ROTHAMSTED EXPERIMENTS.

VALUE OF POTASH TO FARM CROPS

AS INDICATED BY THE

ROTHAMSTED EXPERIMENTS.

By J. J. WILLIS.

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VALUE OF POTASH TO FARM CROPS.

THE importance of the ingredient Potash in the production of all farm crops is now generally recognised, and no crop, probably, shows Potash starvation more strikingly than does that of the Mangel Wurzel, for the reason that Potash has a very essential office to perform in the production, not only of the woody tissue of the plant, but of the carbo-hydrates, sugar and starch. It has been found in the Rothamsted researches that about two-thirds of the solid matter of the feeding Mangel is sugar, consequently both the quantity grown per acre and the quality of this important farm crop is largely governed by the amount of available Potash in the soil.

Farmers fully recognise the value of farm yard manure in the growth of Mangels, but to a very large extent the benefit is due to the improvement in the texture and water-retaining capacity of the soil rather than to the direct supply of plant food provided by the dung, as this is decidedly not a well-balanced manure.

Professor J. P. Roberts gives the following graphic illustration showing the average composition of well-mixed animal manure of cows, pigs, horses and sheep, as compared with the composition of various farm crops :—

	Phosphoric Acid.	Potash.
Animal manure contains for every 100lb. of Nitrogen	49·6 lb.	77·8 lb.
Oats, 1½ straw to 1 grain contain for every 100 lb. of Nitrogen	37·3 lb.	82·6 lb.
Barley, 1½ straw to 1 grain contain for every 100 lb. of Nitrogen	31·5 lb.	98·7 lb.
Potatoes, ¼ tops to 1 tubers contain for every 100 lbs. of Nitrogen	27·0 lb.	110·0 lb.
Mangels, ⅛ tops to 1 roots contain for every 100 lb. of Nitrogen	45·0 lb.	180·0 lb.

The above figures show that for every 100 lb. of Nitrogen which the animal manure furnishes to the growing plant, there is an excess of phosphoric acid amounting to 22·6 lb. in the case of the Potato crop, the least consumer of phosphoric acid, and of 4·6 lb. in the case of the Mangel crop, the greatest consumer of phosphoric acid, with an excess of 12·3 lb. and 18·1 lb. in the case of Oats and Barley.

On the other hand, the manure provides a deficiency of Potash in every instance, amounting to 4·8 lb. in the case of Oats, 20·9 lb. with Barley, 32·2 lb. with Potatoes, and of 102·2 lb. with Mangels.

All the farm crops mentioned, therefore, require a less proportion of phosphoric acid than would be furnished by the animal manure, and without any exception they all require a greater proportion of Potash as compared with the Nitrogen than the manure would supply. These facts show that if heavy farm crops are grown by the addition of farm-yard manure, the plants must needs to draw very largely upon the stores of available Potash, so as to deplete the soil of that material.

Effect of Potash in the Rothamsted Experiments.

In the world-renowned Rothamsted experiments with Mangel Wurzel, the effect of Potash and of the other saline manures is plainly visible in the appearance of the growing plants themselves. On the plots of land receiving Potash in the manure, the plants begin to ripen early in the season, the leaves turn yellow and become flaccid, so that, in the month of October, these plots may be seen outlined from the rest by their lighter green tint at any distance from which the field can be viewed. On the other hand, the plots of land receiving no Potash show all the signs indicating an excess of nitrogen by the premature death of the outer leaves, and the dark green, curled and unhealthy appearance of the remaining tuft of small crown-leaves, which show no signs of completing their growth, however prolonged the season may be.

This fact is strikingly shown in the attached picture.

The two plots from which these plants were collected, each received Nitrogen as dung, Rape-cake and Ammonia Salts. In addition, one plot received Sulphate of Potash at the rate of 500 lbs. per acre, while the other plot received no Potash. The illustration speaks for itself of the great value of Potash.

Considering the large amount of Potash contained in farmyard manure, and the enormous residue which must have accumulated in the Rothamsted soil by the yearly application of 14 tons per acre of that manure for the last forty-seven years, the foregoing illustration is very striking, as showing the dependence of the Mangel crop on an abundant supply of available Potash. The application of farmyard manure is generally considered to supply sufficient Potash to remove the need of any further specific manuring with Potash Salts, even to so potash-loving a crop as Mangels; but the Rothamsted experiments show that even when dung has been applied continuously for a long time, the application of Potash will still result in an increase of crop. The reason of this is very clearly demonstrated by Professor Roberts' diagram, given in the early part of this paper.

The appearance of the growing Mangel crop is even more indicative of the value of the Potash dressing; where it has been applied the crop is altogether healthier and riper, especially if excessive dressings of Nitrogen have been used. The experiments show that when Nitrogenous Manures alone are used in conjunction with dung, the Mangels are among the most unhealthy in the field, and illustrate the greatest evidence of excess of Nitrogen; yet the corresponding plots of land receiving Potash exhibit reasonably healthy and well-grown plants.

Evidence of the want of Potash, as shown by the Mangold,

according to experiments at

Rothamsted

Experiment Station 1903.

Complete manuring with Potash.

Manuring per acre:	2000 lbs.	Rape cake
	400 „	Sulphate of Ammonia
	400 „	Basic slag
	500 „	Sulphate of Potash.
Yield per acre in the year 1903: . . .		32,2 tons.
Increase due to Potash:		22,5 „
Average yield from 1875 up till 1903: (28 years on the same field).		22,83 „
Increase due to Potash:		12,48 „

Complete manuring without Potash.

Manuring per acre:	2000 lbs.	Rape cake
	400 „	Sulphate of Ammonia
	400 „	Basic slag.
Yield per acre in the year 1903: . . .		9,7 tons.
Average yield from 1875 up till 1903: (28 years on the same field).		10,35 „

The following diagram gives some illustrations from the Rothamsted experiments on the growth of Mangels in the year 1903, the twenty-eighth Mangel crop in succession on the same land.

Manures and Produce per acre of Mangels.

	Manures applied.	Produce of Roots per acre. Tons. cwts.	Gain of Roots for the Potash. Tons. cwts.
1.	Farmyard Manure	11 8	...
2.	,, with Superphosphate and Potash	18 4	6 16
3.	,, and Nitrate Soda	24 6	...
4.	,, with Superphosphate and Potash	26 14	2 8
5.	,, and Ammonia Salts	24 8	...
6.	,, with Superphosphate and Potash	30 12	6 4
7.	Rape Cake and Superphosphate	11 12	...
8.	,, and Potash	22 18	11 6
9.	,, and Ammonia Salts	9 14	...
10.	,, with Superphosphate and Potash ...	32 4	22 10

The Rothamsted experiments have shown that neither Basic Slag nor Superphosphate, when used alone, or even in conjunction with dung, have any effect. It is only when the two manurial ingredients of **Potash and Phosphate** are used in combination that profitable results are obtained.

During the first eighteen years of these Mangel experiments it was found that when Superphosphate was applied as a manurial dressing with dung, there was practically no effect upon the increase of produce, and in some cases there was even a falling off of roots from the use of that material.

In the last eight years of the experiments Sulphate of Potash has been supplemented to the dung and Superphosphate, and the foregoing diagram shows that a very decided advantage resulted from its use. In Experiment 2 there is a gain of 6 tons 16 cwts. per acre of roots for the use of the Potash; in Experiment 4 a gain of 2 tons 8 cwts.; in Experiment 6 a gain of 6 tons 4 cwts.; in Experiment 8, where Rape Cake took the place of dung, there was a gain of 11 tons 6 cwts. per acre from the use of the Potash Salts; and in Experiment 10 there was the enormous gain of 22 tons 10 cwts. of Mangel roots per acre from the application of the Potash.

It is characteristic of the various descriptions of feeding roots that they supply to the consuming animal a large amount of the non-nitrogenous, respiratory, and fat-forming substance--sugar. Of the great importance of sugar in the nutritive value of feeding roots there can be no question.

The following table shows the results of Mangels grown in experiment at Rothamsted in the year 1900, being the twenty-fifth crop in succession on the same land, with farmyard manure alone; with farmyard manure and various artificial fertilizers in combination; and with artificial manures without dung. The results show the produce of roots grown per acre and the amount of sugar in the roots, calculated to the acre:—

EXPERIMENTS WITH MANGEL WURZEL AT ROTHAMSTED. SEASON 1900.

Standard Manures	Standard Manures only	Standard Manures cross-dressed with			
		86 lbs. Nitrogen as Nitrate Soda	86 lbs. Nitrogen as Ammonia Salts	98 lbs. Nitrogen as Rape Cake	184 lbs. N. as Ammonia Salts and Rape Cake
PRODUCE OF ROOTS PER ACRE.					
	Tons cwts.	Tons cwts.	Tons cwts.	Tons cwts.	Tons cwts.
Farmyard Manure 14 tons ...	25 3	41 4	26 0	30 5	27 12
Farmyard Manure with Basic Slag and Potash	27 18	41 13	35 12	35 8	38 5
Gain by the Potash ...	2 15	0 9	9 12	5 3	10 13
Basic Slag, 400 lbs.	9 3	28 6	11 19	14 17	14 18
Basic Slag and Potash	7 0	29 12	28 2	29 7	37 10
Basic Slag with Sulphate of Magnesia, Salt and Potash...	8 14	33 1	28 18	34 10	43 2
Gain by the Potash ...	— —	3 0	16 11	17 1	25 8
SUGAR IN THE ROOTS PER ACRE.					
	lbs.	lbs.	lbs.	lbs.	lbs.
Farmyard Manure, 14 tons ...	4674	5998	3671	4469	3584
Farmyard Manure with Basic Slag and Potash	4941	5599	5027	5395	4885
Gain by the Potash ...	267	399 (*loss*)	1356	926	1301
Basic Slag, 400 lbs.	2124	4310	1822	2392	1901
Basic Slag and Potash	1632	4572	5665	4862	5122
Basic Slag with Sulphate of Magnesia, Salt and Potash...	1849	4884	5115	5408	5116
Gain by the Potash ...	—	418	3568	2743	3218

In this season (1900) Basic Slag replaced the usual Superphosphate.

Referring in the first place to the produce of roots, we see that there is on the dunged plots a gain for the application of Potash ranging from 9 cwts. to 10 tons 13 cwts. per acre; and on the fifteen plots of land to which no dung was given, there is a gain of produce for the Potash supply ranging from 3 tons to 25 tons 8 cwts. per acre.

It is seen that the larger the amount of nitrogenous manure supplied, the greater is the increase of roots by the addition of Potash.

Turning to the quantity of sugar per acre in the roots, we find that on the dunged plots there is a gain of sugar from the use of Potash ranging from 267 lb. to 1356 lb. per acre.

Where farmyard manure was cross-dressed with Nitrate of Soda there was, however, a decrease in the amount of sugar amounting to 399 lb. per acre, under the influence of the Basic Slag and Potash.

On the fifteen plots receiving artificial manures without dung there is a gain of sugar in the Mangel roots ranging from 418 lb. to 3568 lb. per acre. That is to say, there is a gain of more than 1½ ton of sugar per acre in the Mangel Wurzel grown under the influence of Potash Salts.

Conclusions.

The main lessons to be drawn from the foregoing results are:—

1. That an abundant supply of Potash is essential to the proper development of the Mangel Wurzel.

2. Despite the large amount of Potash contained in farmyard manure, the Mangel crop is much benefited by further additions of Potash Salts, especially when other Nitrogenous Manures are also being used.

3. That a free supply of available Potash is essential to the proper development of the Mangel root, hence a specific Potash manuring is desirable, even when dung is used in large quantities, and on a strong soil initially rich in Potash.

4. When Nitrogenous Manures are used in addition to dung, the Potash Salts should be increased *pro rata*, in order to maintain the health, vigour and feeding value of the crop, and also to bring the plants to maturity

Experiments on Potatoes.

It has been stated that the great and beneficial effects of Potash upon the Mangel Wurzel crop is to be correlated with the fact that root-crops are essentially sugar-producing

plants and that large supplies of Potash seem to be necessary to the processes of the plant, which result in the formation of sugar and similar carbohydrates.

In the case of the Potato the carbohydrate produced is starch. Potato tubers are reckoned to contain, on an average, more than 21 per cent. of starch, and upon the amount of starch in the Potato depends its nutritive value and cooking properties for domestic use.

The following table shows the results obtained at Rothamsted with Potatoes when grown without manure and with various artificial fertilizers. The figures quoted are the results of the average for ten years in succession on the same land, 1876-1885.

Experiments with Potatoes at Rothamsted. Amount of starch in the tubers per acre—

Plots.	Manures.	Starch per Acre. lbs.	Increase over the Unmanured. lbs.
1.	Without Manure	1,120 ...	—
2.	Phosphate and Potash	1,988 ...	868
3.	Ammonia Salts alone	1,169 ...	49
4.	Nitrate of Soda alone	1,362 ...	242
5.	Ammonia Salts, with Phosphate and Potash	3,436 ...	2,316
6.	Nitrate of Soda, with Phosphate and Potash	3,368 ...	2,248

It is seen that the quantity of starch in the Potato tubers is considerably increased by the application of Phosphate and Potash, amounting on Plot 2 to 868 lb. per acre. The increased amount of starch over that without manure obtained by Nitrogenous Manures alone is very small—only 49 lb. when as Ammonia Salts on Plot 3, and 242 lb. per acre when as Nitrate of Soda on Plot 4. But when both Nitrogen, Phosphate and Potash are employed together, the increased amount of starch produced is more than one ton per acre—2,316 lb. on Plot 5 with Ammonia Salts, and 2,248 lb. with Nitrate of Soda. When Phosphate and Potash are added to the Ammonia Salts or Nitrate of Soda, there is, for one of Nitrogen supplied in manure, over 26 parts increased produce of starch reckoned over the yield of tubers without manure.

Here, then, in the Potato, we have a great increase in the production of the carbohydrate starch, by the use of Potash in manure, just as in the mangel crop we have a considerable increase in the carbohydrate sugar, by the use of Potash Salts.

As, thus, the root crops are essentially sugar yielding crops, and their feeding value depends upon the proportion of this constituent, so the Potato is essentially a starch yielding crop, and its cooking and also feeding value depend to a very large extent upon the per centage of starch in the tubers. And it is seen that provided a liberal supply of Potash is available in the soil, the produce of both sugar and starch is considerably

increased by the amount of Nitrogen taken up, the ingredient Potash acting as a carrier of Nitric Acid from the soil to the plant.

On what does strength of Straw in Cereal Crops depend?

It has frequently been stated that strength of Wheat, Barley and Oat Straw, is dependent on a high per centage of silica in their composition. This important subject was investigated by the late Sir Henry Gilbert at Rothamsted, who found that a high proportion of silica in the straw of cereal crops meant a low proportion of organic substance produced, and hence brittleness and not strength of straw was the result.

Good stout straw depends on the favourable development of the woody substance—the cellulose—which may be described as the structural basis of the vegetable world, and having a constitution characteristic of the carbo-hydrates, which we have already seen is encouraged by the use of Potash.

In the Rothamsted experiments on Barley there are two plots of land to which Phosphate and Ammonia Salts are applied year after year, but to one of these plots, Potash is added in the manurial mixture. The straw on the non-Potash plot gets worse and worse as the experiment continues, so that in unfavourable seasons the straw is so brittle that it can be crushed into fragments in the hand, while in the same unfavourable climatic seasons on the plot to which Potash is applied each year the straw remains stout and healthy. In a chemical analysis of the straw of these two plots it was found that the amount of silica was in the highest proportion on the non-Potash plot where the straw is brittle, while on the Potash manured plot where the straw is stout and good the amount of Potash taken up by the crop is three times as great as on the non-Potash plot. The actual figures are as follows :—

Potash in the Straw.	Per acre.
Plot 2A.—Ammonia and Phosphate...	13·2 lb.
Plot 4A.—Ammonia, Phosphate and Potash ...	39.5 lb.

There can be no doubt, therefore, that strength of straw depends on the favourable development of the woody substance—the cellulose—and the more this is attained, the more will the accumulated silica in the straw be, so to speak, diluted, and this condition is brought about very largely by a full available supply of Potash in the soil.

Manuring on Grass-lands.

No branch of farming in the United Kingdom is more universal, or plays a larger part in the economy of the ordinary farmer, than the growth of grass, either on the pastures,

the meadows, or the temporary leys. It is a crop grown everywhere, alike on highland and on lowland, on arable farms and on grazing farms, on rich lands and on poor lands.

The meadow hay crop, also, is a most important one, for on it depends, in great measure, the quantity of fodder available for winter use, and also the number of stock that can be maintained during the season when pastures provide little or no keep.

Much of the pasture land in the British Isles grows very inferior herbage, and but little of that, with the practical result that the production of milk, meat and wool is greatly restricted. The outcome of this condition of things is, as truthfully stated by Mr. Martin Sutton, an enormous national loss, and the fact must be told, that this loss is almost entirely avoidable.

The prime cause of negligence is begotten of the mistaken idea that a pasture is self-supporting. This is a very general assumption that the owners and occupiers of grass-land are not only relieved from the anxiety and expense of arable tillage, but that they are under little or no obligation to make any return to the soil for all that may be taken from it in the form of hay, meat, milk, or wool.

To keep up a high standard of fertility in meadows and pastures it is absolutely essential that a liberal supply of Potash and Phosphate Manures be applied, since these, and more especially the element Potash, control the growth and the development of the clovers and other leguminous plants upon which the nutritive value of the mixed herbage so greatly depend.

Phosphates useless without Potash.

One frequently hears very conflicting remarks regarding the effects of Basic Slag or of Superphosphate of Lime when applied to pasture lands. With some, the application of Phosphatic manures is most beneficial, resulting in a large increase of clovers among the herbage, and more especially of White Clover, while with others no good effects from phosphatic manures are observed.

From the unique experiments conducted at the Rothamsted Agricultural Station on grass-land, which were started by the late Sir John B. Lawes in the year 1856, and have been continued up to the present time, (1904) thus extending over a period of forty-nine years, it has been fully demonstrated that Basic Slag and Superphosphate are absolutely of no avail if the land is deficient in available Potash. Consequently, applications of Potash Manure, when given in a soluble and available form, have had considerable effect upon both the quantity and the quality of the produce obtained.

Taking for illustration five of the twenty-four plots of the experiments with the mixed herbage of grass-land, we find some very remarkable results both as to weight of the hay crop yielded, and also in the botanical composition of the hay produced, which affects its nutritive properties for stock-feeding purposes.

Rothamsted experiments. Produce of Hay, 1st and 2nd crops (if any). Average over the whole period of 47 years, 1856—1902 :—

		Hay. Per Acre. Cwts.	Increase of Hay over Plot 3. Cwts.
Plot 3.	Without manure	21·9	—
,, 4.	Superphosphate alone	23·3	1·4
,, 8.	Mixed mineral manure, excluding Potash, 1862, and each year since	28·7	6·8
,, 6.	Mixed mineral manure, with Potash, 1869, and each year since	37·4	15·5
,, 7.	Mixed mineral manure, with Potash, for 47 years	38·8	16·9

It is seen from the above figures that, taking the average of 47 years, the total produce of Hay has been increased by the effect of Superphosphate to 1·4 cwt. per acre only. On plot 8, which received a complete mineral manure including Potash from 1856 to 1861, but in 1862, and each year since, the Potash was omitted, this shows an increase of Hay over the unmanured plot of 6·8 cwts. per acre. While plot 6, which receives a complete mineral manure as plot 7; following Ammonium Salts alone during the first 13 years, there is a gain over plot 3 without manure, of 15·5 cwts. per acre. Plot 7, which received the complete mineral manure, including both Phosphate and Potash for the whole period of 47 years, there is an increase of Hay per acre over plot 3, of 16·9 cwts.

The Quality of Herbage.

Nor are the foregoing facts all the story, for an ocular demonstration of the grass plots shows that where the Potash Manure has been applied there is a great increased growth of the clovers and vetchlings in the mixed herbage, with a reduction of the coarse description of grasses, from the fact that finer and better species are encouraged. In other words, the whole produce is considerably enhanced in bulk, and in nutritive quality consequently in value to the owner and the occupier of the land.

A systematical Botanical examination of the mixed herbage composing the hay grown on the Rothamsted grass plots, has been made at five different periods:—In 1862, 1867, 1872, 1877 and 1902. Selecting for our illustration the five plots for which we have quoted the produce of Hay, we find that the proportion of leguminous herbage (the clovers and vetchlings) in the total Hay was as follows:—

TABLE showing the percentage amount of clovers and vetchlings in the Rothamsted Hay.

Years of Botanical Analysis.	Plot 3.	Plot 4.	Plot 8.	Plot 6.	Plot 7.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1862	8·1	2·8	19·3	0·3	24·7
1867	5·4	2·8	8·9	0·1	12·7
1872	9·0	8·6	8·0	1·6	39·8
1877	8·5	5·5	4·0	6.7	13·7
1902	7·5	15·4	22·1	61·0	55·3

These results show that the percentage quantity of clovers in plot 3, without manure, in not very large but is fairly constant. Plot 4 receiving Superphosphate alone shows a diminished amount of leguminous herbage compared with the unmanured plot, except in the year 1902, which is seen to be an exceptionally good season for the production of clovers. Plot 8 where the Potash has been omitted from the manure since 1862, the clovers show a decided decrease in each of the three following years of botanical analysis, but again come forward in the good leguminous producing year of 1902. Plot 6 received Ammonium Salts as manure up to 1868, with the result that in the first two botanical separations, the Leguminosæ formed an extremely small proportion of the mixed herbage. Changing the manure from Ammonium Salts to Phosphates and Potash in 1869, the clover plants immediately began to increase in quantity, until in the year 1902 the total leguminous herbage reached the enormous amount of 61 per cent of the Hay.

Plot 7 with the continuous application of Potash and Phosphate, maintains its leguminous character, and hence its nutritive properties in the Hay. A comparison with the other plots of the Rothamsted grass experiments shows that no other manurial substance exercises such an influence both on the yield and nutritive value of the Hay as does the element Potash.

Chemical Composition of the Hay.

It is well known that very remarkable differences occur in the chemical composition of the ashes of Hay grown under the influences of different manures. Turning once more to the Rothamsted experiments, we find that the ash of the unmanured produce, with its small proportion of grasses, only moderate amount of clovers, but very large quantity of weedy herbage, contained but a small proportion of Potash—namely, 19 per cent. In the case of plot 6, the ash of the Hay grown under the influence of Ammonium Salts analysed but 18 per cent. of Potash, while the Hay grown on the same plot, after several years of

application of Potash Salts, and the consequent increase of clovers in the herbage, analysed 34 per cent. of Potash. On the other hand, plot 8, which received Potash in its manure for six years in succession, realised nearly 31 per cent. of Potash in the Hay on account of the large proportion of leguminous herbage; yet, after the omission of Potash in the manure, and the considerable decrease in the percentage of clovers, the ash of the Hay showed, on analysis, during the later years, but 23 per cent. of Potash.

There is, then, in these illustrations, consistent evidence of the connection between the ultimate chemical composition of the mixed herbage composing the Hay and the supplies of plant food at command in the soil. Further, these supplies, to a great extent, determine both the description of plants encouraged in the meadows and the character of their development.

It is the chemical composition of the mixed herbage of the Hay that determines its adaptability for producing meat, milk and wool.

Experiments on Hay at Cockle Park, Northumberland.

An important series of experiments upon old meadow land mown for Hay was begun by Dr. W. Somerville in 1897, on the Northumberland County Demonstration Farm at Cockle Park.

The land is stated to be rather a thin clay soil resting on the boulder clay; the vegetation is of a poor character, consisting largely of common bent-grass, and Yorkshire fog. Such grass land, carrying little except bent and other creeping, rooted grasses, is characteristic of many of the clay soils of the Midlands and North of England.

The value of these trials was greatly enhanced by a further experiment carried out by Professor Middleton, who had succeeded Dr. Somerville in the charge of the work. He estimated the value of the Hay grown on some of the plots in 1900 by feeding it to sheep. It was found that the feeding value of the Hay from the different plots, as determined by the increase in weight of the sheep, varied very greatly; that grown with Phosphates and Potash, or with a complete artificial manure, being worth from 50 to 80 per cent. more as food than the Hay from the unmanured plot. The most noticeable fact was that the use of Potash as manure added enormously to the feeding value of the Hay, proving that the use of Potash manures is exceedingly profitable to any farmer consuming his Hay for stock fattening purposes.

Experiment with Kainit.

An experiment to test the efficacy of "early" and "late" applications of Kainit to seeds Hay was carried out at Earl's House, Durham.

Three plots were dressed on February 7th, and three plots on March 27th. The quantity of Kainit applied was 412 lb. per acre, and was equal to a dressing containing 50 lbs. of Potash to the acre. The field where the experiment was carried out had previously been dressed with Basic Slag at the rate of 5 cwt. per acre. As far as the results of this experiment go, it is obvious that Kainit should not be applied to Grass Crops much later than the first week in February. This may be quite clearly seen from the following table where the results are summarized :—

Plots.	Kainit applied.	Average Produce per acre.	Value of Produce at £3 per ton.
		Cwts.	£ s. d.
1, 3 and 5	February 7	56¼	8 8 9
2, 4 and 6	March 27	51	7 13 0

The "early" applications have produced on an average 5¼ cwt. more Hay per acre than the "late" dressings. When the produce is valued at £3 per ton, this leaves a sum of 15s. 9d. per acre in favour of the Kainit applied on 7th February, as compared with that applied seven weeks later. These results should prove of much interest to those who use artificial manures for grass land.

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