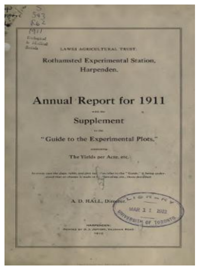
Annual Report for 1911 With the Supplements to the Guide to the Experimental Plots Containing the Yields per Acre, Etc.


Rothamsted Experimental Station,
Harpenden.
Annual Report for 1911
Supplement
"Guide to the Experimental Plots."
The Yields per Acre, etc.

Rothamsted Report for the Year 1911

Rothamsted Research

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ANNUAL REPORT

FOR THE YEAR 1911

THE season of 1911 will long be memorable for the exceptional heat and drought of the summer. The closing three months of 1910 were exceptionally wet, over 12 inches of rain being registered at Rothamsted, but a dry January enabled the wheat plant to recover from the bad start it had made. In February and March the rainfall was about normal with no severe cold, though there were very few nights during the first three months of the year in which a little frost was not recorded on the grass. With April the droughts began, there being then a period of 20 days in which never more than a sprinkling of rain fell. In May the high temperatures began, and there were two spells of dry weather, though the rainfall for the month was considerably above the average. June again opened with a period of drought and heat, but heavy thunder rain about the time of the Coronation again made the total rainfall above the average. July was remarkable for a period of 23 days without any rain at all, and a succession of high temperatures which made the mean maximum for the month as high as 76·3°. The first 19 days of August were almost absolutely dry with very high temperatures, a maximum of 92·3° being registered on the 9th, the highest air temperature that has ever been recorded at Rothamsted. The mean maximum for the month was almost as high as in July, namely 75·9°. Another period of drought extended from the 22nd of August to the 13th of September, though on several days a measurable shower of fine rain was recorded; the weather broke in the middle of October, and from that time to the end of the year there were only 6 days without some rain being recorded.

The sunshine records were also well above the average, there being an excess of 99 hours in July, 25 in August, and 66 in September above the average of the 18 years, 1892—1910. Even these figures hardly serve to express the exceptional character of the summer and the severe conditions of drought which all the crops experienced during comparatively long periods.

The wheat on Broadbalk Field was sown on October 21st, and though it suffered a good deal during the early part of the winter, it tillered and grew very well during April and May; it also continued to flourish through the heat, and like the wheat all over England, became a very handsome crop, exceptionally clean and bright and standing up everywhere. A new variety was grown for the first time—"Little Joss"—one of the varieties raised by Professor Biffen of Cambridge, distinguished by its resistance to rust, and whether the variety or the season is responsible, it is certainly many years since the Broadbalk wheat seemed so free from disease. The yields were generally good without being exceptional, only Plot 16 reached as much as 40 bushels to the acre. The unmanured plot yielded as high as 12½ bushels to the acre, but the crop on Plot 2 receiving farmyard manure did not come to the front so much as might have been expected in so dry a season. The weight per bushel was exceptionally high; the average of all the plots was 65·5 lbs., and Plot 16, with the highest yield, reached the exceptional figure of 66·8 lbs. The highest weight of any individual bushel was 67·5 lbs.—also on Plot 16—while on the farmyard manure Plot grain was produced weighing only a fraction less. These are the highest figures that have ever been recorded.

The Half Acre Plot, grown after a bare fallow in alternate years, also yielded well, 17 bushels to the acre, which is higher than it has been for many seasons past. This result is rather remarkable considering the heavy rainfall of the last 3 months of the year 1910, which might have been expected to wash out of the soil the nitrates accumulated during the summer fallow. In an ordinary way the yield of wheat after fallow is largely determined by the rainfall of the preceding autumn.

If the season was exceptionally good for the wheat, it was equally bad for the barley, which was sown on March 27th. The highest yield was rather under 29 bushels to the acre, and the unmanured Plot fell below 5 bushels to the acre. There was a considerable attack of gout fly, but doubtless the great heat and drought ripened off the barley too early and prevented the formation of the grain from running its proper course, as may be seen from the fact that the weight per bushel, although above the average, was not good and the proportion of grain to straw was exceedingly low. It is rare to find the weight of barley-grain falling as low as half the weight of the straw; indeed in a dry year one generally expects the two to be equal on the good plots, but in 1911 the grain was less than half the straw on as many as 12 plots out of the 29. In consequence of the very scanty growth on many of the plots there was an enormous development of weeds, which indeed have been increasingly troublesome on the barley plots for some years past. So serious has the situation become that it has been decided to leave the plots without crop during 1912, and by continuous cultivation under bare fallow to try and restore the plots to a reasonable degree of cleanliness.

Like all other root crops the mangolds on the Barn Field suffered from the season. They were first sown on May 9th and 10th,

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but as the sowing was followed by rain and then drought, the surface of the land caked very badly and the germinating seed was unable to push through the ground. Only on Series 1 and 2, where farmyard manure is supplied, was anything approaching to a plant attained, and in June the field presented a remarkable illustration of the value of farmyard manure in ameliorating the texture of the soil and enabling germination to take place. The plant was so scanty on the other plots that they were scuffled over and re-sown on June 12th. The second sowing germinated fairly well, but never grew freely. The highest yield of roots was a little over 21 tons per acre on the plot receiving farmyard manure and rape cake, but it was not more than 4 or 5 tons per acre on the plots receiving a purely inorganic manure with nitrogen in the form of nitrate of soda or sulphate of ammonia. The yields seemed entirely dependent upon the amount of organic matter supplied by the manure and its cumulative effect upon the soil. It was characteristic of the season that the usual attacks of *Uromyces betae* on the high nitrogen plots was almost entirely absent this year.

On the Agdell Field wheat was taken, this being the close of the 16th complete rotation. A fine plant of wheat was to be seen all over the field, and the yield was especially remarkable on the unmanured plots, where as much as 24 bushels to the acre, weighing 65 lbs. to the bushel, was obtained. Still more remarkable, perhaps, was the yield of almost 32 bushels to the acre on the plot which receives no nitrogen and on which clover is not grown; indeed it is not immediately obvious where the large amount of nitrogen necessary for a crop of this magnitude can have come from, for the plot has received no nitrogen since 1848, and has never grown clover or any other leguminous crop (except the *Medicago* which is a very abundant weed on occasions). The effect of the preceding clover crop as compared with a preceding bare fallow was clearly visible, raising the yield by about 5 to 6 bushels on Plots 1 and 3 which had received fertilisers for the root crop at the beginning of the rotation. Plot 1, on the portion of the field which receives a complete fertiliser for the roots, suffered somewhat during the winter, for water lay there badly during the heavy rains of December and killed off some of the plants, which were only imperfectly replaced by re-seeding in January.

The yield on the Permanent Grass Plots in the Park was below the average, and the proportion of leguminous herbage was also below the average. On most of the half plots the effect of the liming was apparent in a considerable increase of crop, and the leguminous plants were also more abundant on the limed portions. On the un-

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limed portions of the plots receiving sulphate of ammonia, where the soil is now markedly acid, the vegetation suffered considerably during the drought, and the bare patches which have been developing of late years are now very prominent.

The Little Hoos Field, on which the residual values of manures are being tested, was sown with mangolds, and though an even plant was obtained it grew very indifferently through the drought and yielded but a small crop of about twelve tons to the acre. The effect of the manure applied in the current year was very evident, but the manurial residues had but a small influence upon the yield.

All experiments with root crops were unsatisfactory this year, so that the yields were small and somewhat irregular on the plots that are used to test the value of the new nitrogenous fertilisers—cyanamide and nitrate of lime. As in previous years, nitrate of soda has proved the most effective source of nitrogen for mangolds on the Rothamsted soil, and the newer fertilisers did not give the results which might have been expected.

At the Laboratory the pot experiments on the continuous growth of plants in the same soil have been continued for another season without as yet any conclusive results, and the same statement might be applied to the experiments upon clover sickness. The vegetation house was very largely given up to a new series of experiments on the treatment of "sick" greenhouse soils, which have become unfit for the continued growth of crops after two years' use in the greenhouse, though they are still exceptionally rich in plant food. Methods of treating the soil by heating to various temperatures and by the use of antiseptics were tested with satisfactory results, and a method for dealing with soil on a commercial scale has been worked out, which is being extensively tested. It seems likely that at a very small cost the growers of tomatoes and cucumbers under glass may be saved from what has hitherto been the expensive necessity of frequently renewing their soil. Drs. Russell and Hutchinson, with Mr. Petherbridge, have been studying in detail the chemical, physical and biological changes brought about in the soil by the treatment, and the results are almost ready for publication. Dr. Russell has also been extending his work upon the part played by the protozoa in the production of sewage-sick soils and the effect of partial sterilisation in restoring their activity. This work has been undertaken in connection with Mr. J. Golding on sewage farms at Kegworth and Kingston, and a very considerable measure of success has been attained by the treatment.

The experiments on the toxic and stimulating effects of small

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quantities of various mineral substances were continued, and a series of experiments were begun on the growth of plants in extracts of the soils from the experimental plots. These latter trials have yielded some very striking results, which are to be repeated and extended in the coming year. Another series of experiments dealt with the growth of plants in nutritive solutions of various concentrations, either as water cultures or with the nutritive solution added to sand so as to keep the sand moist but not wet. In all cases growth was found to be proportional to the concentration of the solution, even though the solutions were regularly renewed and always provided the plant with an excess of nutrients. It was also found that the soluble nutrients could diffuse with perfect freedom along the thin water films coating the grains of sand, and that there was no retardation of growth even when the nutrients were enclosed in porous pots inside the sand, so that they were forced to travel by diffusion before they could reach the plant's roots. Further experiments on this subject are projected for the coming year.

Dr. Brenchley resumed her study of the weeds of arable land, taking this time a district on the borders of North West Wiltshire and Somerset, which gave her a range of formations including some of those that were dealt with in her work of 1911 on the soils of South Bedfordshire. It is interesting to find that the association of particular weeds with particular soils which prevailed in South Bedfordshire did not always hold for the same formations and weeds in the new district. Dr. Brenchley's second paper dealing with her 1912 work is now going through the press.

During the year the Board of Agriculture has published the Report on the Agriculture and Soils of Kent, Surrey and Sussex carried out by Dr. Russell and myself. The Report forms a book of 206 pages with 56 maps and plates, and gives the analyses, mechanical and chemical, of 124 soils with their subsoils, derived from 14 formations. The report contains an account with some historical notes of the agriculture and rural industries of the district, illustrated by a series of maps showing the distribution of crops. The dependence of this distribution upon the character of the soils and the rainfall is discussed, and recommendations are made as to the systems of manuring, seed mixtures, etc., appropriate to each formation.

A more elaborate study of the fatting and non-fatting pastures of Romney Marsh has been brought to a conclusion, and a paper on the subject is now ready for the press. No very pronounced difference could be found between either soils or the herbage of the two pastures. The difference, which is very real in practice, seems to be due to an accumulation of small causes acting over a long period of time, the fatting pastures being slightly higher and drier, while the only chemical difference in the soils was a greater proportion of phosphoric acid in the soils from the fatting fields. The soils from the fatting fields were also considerably more active, and produced ammonia and nitrate at a greater rate, especially in the earlier part of the season. No light on the greater feeding value of one herbage over the other was obtained from their analyses; it is evident that the ordinary methods of analysis of feeding stuffs are not sufficiently refined to deal with a question of this kind.

The following papers have been published during the year.

H. B. HUTCHINSON and N. H. J. MILLER. "*The Direct Assimilation of Inorganic and Organic Forms of Nitrogen by Higher Plants.*" Centr. Bakt. Par. 1911. ii, **30**, 513.

In these experiments barley and peas were grown in water cultures under perfectly sterile conditions, and the nitrogen required for nutrition was supplied in various forms of combination other than the nitrates upon which plants are generally considered to be dependent. The technical difficulties of growing plants under sterile conditions are considerable, but they were successfully overcome, and in all the cases dealt with the culture medium was found to have remained sterile at the end of the experiment. It was found possible to get plants to grow when supplied with a large number of compounds of nitrogen, which must have been taken up directly because of the absence of organisms to convert them into simpler forms of combination. Of the compounds tested ammonia gave satisfactory growth, the plants being characterised by a high proportion of nitrogen in their dry matter. The greatest growth however was obtained with urea. Barbituric acid, acetamide, alloxan, soluble humus, and peptone were also satisfactory sources of nitrogen, while formamide, glycine, alanine, guanidine hydrochloride, cyanuric acid and oxamide gave rise to a distinct though more limited amount of growth. Hydroxylamine hydrochloride, ethyl nitrate, propionitrile, methyl carbamate, gave negative results, as also probably did trimethylamine, *para*-urazine and hexamethylenetetramine. Tetranitromethane proved to be toxic. Plants are thus shown to be capable of utilising directly many of the compounds of nitrogen which may occur in the soil as products of bacterial decay, as well as the ammonia and nitrates which are the final terms of such changes.

T. GOODEY. "*A contribution to our knowledge of the Protozoa of the Soil.*" Proc. Roy. Soc. 1911. B. **84**, 165.

In this paper Mr. Goodey gives a detailed description with figures of the various species of protozoa which he has been able to isolate from soils. Mr. Goodey also devised a method for driving the protozoa rapidly out of the soils, and so of enumerating them directly. The method depends essentially upon the fact that when an electric current is applied to a medium containing living protozoa they travel with the current to the cathode. It was not found possible to obtain ciliated protozoa in an active condition until after the cultures had been incubated for from two to four hours. When first observed they also had the appearance of organisms that had just emerged from the encysted state, and contained no trace of food. As two to four hours is also the time required for these ciliated protozoa to emerge from their cysts, Goodey concludes that in any normal soil the protozoa are not active but encysted, and therefore cannot be effective in limiting the number of bacteria, as has been suggested by Russell and Hutchinson. The investigation deals only with the ciliated protozoa, and the amoeba in the soil may still have the effect that Russell and Hutchinson attribute to them. Moreover, under certain conditions of free moisture supply and temperature the protozoa must become active, and these are also the conditions which would make for the development of bacteria.

A. D. HALL and N. H. J. MILLER. "*The Absorption of Ammonia from the Atmosphere.*" Jour. Agric. Sci. 1911. 4, 56.

This paper deals with a series of experiments on the rate of absorption of ammonia from the atmosphere, when shallow dishes containing dilute sulphuric acid were exposed close to the surface of the ground and at 4 feet above it, in the Laboratory grounds, above Broadbalk field and the grass field. The dishes were protected from rain, and were also covered by fine gauze screens to keep out the flies and dust, which were found in the earlier experiments to interfere seriously with the results. Determinations of the ammonia absorbed were made every month, and the trials were continued for two years. The amount of ammonia absorbed proved to be very much less than had been obtained by previous investigators working with similar methods, and there is evidence that this was due to the exclusion of dust, etc., and perhaps to the diminished circulation of the air over the absorbing liquid which was brought about by the gauze screens. The dishes on the high level generally absorbed more ammonia than those near the ground; this also is probably due to the greater circulation of the air. The dishes in the Laboratory grounds gave the highest returns, probably because of the proximity of chimneys. The method however did not lead to any conclusions as to whether the soil acts normally as an absorbent of ammonia from the atmosphere, or whether it yields ammonia to the atmosphere.

However, for some weeks after ammonium salts had been supplied as manure to the Broadbalk Field, there was an enormous increase in the amount of ammonia absorbed from the air, and the lower dishes during this period absorbed much more than the upper one. This may be taken as evidence that there will be some loss of nitrogen to the soil as free ammonia, whenever ammonium salts are supplied as a fertiliser to soils containing calcium carbonate.

W. E. BRENCHLEY. "*The Weeds of Arable Land in relation to the Soils on which they grow.*" Annals of Botany. 1911. **25**, 155.

This paper contains a description of the distribution of weeds of arable land upon the following formations in Hertfordshire and South Bedfordshire : — Clay-with-flints, Alluvium, Chalk, Gault, Lower Greensand and Oxford Clay. A distinct association was found to exist between some of the species and the soils upon which they grew, but the determining factor proved to be the texture of the soil, except in the one case of the calcareous soils derived from the chalk. For example, *Bartsia Odontites* and *Mentha arvensis* were confined to clay, *Chrysanthemum segetum*, *Rumex acetosella* and *Spergula arvensis* were confined to sand, and are probably characteristic of an acid soil condition, while the Bladder Campion, *Silene Cucubalus*, *Geranium pusillum* and a few others were confined to Chalk. A certain number of weeds, like Shepherd's Purse, Chickweed, Horsetail, Coltsfoot, etc., appeared to occur indifferently on all soils. It is impossible to say how far some of the associations are valid until the work has been extended to a number of similar soils in different localities.

W. B. MERCER and A. D. HALL. "*The Experimental Error of Field Trials.*" Jour. Agric. Sci. 1911. **4**, 107.

This paper contains a discussion of the results obtained in 1910, when an acre of mangolds apparently uniform was harvested in 200 equal plots, and an acre of wheat was similarly divided into 500 plots, from each of which the grain and straw were harvested separately. The results are set out and discussed by various statistical methods. They show that the probable error attaching to a field trial consisting of two plots alone is in the neighbourhood of plus or minus 5 per cent., and this error, though it diminishes with the size of the plots, is not greatly reduced when the plots are made larger than $\frac{1}{50}$ of an acre. By repeating the plots receiving any particular treatment and scattering them about the experimental area, a considerable reduction can be effected in the experimental error, though an increase of the number of plots above 5 is not attended by any great further reduction of error. The authors consider that the most satisfactory unit for field trials consists of five plots, each $\frac{1}{50}$ of an acre in extent, regularly distributed about the experimental area, and each harvested separately. This would yield results true within 1 to 2 per cent. for the particular season. Effects of climate can only be eliminated by continuing the experiments over a term of years.

A. D. HALL and E. J. RUSSELL. "*Report on the Agriculture and Soils of Kent, Surrey and Sussex.*" Published for the Board of Agriculture by H. M. Stationery Office. 1911. 2/6.

This Report has been already described.

A. D. HALL and E. J. RUSSELL. "*Soil Surveys and Soil Analyses.*" Jour. Agric. Sci. 1911. **4**, 182.

In this paper the results of the analyses contained in the above Report are discussed from a scientific standpoint. The paper deals with the methods of taking a sample, and the degree of accuracy which may be expected to attach to the processes both of analysis and sampling. The fractions of the soil, consisting of particles of a specified size, were also subjected to analysis, and the paper further discusses the interpretation of the results obtained by analysis and certain correlations which are shown to exist between the chemical and mechanical analyses. This paper is of technical interest only, being addressed to chemists who have the conduct of the soil analyses rather than to the general agriculturist.

E. J. RUSSELL and J. GOLDING. "*Sewage Sickness in Soil and Its Amelioration by Partial Sterilisation.*" Jour. Soc. Chem. Ind. 1911. **30.**

This paper deals with an investigation of the state into which the soil of sewage farms arrives after the continued application of sewage, whereby it is so far injured both in its physical and biological conditions that it will no longer either let the sewage percolate or purify what passes through. Sewage-sick soil was found to possess a very limited bacterial activity and to be exceptionally rich in those protozoan organisms which Russell and Hutchinson have regarded as the limiting factor in the development of bacteria in soils. Partial sterilisation of the soil, either by treatment with antiseptics or by heating, was followed by a very large increase in the number of bacteria; in one case they rose from about 40 million to over 400 million per gram of the soil. Accompanying this increase in bacterial activity there was a renewal of the purifying effect of the soil upon the sewage, and it was found possible to restore the sewage-sick soil and make it become an even more effective filter than before, either by heating the soil sufficiently to char it slightly or by treating it with the vapour of toluene.

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CROPS GROWN IN ROTATION. AGDELL FIELD.

PRODUCE PER ACRE.

Year.	CROP.	O. Unmanured.		M. Mineral Manure.		C. Complete Mineral and Nitrogenous Manure.	
		5. Fallow.	6. Beans or Clover.	3. Fallow.	4. Beans or Clover.	1. Fallow.	2. Beans or Clover.
FIFTEENTH COURSE, 1904-7.							
1904	Roots (Swedes) Cwt.	16·8	6·4	151·2	171·4	318·6	203·2
1905	Barley Grain ... Bus.	15·5	7·3	16·0	15·2	23·1	31·4
	Barley Straw ... Cwt.	10·6	8·0	10·5	11·3	13·5	20·1
1906	Clover Hay ... Cwt.	—	4·1	—	41·0	—	9·5*
1907	Wheat Grain ... Bus.	16·3	21·4	19·1	36·8	25·1	29·3
	Wheat Straw ... Cwt.	21·4	27·1	28·6	49·6	35·3	35·1
LAST COMPLETE COURSE (16th), 1908-11.							
1908	Roots (Swedes) Cwt.	21·6	6·4	179·0	235·8	395·4	314·0
1909	Barley Grain ... Bus.	11·4	10·0	17·4	22·1	26·8	33·4
	Barley Straw ... Cwt.	10·1	11·3	12·7	16·9	18·7	23·8
1910	Clover Hay 1st crop Cwt.	—	1·6	—	24·1	—	32·2
	Clover Hay 2nd crop Cwt.	—	15·8	—	40·0	—	44·5
1911	Wheat Grain ... Bus.	23·9	24·5	31·9	37·8	33·3	38·0
	Wheat Straw ... Cwt.	20·4	21·4	28·6	33·5	29·3	32·5

* The plant almost entirely failed on this plot, and new seed was sown broadcast on May 1st, 1906.

METEOROLOGICAL RECORDS, 1911.

(*See "Guide," page 16, Table IX.*)

	Rain. Total Fall. 5-inch Funnel Gauge.	Rain. Total Fall. 1/1000 Acre Gauge.	Rain. No. of Rainy Days. 1/1000 Acre Gauge.	Drainage through soil. 20 ins. deep.	Drainage through soil. 40 ins. deep.	Drainage through soil. 60 ins. deep.	Bright Sun-shine.	Temperature. Max.	Temperature. Min.
	Inches.	Inches.	No.	Inches.	Inches.	Inches.	Hours.	°F.	°F.
Jan. ...	1·269	1·375	15	1·163	1·277	1·266	64·7	41·9	32·2
Feb. ...	1·782	1·878	15	0·776	0·717	0·741	76·4	45·9	33·1
March ...	2·090	2·267	20	1·245	1·356	1·370	85·2	47·1	34·8
April ...	1·501	1·594	11	0·533	0·586	1·091	163·8	53·5	37·7
May ...	3·688	3·788	10	2·020	1·856	1·878	211·6	65·1	44·6
June ...	2·601	2·736	12	0·854	0·837	0·792	201·8	67·4	49·1
July ...	0·636	0·654	5	0·007	0·040	0·045	315·6	76·3	53·5
August ...	0·950	1·048	10	—	0·004	0·004	227·3	75·9	55·0
Sept. ..	1·366	1·517	9	—	—	—	222·9	68·8	47·2
Oct. ...	3·301	3·474	17	1·947	1·828	1·723	98·8	56·1	42·0
Nov. ...	3·266	3·444	21	2·847	2·719	2·672	68·2	48·3	37·0
Dec. ...	6·110	6·255	26	6·164	5·971	5·822	49·3	48·0	37·0
Total or Mean	28·560	30·030	171	17·556	17·191	17·404	1785·6	57·9	41·9

MANGOLDS, BARN FIELD, 1911.

(*See "Guide," page 11, Table VI.*)

Strip.	Strip Manures.		Cross Dressings. O. None.	N. Nitrate of Soda.	A. Ammonium Salts.	A.C. Rape Cake & Ammonium Salts.	C. Rape Cake.
			Tons.	Tons.	Tons.	Tons.	Tons.
1	Dung only ...	R.	**13·41**	**14·87**	**9·14**	**14·53**	**15·77**
		L.	2·24	5·32	4·12	3·60	3·55
2	Dung, Super, Potash	R.	**14·94**	**12·29**	**12·45**	**20·30**	**21·19**
		L.	2·40	5·12	5·34	4·73	3·97
4	Complete Minerals	R.	**2·14**	**6·41** / **4·89**	**6·14**	**13·41**	**11·79**
		L.	1·28	4·69 / 4·02	4·27	6·12	3·97
5	Superphosphate only	R.	**0·90**	**5·64**	**1·15**	**0·95**	**0·86**
		L.	1·20	4·45	1·71	1·32	1·04
6	Super and Potash	R.	**1·36**	**5·18**	**4·53**	**8·23**	**8·13**
		L.	0·99	3·82	3·45	5·24	4·02
7	Super, Sulph. Mag. & Chloride Sodium	R.	**1·48**	**5·16**	**5·75**	**8·88**	**8·34**
		L.	1·12	4·13	3·79	5·72	4·13
8	None	R.	**0·80**	**2·30**	**1·09**	**1·14**	**0·51**
		L.	0·99	2·55	1·43	1·47	0·93

HAY. THE PARK GRASS PLOTS, 1911.

(*See "Guide," page 19, Table XI.*)

Plot.	Manuring.	Yield of Hay per acre. 1st Crop.	2nd Crop.	Total.
		Cwt.		Cwt.
3	Unmanured	17·3	NO SECOND CROP.	17·3
12	Unmanured	19·0		19·0
2	Unmanured (1)	21·3		21·3
1	Ammonium Salts alone (1)	21·1		21·1
4-1	Superphosphate of Lime	20·4		20·4
8	Mineral Manure without Potash ...	23·6		23·6
7	Complete Mineral Manure	31·9		31·9
6	As 7, 1869 and since (2)	28·8		28·8
15	As 7, 1876 and since (3)	33·3		33·3
5	Superphosphate and Potash, 1898 and since	16·7		16·7
17	Nitrate of Soda alone	30·3		30·3
4-2	Superphosphate and Amm. Salts ...	26·5		26·5
10	Mineral Manure (without Potash) and Amm. Salts	31·1		31·1
9	Complete Mineral Manure and Amm. Salts	45·5		45·5
13	Dung and Fish Guano, once in 4 years	39·1		39·1
11-1	Complete Mineral Manure and extra Amm. Salts	46·5		46·5
11-2	As 11-1, and Silicate Soda	52·9		52·9
16	Complete Mineral Manure and Nit. Soda = 43 lb. N.	39·9		39·9
14	Complete Mineral Manure and Nit. Soda = 86 lb. N.	44·4		44·4

Quick Lime (ground) at the rate of 2000 lb. per acre, applied to the South half of plots 1 to 4-2, 7 to 11-2, 13 and 16, in January, 1907.

(1) Received Farmyard Dung, 8 years, 1856—63. (3) Nitrate of Soda alone previously.

(2) Ammonium Salts alone previous to 1869.

BOTANICAL COMPOSITION, PER CENT.

First Crop, 1911.

(*See "Guide," page 20, Table XII.*)

Plot.	Manuring.	Gramineæ.	Leguminosæ.	Other Orders.
		Per cent.	Per cent.	Per cent.
3	Unmanured	45·7	4·5	49·8
4-1	Superphosphate of Lime ...	45·2	10·0	44·8
8	Mineral Manure without Potash	51·5	9·0	39·5
7	Complete Mineral Manure ...	65·3	10·4	24·3
6	As 7, 1869 and since (2)	58·3	12·1	29·6
15	As 7, 1876 and since (3)	61·8	4·8	33·4

WHEAT. BROADBALK FIELD, 1911.

(*See "Guide," page 26, Table XIV.*)

Plot.	Manuring.	Dressed Grain. Yield.	Dressed Grain. Weight per Bushel.	Straw.
		Bushels.	lbs.	Cwt.
2	Farmyard Manure	35·2	66·7	36·9
3	Unmanured	12·5	64·4	9·8
5	Complete Mineral Manure	14·8	65·1	12·8
6	As 5, and single Amm. Salts ...	17·2	65·3	17·9
7	As 5, and double Amm. Salts ...	25·6	66·0	27·6
8	As 5, and treble Amm. Salts ...	36·4	66·6	35·7
9	As 5, and single Nitrate Soda ...	29·9	65·6	29·0
10	Double Amm. Salts alone	22·8	65·1	17·2
11	As 10, and Superphosphate	20·1	63·2	15·2
12	As 10, and Super and Sulph. Soda	27·0	64·8	20·6
13	As 10, and Super and Sulph. Potash	29·7	66·0	27·4
14	As 10, and Super and Sulph. Mag.	24·1	64·4	18·9
15	Double Amm. Salts in Autumn, and Minerals	24·1	65·8	22·3
16	Double Nitrate and Minerals ...	40·4	66·8	42·4
17	Minerals alone, or double Amm. Salts	*13·8	*64·9	*11·7
18	alone, in alternate years	†27·3	†66·1	†24·6
19	Rape Cake alone	28·6	65·8	24·7
20 (1)	As 7, but excluding Superphosphate	21·6	65·7	18·0

* Produce by Minerals. † Produce by Ammonium Salts.
(1) Commenced in 1906.

BARLEY. HOOS FIELD, 1911.

(*See "Guide," page 33, Table XVI.*)

Plot.	Manuring.	Dressed Grain. Yield.	Dressed Grain. Weight per Bushel.	Straw.
		Bushels.	lbs.	Cwt.
1 O	Unmanured	4·9	54·4	5·5
2 O	Superphosphate only	11·9	55·8	9·1
3 O	Alkali Salts only	4·3	54·9	5·3
4 O	Complete Minerals	5·9	56·1	7·8
1 A	Amm. Salts only	13·8	52·9	12·5
2 A	Superphos. and Amm. Salts ...	10·3	53·5	11·6
3 A	Alkali Salts and Amm. Salts ...	11·8	55·6	14·1
4 A	Complete Minerals and Amm. Salts	28·5	56·3	22·9
1 N	Nitrate of Soda alone	16·2	53·8	17·8
2 N	Superphos. and Nitrate Soda ...	26·1	55·4	24·7
3 N	Alkali Salts and Nitrate Soda ...	12·5	54·3	14·5
4 N	Complete Minerals and Nitrate Soda	28·9	55·8	23·7
1 C	Rape Cake alone	27·4	56·8	20·7
2 C	Superphos. and Rape Cake	28·2	57·1	20·8
3 C	Alkali Salts and Rape Cake	21·6	56·0	18·6
4 C	Complete Minerals and Rape Cake	25·7	56·6	20·1
7-1	Unmanured (after Dung, 1852-71) ...	9·5	56·4	10·5
7-2	Farmyard Dung	23·0	56·2	24·0

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BARLEY. HOOS FIELD, 1911.

(Previous Cropping: Potatoes, 1876-1901; Barley, 1902 and 1903; Oats, 1904; Barley, 1905 and since.)

(*See "Guide," page 40, Table XIX.*)

Plot.	Manures applied to the Potatoes, 1876-1901. Unmanured since.	Dressed Grain.		Straw.	Total Produce.
		Yield.	Weight per Bushel.		
		Bushels.	lbs.	Cwt.	lbs.
1	Unmanured	(36 lbs.)	—	1·2	175
2	Unmanured 1882 to 1901, previously Dung only ...	4·0	54·1	5·0	797
3	Dung 1883 to 1901	10·8	56·3	11·4	1919
4	Dung 1883 to 1901	13·6	57·0	13·5	2337

WHEAT AFTER FALLOW (without manure 1851 and since).

HOOS FIELD, 1911.

(*See "Guide," page 41, Table XX.*)

Dressed Grain	Yield—17·0 Bushels. Weight per Bushel—64·2 lbs.
Straw	13·7 cwt.
Total produce	2687 lbs.

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COMPARATIVE TEST OF NITROGENOUS FERTILISERS.

MANGOLDS (after Wheat in 1910, and Barley in 1909).

LITTLE HOOS FIELD, 1911.

Plot.	Manuring in 1911.	Produce per acre. Roots.	Leaves.	Total.
		Tons.	Tons.	Tons.
1	3 cwt. Superphosphate, and 200 lb. Sulphate of Potash	9·7	2·2	11·9
6		9·8	2·4	12·2
2	As 1 and 6, and Nitrate of Soda = 50 lb. N.	17·6	3·1	20·7
7		13·1	2·7	15·8
3	As 1 and 6, and Nitrate of Lime = 50 lb. N.	14·0	3·6	17·6
8		11·4	3·3	14·7
4	As 1 and 6, and Sulphate of Ammonia = 50 lb. N.	14·0	2·2	16·2
9		9·5	2·4	11·9
5	As 1 and 6, and Cyanamide = 50 lb. N.	12·6	2·3	14·9
10		9·5	2·4	11·9
0	As 1 and 6, and equal parts Nitrate of Lime and Cyanamide = 50 lb. N.	9·6	3·1	12·7
11		9·9	2·4	12·3
00	As 1 and 6, and a mixture of 1 part Nitrate of Lime and 2 parts Cyanamide = 50 lb. N.	9·9	3·1	13·0
12		8·4	2·0	10·4

LITTLE HOOS FIELD, 1904-1911.

RESIDUAL VALUE OF VARIOUS MANURES.

(See "Guide," pages 41 and 42.)

TOTAL PRODUCE—Grain and Straw, or Roots and Leaves, per acre.

Series and Plot.	Manuring.	Swedes 1904.	Barley 1905.	Man-golds 1906.	Spring Wheat 1907.	Swedes 1908.	Barley 1909.	Wheat 1910.	Man-golds 1911.
		Tons.	lbs.	Tons.	lbs.	Tons.	lbs.	lbs.	Tons.
A 1	Unmanured	10·3	2323	17·1	3650	14·0	3792	2270	11·6
2	Dung (ordinary), 1904 and 1908	**13·1**	4649	18·2	4673	**19·1**	5128	2572	13·9
3	,, ,, 1905 and 1909	8·8	**3501**	17·5	5393	14·5	**5544**	2681	14·1
4	,, ,, 1906 and 1910	8·8	2269	**18·2**	5471	15·5	4057	**2406**	12·5
5	,, ,, 1907 and 1911	9·8	2402	14·9	**6903**	17·3	4581	2358	**15·8**
B 1	Dung (cake fed), 1904 and 1908	**15·7**	4177	19·4	4319	**22·4**	5362	2386	14·1
2	Unmanured	10·0	2417	16·2	4025	14·3	3862	2261	12·0
3	Dung (cake fed), 1905 and 1909	9·5	**5530**	18·5	5497	14·2	**6641**	2921	14·2
4	,, ,, 1906 and 1910	11·4	2772	**25·6**	6489	16·9	4400	**3502**	14·4
5	,, ,, 1907 and 1911	9·4	2649	14·4	**9407**	19·0	4298	2369	**17·1**
C 1	Shoddy, 1904 and 1908 ...	**14·7**	3656	21·0	4667	**19·7**	3969	2295	11·4
2	,, 1905 and 1909 ...	11·1	**4363**	23·6	4550	16·3	**4558**	2387	11·6
3	Unmanured	10·6	2588	17·7	4334	15·1	3850	2561	11·7
4	Shoddy, 1906 and 1910 ...	10·7	2512	**24·2**	6231	19·1	4466	**3461**	14·0
5	,, 1907 and 1911 ...	10·3	2615	16·9	**7495**	22·2	5448	2560	**14·7**
D 1	Guano, 1904 and 1908 ...	**14·6**	2550	20·1	4056	**20·9**	3608	1742	10·5
2	,, 1905 and 1909 ...	11·0	**5176**	19·7	4165	15·3	**6834**	2114	11·5
3	,, 1906 and 1910 ...	10·9	2857	**25·6**	4846	15·9	4053	**3392**	11·1
4	Unmanured	10·6	2985	18·7	4618	17·4	4510	2739	11·8
5	Guano, 1907 and 1911 ...	10·6	2680	17·4	**7375**	15·7	4014	2374	**14·2**
E 1	Rape Cake, 1904 and 1908 ...	**14·1**	2674	17·8	3887	**19·7**	3750	2180	10·7
2	,, 1905 and 1909 ...	11·2	**4185**	17·9	4326	15·1	**5203**	2242	11·7
3	,, 1906 and 1910 ...	9·5	2645	**22·7**	4584	14·5	3866	**3486**	11·5
4	,, 1907 and 1911 ...	10·5	2734	19·4	**6619**	15·2	4661	2516	**14·5**
5	Unmanured	10·8	2769	19·5	4527	14·7	4155	2784	12·7
F 1	Unmanured	11·7	3132	22·9	4749	14·1	4814	3166	8·7
2	Superphosphate, 1904 and 1908	**12·2**	3025	23·2	5064	**16·9**	4726	3223	10·9
3	,, 1905 and 1909	10·2	**3949**	23·6	4956	14·6	**4973**	2922	11·7
4	,, 1906 and 1910	9·7	3913	**24·1**	5419	16·0	5280	**2682**	12·8
5	,, 1907 and 1911	9·7	4221	23·6	**5698**	16·4	5641	3190	**14·2**
G 1	Bone Meal, 1904 and 1908 ...	**12·9**	3176	23·1	5203	**16·7**	4445	3345	9·9
2	,, 1905 and 1909 ...	10·1	**3636**	22·1	5821	14·3	**4922**	3657	9·9
3	Unmanured	10·2	3495	20·6	5491	12·7	4247	3701	9·2
4	Bone Meal, 1906 and 1910 ...	9·9	3450	**22·6**	6043	14·2	4711	**3263**	10·5
5	,, 1907 and 1911 ...	9·2	3525	22·1	**6276**	19·9	5285	3512	**12·6**
H 1	Basic Slag, 1904 and 1908 ...	**11·8**	4400	20·5	6285	**13·8**	4182	3564	11·5
2	,, 1905 and 1909 ...	10·4	**4002**	21·3	5930	13·6	**4530**	3596	12·0
3	,, 1906 and 1910 ...	9·4	3662	**21·4**	5860	13·6	4431	**3943**	12·5
4	,, 1907 and 1911 ...	9·1	3624	17·0	**5816**	14·4	3860	3804	**12·0**
5	Unmanured	8·6	3293	17·4	5933	11·4	4511	4005	10·5

The yields on the plots to which the manure was applied in any given year are printed in heavier type.

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