THE HALF FIELD METHOD OF GRASS MANURIAL TRIALS

BY A.H.FLAY, Canterbury Agricultural College, Lincoln.

In practical agriculture it is essential when making investigations and experiments to keep in mind the need of the farser: i.e. - that the investigations and experiments be conducted in such a way that truly sound and reliable results may be secured. If the information given to the farmer is misleading,,i.e., the experiment or investigation fails to obtain the'truth, then the farmer who heeds erroneous instructions must lose accordingly.

The object of this article is to criticise the half field method of conducting manurial trials on grass. The advantages of the method are mentioned, and a scheme suggested to supplement it so that reliable information might be obtained.

This method of conducting grass manurial trials with sheep may be described briefly as follows. A suitable field is divided into two, three, or perhaps four fields. Each subdivision receives a fertiliser or fertilisers which are to be compared with that on the neighbouring subdivision. In the majority of the experiments one half of the field is compared with the other half, the point being that only one field is compared with one control - there are no replicates. The co-operating farmer agrees to control the grazing, and to graze the fields rotationally, recording not only the treatment each field receives, but also the number of stock and time of day they go on and off the field. The stock are brought on to the manured field off any ordinary field, graze in turn the fields under trial, and then go off again until there is sufficient grass growth for another grazing. Any type of sheep may be used, viz., ewes and their lambs., dry ewes, wethers, or rams, on the one field during the year. An equation is used for converting lamb-days for lambs of various ages to sheep days, but other sheep are considered as similar, The number of sheep days per acre for the fertiliser in question is compared with that for a control field. Farm costing has shown that the value of one sheep day, i.e. the returns given by an ewe, have been such that, no net profit being made, ½d. per day could be paid for her feed. This figure was obtained before the present slump in sheep prices occurred. The value of a sheep day is discussed later. The number of sheep days per acre multiplied by ½d. gives the returns per acre for the manure. The increased return per acre compared with the cost of the fertiliser and its application shows the profit or loss from the fertiliser.

The fertilisers in question are supplied gratis to the farmer who agrees to provide the basic manures, phosphate and lime.

There are (a) several points of weakness where by the number of sheep day8 may be quite misleading, (b) possibilities that the ½d. per day which ha6 been obtained on the best of farms in years of high prices is unsatisfactory, and (c) other factors which the financial measures outlined does not take into account.

SHEEP DAYS MISLEADING,

The two compared fields may not be grazed at the same time. When pastures are grazed at different times this allows the influence of different weather conditions to effect the two pastures differently. If one field is just grazed and heavy rains, hard frosts, or nor-westers and dry spells follow, the effect on the field in question is quite different from that on the field over the fence. Rains stimulate fresh growth, frosts retard it, and dry spells not only stop growth but may cause, due to the dying of some plants, an opening of the sward, In the case of hard frosts and dry weather, especially the latter, the field just grazed is at a 'disadvantage, especially if the season continues. With wet weather, especially if it is warm, the newly grazed field is at an advantage. These conditions affect the grass growth and hence the carrying capacity of any field.

* Canterbury Agricultural College reports - Farms costed by Dr. I.W.Weston and R.A.Sherwin.

It is not always convenient for a co-operating farmer to graze both fields at the same time.

Every farmer has different kinds of sheep, if not in breed, usually in type and condition. When calculating sheep-days, no distinction of any value can be made between grown sheep of different breeds, sexes, ages, or planes of nutrition. It is certain that a four-tooth half-bred dry ewe does not eat as much as an in-lamb strong cross-bred ewe. Such wide differences as this rarely occur, but sometimes rams graze one field and ewes the other, or young sheep graze one field and old sheep the other. Ewes and their lambs are equated to dry sheep by a series of fractions which vary according to the age of the lamb, but the thrift of the lamb cannot be measured. Again, a ewe in lamb must require more feed than a dry ewe." These differences would not be very great if at each grazing it were possible always to graze one mob over both fields in rotation. In practical farming it is not always possible or convenient.

When the same mob grazes both fields, and the area of the two fields differ, very wrong results can be obtained. If one field happens to be 12 acres and the other 8 acres, the stock should be approximately one half as long again on the 12-acre field. This seems to happen rarely, and even if it did,, the different treatment in regard to quickness of grazing off the two fields is only accentuated, Because of water supply, cost of fencing, or accessability of gates, it is not always possible to have fields of exactly the same area. Perhaps one of the most disturbing facts of all is the carry over from one field to another. Sheep coming from unpalatable on to highly palatable feed will consume larger quantities of such feed in a short time. Under such conditions the grazing day as a unit of measurement tends to give a negative value to quality. For instance, in the Spring, sheep may be grazing greenfeed oats or feeding on dry feed and roots on a bare pasture when they are shifted on to a fresh green growth of nitrogen treated grass. They eat with avidity until completely. satisfied, or the pasture is eaten short, and then are shifted on to a less palatable feed, possibly being "run over" the phosphate field. Under such conditions it is quite obvious that the grazing days give no true measure of the carrying capacity of either field. Similarly, a control field of perhaps no fertiliser may be quite unpalatable and so the sheep are kept on it relatively longer to eat it down than they would be on the neighbouring topdressed field, despite the fact that the manured field, to the eye at any rate, has more growth. on it. Not only are the records of grazing days upset and unreliable but the accumulation of animal droppings on the control or unpalatable pasture is greater in regard to its productiom than on the fertilised field. There is also the fact that the droppings on one field are the undigested feed consumed while on another field. Keeping variations in mineral content and quality of herbage in mind; on treated fields it must be clear that the effect of carry-over considered over a period of years must be quite large,

Management of the pasture in regard to degree of shortness of grazing can quite upset the reliability of the records. The grazing is carried out on the rotational system to the best of the farmer's ability. The tendency with large numbers of stock on small fields is to give each field according to the grass growth, two, three, or four days' grazing. Under these conditions, half a day or even less each time the stock graze the fields in question, has a very upsetting accumulative effect. If the degree of shortness affects one pasture and not the other, then the one is at an advantage over the other. The other may be eaten too bare each round with consequent opening up and reduced carrying capacity, or it may not be eaten short enough which will result in the carrying capacity being lower than the production warrants. It is difficult for the farmer to give that attention to an experiment necessary to enable both pastures to be grazed to the same degree. of shortness, and yet allow that the sheep will never be short of feed,

In the Spring time, when it is considered that young fresh grass produced earlier than normal has its greatest value, the tendency amongst farmers is to save the feed for backward ewes or early lambing ewes. This shows the practical value of such feed, but can be quite disturbing when the recording of grazing days is the object, If the grass is allowed to grow long and a few sheep put on, not only is th production later in the season affected, but good grass may be wasted by tramping.

THE' VALUE OF ½D. PER DAY &SATISFACTORY.

This figure has been obtained on certain farms where the efficiency of sheep and pasture management have been fairly high. It is not an average figure, and was obtained in years of good prices for sheep produce. The value of a sheep-day today (June, 1931) would be nearer one fifth or one-sixth of a penny. In one instance of efficient sheep management it was 1¼d. per sheep week, which is one sixth of a penny per day. This figure is calculated by deducting from the total income from the sheep all costs of labour of management, shearing, dipping, wool packs, cartage, and depreciation, and deaths in the flock, leaving an amount which has to pay for the grazing. This amount divided by the total sheep-days for the year gives the return for one sheep-day. It has nothing to do with the cost of feeding a sheep for one day. Instances of the cost of a sheep-day being as high .as Id, are recorded when the returr for the sheep was only ¼d. per sheep day.

As in all farm costing, the figure is subject to much 'variation from farm to farm, It may also be quite arbitrary for any particular farm. This means that the same number of sheep days on one' farm has not the same value as on another farm. The method of calculating. returns from fertilisers gives all farms the same value for their grazing. From the point of view of an experimenter, it is satisfactory to credit the fertiliser with the return obtained for a sheep-day by the, most efficient farmer. If the manure shows a profit when this figure is used on any farm, it does not necessarily mean that the farmer in question is in pocket to that extent'. The real value of the experiment lies in the fact that the result is or is not profitable to the farmer. It would seem that all those experiments 'giving., a cash profit may be true only for the best and most efficient farmers in times of good prices.

IMPROVEMENTS NOT MEASURED IN ONE YEAR BY GRAZING DAYS.

On any pasture on which topdressing is carried out once or twice a year Over a period of years there is usually a very definite improvement in the sward. The effect of continued balanced or complete topdressing is usually cumulative, i.e. the soil's ability to produce grass is improved, the better species of pasture plants become dominant, the sward becomes denser, and the growing season may be lengthened or even made continuous. Unless the records of grazing days are continued over a period of years no measurement is obtained of this long term improvement.

One *of* the most important advantages of fertilising pastures is the beneficial effect on the stock. Analysis shows that the mineral content and hence the feed value of topdressed pastures is superior. to untreated are as. In the half field trial as outlined no measurement of this factor can be made.

Fresh green grass for flushing ewes before and after lambing is of distinct advantage. The indications are that green grass for this purpose is less costly than greenfeed oats and in some cases Italian Ryegrass. Also the value of grass at different times of the year shows much variation. In fact, at the same time in one year because of drought or severe *winters* the value may not be the same as in another year, Fertilising may have a distinct advantage in promoting a certain amount of growth all winter and in dry weather, which might quite materially affect the nett returns of the farm.

In this method of manurial trial no measurement can be obtained of the seasonal value of grass, and it is doubtful if even an accurate measurement can be introduced.

The cost of pasture renewal, , i.e. the sowing of new pastures on the Canterbury farm varies from £1 to £4 per acre. The pasture usually lasts two, three, or at the very best four years. In the last year or two the production is very low, especially on the medium and light lands. There are definite indications and information showing that high producing permanent pastures, if not of the perennial rye type, certainly of the cocksfoot white clover type, can be maintained even on the light lands of Canterbury, by annual fertilising.

Provided the cost of the applied fertiliser does not exceed the cost of renewal, plus the value of lost production off the run out pasture in its last year or two prior to ploughing, topdressing on medium and light lands even, is a profitable business. This is true even when the fertilised permanent pastures do not show an increased carrying capacity over the newly sown temporary types.

It might be contended that large numbers of trials would eliminate many of the errors and difficulties of measurement. This is true when the only other possible variant is soil as is the case in wheat and turnips and rape manurial trials conducted on a few square chains of even soil in one field. The previous treatment of each small plot or drill strip is the same, the soil is as even as it is possible to judge in fertility and moisture content, and the weather conditions are the same. The only varied factor is the fertilisers under test. In half field grass manurial trials multiplicity of factors operate to varying degrees in different directions, the major ones being those mentioned. It is therefore impossible even to compare two half field experiments without consideration of all these factors, not to mention the uselessness of an average. Unless a means of measuring the reliability of error of an'average is available, the average has little real value. There is no means of making such a measurement when the results or figures given do not, in themselves, show the complete and true situation. In half field trials each experiment must be interpreted individually, consideration being given to all the factors operating. Thus observations on soil type, climatic conditions, rainfall, class of sheep, efficiency of grazing, improvement in sward, etc., must be supplementary to any statistical data given. It is certain that wifh this information a very much truer picture is gained.

The unsatisfactory nature of the half field method of grass manurial trial has been shown. There are, however, some distinct advantages that cannot be overlooked.

1. In. the first instance, some information is better than none, i.e., if we cannot get the whole truth we must get all we can. Unless this spirit is adopted no advancement would be made at all, and it very often happens that the gaining of part of the truth opens up ways and means of gaining more of it.

Large numbers of trials can be handled by one experimenter there- & ensuring trials under many different circumstances and conditions of pasture, soil and climate. Large numbers of trials in this type of experiment as already stated do not reveal the weaknesses in this class of trial or experimentation, but they are of distinct advantage to the experimenter, the farmers concerned and the community generally in that a greater volume of information is collected. Also, the general influence for better farming especially pasture management, through the farmer's own experience in regard to pastures and through contact with the investigator, can be quite marked. This is especially so if the investigator has a complete knowledge of practical and economical farming and marketing, as well as the tact and enthusiasm to gain the farmer's confidence and discuss with him his every day problems. The mere fact of making him think, and giving him sound, up-to-date information - the investigator must be abreast of the times re general farming information - is a service in itself. The manurial trials give' a definite continuous contact with the farmer.

3. When visiting many different farms the investigator has the opportunity of studying and collecting information on the economics of particular enterprises or particular crops, and should, in the course of a few years, be of considerable value to the farming community, since he is able to study the many different types of farms and farm management.

The object of manurial trials is to gain reliable information about manures. From this point of view the half field method is unsatisfactory alone.' There must be in conjunction with it, trials so conducted that the information gained is truly reliable as far as it is possible.

'The mown and grazed method of grass manurial trial approaches to some extent the type of experiment required, but. it takes no account of the thrift of the stock and does not avoid the droppings of sheep being spread over manured and unmanured plots; Mineral content analysts are taken and do give some idea of the probable thrift. The mowing of the grass does not resemble the grazing of the animal, and further, the mowing of all plots, regardless of the amount of growth, takes place at the same time.

The following suggestions are put forward *as* the nearest approach to the perfect experimental method. At several centres, in conjunction with the half'field method, experiments should be laid down taking into consideration the following points:'

1. Each fertiliser should be put on at least six fields of similar ares with six control fields on the same soil type alongside.

2. There should be one large holding field to carry surplus sheep in "flush" season for each manurial treatment or control.

3. The total areas of each treatment should not be less than that required to graze 50 sheep on grass alone in the low producing season.

4. The large holding field for each treatment should be kept grazed by the use of outside sheep to the same extent as the small fields throughout the year;

5. Systematic control and rotational grazing should be practiced

6. The- sheep should be of the same type and at the" same plane of nutrition.

7. The sheep should be kept on the one treatment for several years'.

8. The sheep should be weigheddmonthly.

9. The sheep used should be ewes which would rear. a lamb and fatten it on the mother on the treated grass each year, or the lamb might be kept for a hogget to maintain the flock.

10. Fat lambs records and wool records should be kept.

11. A sufficient number of treatments should be under test to enable a resident expert being employed at each centre to carry out the work,

An experiment of this type would overcome many of the disadvantages of the half field method, and give information which could be worked up on a cash basis,

The results would be more. reliable than those obtained by the half field method.

An even better method of experimentation is that of a complete farm being managed so as to give the maximum nett returns, this year, next year, and all the years to, come, while, at the same time, maintaining the soil fertility and capital equipment. In this method fertilisers would be used wherever our present information shows topdresssing to be profitable, and the results would, be measured by the nett returns.

The real measure of the value of any farm expenditure is its influence on nett returns. If the expenditure on, and the use of fertilisers enables the farmer to make more nett profit, then fertilisers are profitable. The extent to which manuring affects the nett returns of the farm as a unit can only be obtained by comparing the nett returns of topdressing and non-topdressed farms which are under similar management, or by comparing the nett returns of. a particular farm before and/after topdressing.

An investigation of this type would involve the best possible efficiency in management and show how the best management and the use of fertilisers , could affect the nett returns. By comparison with neighbouring farms; especially those particularly well managed, much useful information would be gained.

It might be possible to divide a farm of this type into two similar and equal halves, and to treat each with, the same management. Fertilisers would be used on the one and not on the other half. Complete records of grazing, management and costs and returns would be kept. With stock and products at standard values the economy of fertilisers at high or low prices could be shown. It is considered that practical demonstrations of this type, showing the details of expenditure, income and nett returns, would do more to improvement in' farming than any other experiment that could be arranged.

Further, from the point of view of economy, this type of experiment is the cheapest, in that the income from the farm would pay rent and 'normal working charges.

SUMMARY.

The half field method of grass manurial trial is unsatisfactory from the point of view of gaining really reliable information on the economics of the use of fertilisers. When one' year's, production is considered, against that year's fertiliser cost, this is particularly true. There are some distinct advantages of this method to the farmer and the investigator which warrant consideration. In spite of the objections, the half field method, or any other method which collects information, should be persevered with, in that collected information expressed in a figure together with the necessary supplementary observations, is infinitely better than eye observations only.

Although the idea outlined may be impracticable in times of economic stress, as the world is how passing through, yet it should be kept in mind, for, conducted in conjunction with the half field method, it has everything to recommend it.

Perhaps the greatest immediate improvement in farming would take place by commercially run practical farms showing that the nett returns were greater because fertilisers and management. were applied. Such farms, at any rate, would demonstrate to the farmer what he wants to know; that is, how much better off at the end of this year, next year, and so on, he will be by the use of fertilisers and good management. The method has the advantage in difficult financial times in that the expenditure is not large.

In the meantime, interpreters and readers of experiments conducted on the half field method should remember that the results given do not measure fully the value of the fertilisers in question. When considering the economics of fertilisers in Canterbury, special attention must be paid to:

1. Improvement in sward - cumulative effort.
2. Thrift of stock - mineral content and quality of grass.
3. Seasonal value of grass.
4. Avoidance of the high cost of pasture renewal.