggests that a number of experienced farmers judging standing crops showed an accuracy of two to twelve and half per cent I should say they are doing quite well at that but probably they were basing their system on quantity of production. I am perfectly certain if they based their system on changes of sward composition they would get much closer than that. You would say there is no result there. Closer examination might show that bad grasses were being replaced by 'better grasses and poor clovers being replaced by better clovers and that is one of the main objections to weighing experiments. I think in connection with the degree of accuracy and the standardization of observation both of these can be greatly improved. Practice does make one detect differences much more readily. The other point raised - the use of stock in grazing of new trials - I would like to say that it sounds ideal on paper, I myself did think that stock represented the ideal method of finding the value of the fertiliser. I am not so sure of that now. I had two years experience in trying to arrange a sheep grazing trial on a pasture,

There was nothing that we left undone. At the end of the first year we could give no results, and at the end of the second year we could still give no results. That experiment was very difficult to carry out. A similar trial was carried out at Ruakura. In my opinion the only thing that you can ask from a L.P.K. trial is a response. Whatever amount you get of response you have definitely got a soil deficiency. In my opinion all that you put down L.P.K. plots is to find out what is the deficiency in that area or your soil, Whatever the response is, that response must indicate the deficiency. The question with regard to the degree of accuracy in chemical analyses Mr. Grimmett, I think, has answered very well. There is a question I would like to ask Mr. Grimmett, supposing we had two plots, just average farm land, one receives a dressing of 1cwt. super and the other receives no manure. Could he say, a week after take a sample of that soil, tell us or find any difference in analysis as the result of that 1 cwt. superphosphate?

R.E.R. Grimmett:
It would depend on circumstances. You could just possibly pick it. I would not like to say you could not detect the difference from 1cwt. super-phosphate.

P.W. Smallfield:
There are quite a number of questions regarding my advocacy of clover as a measure of fertiliser response. In my paper I definitely indicated that I did not mean at all that the clover responses were the whole story of pasture production. I simply stated that they were a very important part of the responses and that an accurate measure of their production would help us considerably In our investigation of soil deficiencies, I believe that the L.P.K. plots have served a very useful purpose indeed and still will, in defining major deficiencies in the soil, I also believe that livestock experiments are necessary but before livestock experiments are necessary we have got to find out more about the deficiencies and reduce the question that we ask the livestock to tell us, to not more than two treatments. We cannot have a great number of treatments in a livestock experiment. The mowing trials were originally-discountenanced because the swards became clovery and to got over the clovery condition livestock was brought in. My opinion is that the stock and transference of fertility has spoilt these mowing and grazing trials.

Livestock experiments will have to be reduced to a few treatments if they are to be successful. Preliminary work will have to be carried out; if we want to find the effect of potash topdressing we will have to be sure we are using the correct form of phosphate and the necessary amount of lime. If on a soil superphosphate and slag is better than superphosphate and lime in white clover growth, and slag and potash and lime is better than slag and lime, then a clover and mowing experiment will give the necessary preliminary data to plan a grazing trial which could be made a straight-out test between slag and limo and slag, potash and limo.

Also the clover mowing experiments would help the Chemist; he wants actual weights of differences; ha finds it very difficult when we present him with words which merely indicate that superphosphatc and lime is slightly better than superphosphate.