

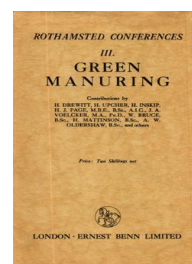
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Green Manuring

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striking possibilities. The costing of manure-making by beasts is a subject on which very little reliable information exists. The results of an experiment carried out recently at the Seale Hayne Agricultural College illustrate what a heavy price may be paid for the manurial value of dung, and in the present state of the beef trade such results must be common. These results showed that, at the lowest estimate, the net cost of the dung, when applied to the land, was 35s. per ton, or £15 per acre for a ten-ton dressing, after allowing for the value of the increase in weight of the stock. The disparity between the cost of manuring with dung and with green manures is so large that a further attempt to work out a practical means of utilizing the latter more generally in British agriculture seems to be urgently called for.

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BY J. A. VOELCKER, M.A., Ph.D.

AFTER Hellriegel had made clear the method by which certain of the leguminosæ were able to avail themselves of nitrogen from atmospheric sources, and thereby supplied the long-wanted explanation of the independence of the clover for direct supply of nitrogenous manures, while providing in itself the nitrogenous need of a succeeding corn crop, it struck me as being well to ascertain, by actual field experiment, whether the same power was possessed, and to equal extent, by other leguminous crops—*e.g.* tares (or vetches)—ordinarily grown on the farm as green crops. If this held good for such, probably the most economical way of growing a corn crop would be alternating it with a leguminous green crop, either ploughed in or fed off upon the land. For the purpose of comparison a leguminous crop—tares—was taken on the one hand, and on the other a non-leguminous one—mustard. The experiment was carried out on two different fields of the Woburn farm, green crops being grown one year and cereal crops the next. In the one case the green crops were ploughed in, in the other they were fed off. The soil of either field was a light sandy loam but poorly supplied with organic matter and deficient in lime. The work began in Lansome Field—the less even and less satisfactory of the two—in 1892, and on this the green crops were ploughed in, two such crops being grown each alternate season and a corn crop followed—generally wheat, though, occasionally, barley has been taken. On the other field—Stackyard Field—which is of very even character and well adapted for experiment, the work began in 1911, and here the green crops grown have been fed off on the land by sheep, which received cotton-cake in addition. This modification of the original plan as adopted in Lansome Field was introduced in

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order to see whether the unexpected results hitherto obtained, when the green crops were ploughed in, would be repeated when the green crops were fed off instead of being ploughed in. With but few exceptions this alternation of green crop and cereal has been maintained in both fields—in Lansome Field since 1892, in Stackyard Field since 1911. Nor has the supply of mineral manuring and of lime been neglected, as, at intervals on both fields, the green crops have had superphosphate and potash salts given to them, and lime has also been supplied. Without going fully into details it will suffice to say that in each field, and with but few and unimportant exceptions, all through this long series of experiments one general result has been reached—viz. that the corn crop following the non-leguminous green crop, mustard, is better than that which follows the leguminous crop, tares, and this whether the green crops have been ploughed in (Lansome Field) or fed off (Stackyard Field). This is quite contrary to what one would, from theoretical considerations, expect.

To take, by way of illustration, the results for the past nine corn crops since the experiment in Stackyard Field was commenced (1911), we have the following results—the crop in each case being wheat :

STACKYARD FIELD : PRODUCE OF WHEAT PER ACRE AFTER GREEN CROPS FED OFF

Year	Bushels per Acre	
	After Mustard	After Tares
1912 . . .	18.2	18.8
1914 . . .	16.1	14.2
1916 . . .	11.3	8.1
1918 . . .	15.2	12.2
1920 . . .	14.2	9.7
1922 . . .	7.5	6.9
1923 . . .	5.6	8.0
1924 . . .	9.1	7.3
1925 . . .	5.7	6.4
	102.9	91.6
Average of nine crops	11.4	10.2

In Lansome Field, where the produce has been higher, the results over a long period have been in a similar direction—viz.

After mustard . . .	21.6 bushels per acre
After tares . . .	15.9 bushels per acre

Not only are the results the opposite of what one would expect, but the produce is seen—from the above Table—to be a diminishing one, and one not accounted for by seasonal variations only. Moreover,

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for the last three periods given above, the green crop has in each year been put in with 3 cwt. per acre of superphosphate and 1 cwt. per acre of sulphate of potash, while lime (2 tons per acre) was given in the autumn of 1923. So it could not be said that failure was due to absence of minerals or lime. Nor should it be due to lack of organic matter or nitrogen, as, in addition to the feeding off of the green crop, the sheep had also 3 cwt. of cotton-cake to the acre given to them along with a little clover-hay.

Altogether it seems quite unaccountable that such miserable crops of wheat should follow the pursuit of what would ordinarily be considered good farming practice.

It is quite evident that there must be some factor, as yet unknown to us, which produces a result not only at variance with scientific deductions, but with practical experience generally, for, without assuming some disturbing element of this nature, it is incomprehensible that liberal treatment such as these plots have received could result in the production of crops so meagre. Many have been the attempts I have made to find a possible explanation, and many the suggestions put forward, but none has so far been found to be tenable. It is not that the green crops have been poor, for, with hardly an exception, excellent crops have been grown, as evidenced by the fact that they are always taken by a neighbouring farmer for feeding his lambs on. What, further, is remarkable, is, that during the winter and spring the wheat crop on either plot looks capital, and that it is not until May or June that any falling off is perceptible. Then, and especially if a spell of dry weather comes, the wheat crop begins to fall away, and never matures properly. In the winter and spring of the 1924-1925 season there was no wheat crop on the whole farm that looked as well as did these green-manure plots—as can be testified to by members of the Rothamsted staff who visited the farm—and yet, from May 1925 onwards, the crop began to fail and ultimately gave, as the Table shows, only 5·7 bushels and 6·4 bushels per acre. That such result is due to the particular soil only is negated by the fact that the same results are found in Lansome Field—about a mile distant, and where the green crops have been ploughed in. Further, in Stackyard Field, on another block of 2 acres, not 100 yards from the green-manure plots, wheat grown in rotation after clover which had been taken off as hay, and the ley ploughed in without further manuring, produced in 1925 25·2 bushels per acre. At intervals, also, the soil has been analysed, and on the last occasion (1920) the tares soil was found to have ·114 per cent. of nitrogen, while the mustard soil gave ·098 per cent. only; and yet the tares soil (richer in nitrogen) produced only 9·7 bushels of wheat per acre while the poorer mustard soil gave 14·2 bushels per acre. From this it would appear that the tares soil, though richer in nitrogen, has this present in a form in which the corn crop can less readily utilize it. Certain it is that more nitrogen has been conveyed

to the soil by the tares crop than by the mustard, and on two occasions the entire green crops have been cut, weighed and analysed, the results showing that not only is a greater weight of material conveyed in the tares, but also that more organic matter and more nitrogen are supplied by them, while, as already stated, the tares soil is found to be richer in nitrogen than the mustard soil. This would seem to indicate that for some reason, as yet unknown, the tares soil, though richer in nitrogen, cannot yield this up so well, so that it is not utilized by the corn crop. Again, it has been suggested that mechanical considerations of the condition in which the soil is relatively left by the growing of mustard and tares respectively have a bearing on the question, but, though it is certainly the case that the ploughing in of mustard leaves the soil in a more open and loose condition, the bearing of this would be negated by the similarity of the results when, as in Stackyard Field, the land is consolidated by the treading of the sheep.

These experiments have now been continued for such a long series of years, and with such consistent results, as to leave hardly any possibility of doubt being entertained as to their accuracy. But the question as to what these results are due to remains as far from solution as ever, and I shall welcome any suggestion made in the Discussion of to-day that will help in elucidating it.

ORGANIC MANURING IN THE LOTHIANS

BY W. BRUCE, B.Sc.

THE term "green manuring" is scarcely known in Scotland; but an increasing number of progressive farmers do appreciate the importance of keeping the humus content of their soil at a high level, and are becoming more alive to methods of doing it. The idea of catch-cropping is more popular in the North than just green manuring. The Scotsman looks for some direct return for his outlay, and the most successful efforts have been made on land in high condition. A cheap seeding is put down where opportunity occurs, growth is rapid, the herbage is consumed by sheep, and is highly prized for fattening off black-faced lambs from the hills. These usually pay the cost of the seeding and the land is benefited by the residue.

My first experience of green manuring in this way goes back nearly thirty years, when I commenced teaching. In the vicinity of Dundee my attention was drawn to great deterioration of soil where potatoes were lifted for the early market, in July or August, and nothing put on the land until the wheat was sown in November, as