ROTHAMSTED RESEARCH

# Rothamsted Report for 1908

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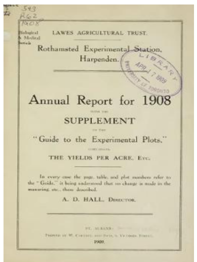
LAWES AGRICULTURAL TRUST.

Rothamsted Experimental Station, Harpenden.

Annual Report for 1908

SUPPLEMENT

"Guide to the Experimental Plots."

THE YIELDS PER ACRE, Etc.

A. D. HALL, Director.

## Rothamsted Report for the Year 1908

### Rothamsted Research

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# ANNUAL REPORT

## For the Year 1908.

The weather of 1908 presented many peculiarities, but was on the whole favourable to vegetation. The autumn and early winter of 1907 were exceptionally open and mild, both rainfall and mean temperature being considerably above the average for the last quarter of the year; on this account and because of the sunless character of the previous season, most perennial plants were in a soft and unripened state at the end of the year. In early January severe frosts came (there were two short spells when the grass temperature fell to 11° F.), accompanied by drying winds and no snow, whereupon great destruction was wrought, even among hardy plants.

The Wheat in Broadbalk, sown on November 6th and 7th, 1907, lost plant considerably at this stage and continued to show very indifferent promise up to May. It recovered very rapidly during the fine hot weather of May and June, and eventually yielded more than an average crop of excellent quality, the wheat from several of the plots weighing over 64lb., that from one plot even reaching 65lb. per bushel. The unmanured plot (65th successive crop of wheat, no manure since 1838) yielded 12·4 bushels of wheat (weighing 63·5lb. per bushel) and 7·7 cwt. of straw.

The Barley was sown on Hoos Field (57th crop on the same plots) on April 2nd; the land was in good tilth and the seed germinated well, but the weather about that time was of the worst description; night frosts were recorded on 19 occasions during April, the reading on the grass being as low as 22° on the 27th. The young plant never seemed to grow away properly, and eventually a very low yield of poor quality was obtained.

The crops on the permanent grass plots (53rd year of the experiment) were rather above the average, the proportion of leguminous plants in the herbage was also rather above the average. It is noticeable that Plot 14, which receives the high dressing of 550lb. per acre of nitrate of soda, is beginning to be over-run by *Lathyrus pratensis*, though in earlier separations it has never shown more than a few per cent. of leguminous plants. Through the long continued use of nitrate of soda the soil of this plot has become so alkaline that when extracted with water it yielded free alkali equivalent to 175lb. per acreof sodium carbonate in the soil down to a depth of 3 feet.

Owing to an accident to the manure drill and subsequent wet weather the Mangold field was not sown until May 11th and 18th. Partly through the caking of the surface following the long continued use of saline manures on this field, and partly through the attack of some insect, but a scanty and irregular plant started. On some of the plots very few seeds survived, and as it became obvious that the results would bear but little relation to the manures supplied, it was decided to skim over the surface and sow with Swede Turnips, which was done on July 9th and 11th. No Swede Turnips had been grown on this land since 1870; the value of a change of crop was seen in the exceptional vigour with which the Swede seed germinated and began to grow. Having been sown late and on land receiving such large amounts of nitrogenous manure, the crop ran very much to top; on several plots the leaf weighed half as much again as the roots when the crop was harvested in November. But the crop was extraordinary in the great uniformity of the growth; there were no blanks and every plant was clean and vigorous. Even on the plots which receive an excess of nitrogen and are potash starved, where the mangolds are every year attacked by *Uromyces betae*, the Swede turnip leaves were free from fungoid attack, though they presented a curious flecked appearance, patches of dead tissue being visible near the margins.

On the Agdell Field the 16th four-course rotation began with a crop of Swede Turnips, sown on the 12th of June. A very regular plant was obtained, which made good growth throughout the season and showed several interesting features, illustrated by the following photograph taken of the entire crop from each plot.

Plots 6 5 4 3 2 1

On the middle plots to which no manurial nitrogen is applied, the yield on Plot 3 (bare fallowed before the wheat) was 9 tons against 11·8 tons on Plot 4, which carried clover two years before. Thus the roots and stubble of the clover grown in 1906 had left behind sufficient nitrogen gathered from the atmosphere to raise the wheat crop in 1907 by 92·8 per cent., and the Swede crop in 1908 by 31·7 per cent.

On the wholly unmanured plots 5 and 6, however, the yield of turnips after clover was only 6·4 cwt. against 21·6 cwt. on the bare fallowed portion. The reason for this difference between the after effect of clover on Plots 5 and 6, and on Plots 3 and 4, is probably to be found in the fact that the clover of 1906 was followed by a bigger wheat crop in 1907; 21·4 bushels were obtained from Plot 6 as against 16·3 bushels from Plot 5. This increased crop caused a greater draught on the phosphoric acid and other minerals in the soil, consequently as the phosphates form the limiting factor for the Swede crop in the absence of fertilisers of any kind, the yield from Plot 5 is less than that of Plot 6 because of the greater removal of phosphoric acid by the previous wheat crop. The clover crop grown on Plot 6 in 1906 must also have removed phosphoric acid, and the extra nitrogen it left behind annot compensate the Swede crop for the phosphoric acid that is lacking.

The Little Hoos Field, used for testing the effect of residues of manures, was also in Swedes this year; there was a regular plant and satisfactory growth. Shoddy and Farmyard manure continue to show large residues, perceptible up to the fourth year after their application, but the superiority of cake-fed dung over dung made from roots and hay only, very marked in the year of application, is small in the succeeding years.

In the Laboratory a beginning was made of an investigation of the existence and nature of land "sickness," whether plants do not unfit the soil for their continuous growth in some other way than by depleting the plant food or infecting the soil with a specific disease. Different plants have been started in soil, sand, and water respectively, some are grown repeatedly in the same medium, in other cases a rotation is followed. The great heat of June and July was not, however, very favourable for work in pots. A heating apparatus is being put in the glasshouse to enable us to make an earlier beginning in the year, so as to obviate the necessity of starting the second crop so late.

As part of the same investigation, an examination was also begun of the changes taking place in soil when it is heated to the temperature of boiling water or partially sterilised by treatment with volatile antiseptics such as chloroform. Dr. Russell has been working on the chemical and Dr. Hutchinson on the bacteriological side of the problem; the usual great increase of crop was seen, heating raised the yield from 100 to 180, and treatment with toluene to 120. These charges are being correlated with a redistribution of the bacterial flora of the soil, together with some direct chemical change brought about by the treatment ; the investigation is not however completed.

A number of experiments on clover "sickness" have been started, designed with the view of getting some clue to the susceptibility of the plant to disease ; and the pots are now awaiting the effect of the winter, during which the killing usually takes place.

Other investigations of a bacteriological character are intended to deal with more technical points, such as (1) the nature of the competition between the higher plants and the bacteria and fungi for plant food in the soil ; and (2) the growth of plants under sterile conditions with ammonium salts as their sole source of nitrogen ; such work is necessary to provide data for the elucidation of wide practical problems.

Soil inoculation has occupied a good deal of public attention during the year ; pure cultures of the nodule organisms associated with beans and clover have therefore by request been distributed to members of the various Agricultural Colleges, etc., who wanted to conduct field experiments in that direction ; thirty-eight cultures were thus sent out.

In connection with the field experiments on the duration of manures and the value of their residues, a series of experiments are being made in the Laboratory on the rate at which the various nitrogenous fertilisers give rise to nitrates in the soil, so as to obtain another measure of their relative activity. This experiment will be continued during several years until the nitrogen applied to the soil has been practically recovered.

Miss Brenchley has continued her work on the effect of minute traces of metallic salts on the growth of plants, in order to ascertain metals which are poisonous at high concentrations will stimulate all plants when excessively dilute. Some interesting facts have been observed which are to be verified on a larger scale in the coming year.

Part of Miss Brenchley's work on the development of the wheat grain has been published ; the chemical side of the work is now being written up.

The following papers have been published during the year. "*Nitrification in Acid Soils*," by A. D. Hall, N. H. J. Miller, and C. T. Gimingham, Proc. Roy. Soc., B. 80, 196. This paper contains a study of the conditions prevailing on certain of the permanent grass plots to which sulphate and chloride of ammonium has been applied every year, the soil of which is now acid to litmus paper. It is shown that the acidity is mainly due to free humic acid, though in the aqueous extract of the soil a little free sulphuric and hydrochloric acid must also exist, especially in the spring just after the application of the manures. The acid arises from the ammonium salts, which are split up by certain micro-fungi abundant in the soil of these plots, the ammonia being utilised by the fungus and the acid set free. Year by year this soluble acid has attacked the normal calcium humate of the soil, setting free the humic acid, which being very sparingly soluble has accumulated. Owing to their acid condition nitrification has almost ceased in these soils, the bacteria causing the change being only occasionally found, so that the grasses and other plants living on the plots must be feeding directly on the ammonium salts. The poor growth of plants on acid soils may be attributed to the displacement in the soil of the normal bacteria by a fungus flora which competes with the crop for any manure or other plant food in the soil.

"*The Nitrogen Compounds of the Fundamental Rocks*," by A. D. Hall and N. H J. Miller, Jour. Agric. Science, Vol. II., Part 4, 1908. This paper continues the study of the carbon and nitrogen compounds which exist in many rocks taken from great depths beyond the reach of weathering. It is shown that when subjected to the action of soil bacteria such compounds are attacked, but they yield nitrate so slowly that in all probability some of the nitrogen found in soils is not of recent origin but has come from the original rock out of which the soil was formed. Ammonia and nitrates were found in all the rocks.

"*The Chemical Changes taking place during the Ensilage of Maize*," by E. J. Russell, Jour. Agric. Science, Vol. II., Part 4, 1908. The conversion of green crops into silage is not an ordinary feature of English farming, but it can be and often is practised in certain not unusual circumstances. When the season is too wet for making hay the grass can be made into silage. On many of the light chalky soils of the South-Eastern Counties good crops of green maize can be obtained even when roots have failed, but any of the crop that has not been fed off by the end of September must be made into silage or it will not keep. The extension of the area under green leguminous crops would be considerably simplified if the green material could be profitably converted into silage. The problem is therefore of considerable importance, and the investigations begun at Wye were finished here. The object of the enquiry was to trace the changes taking place in the silo, to ascertain which are the fundamental changes that would go on in any silo however perfect, and which are the secondary changes that come into play in an ordinary imperfect silo.

The course of the change was found to be as follows: The maize cells are still living when put into the silo, and continue their respiration, using up sugar with production of carbonic acid, acetic acid, etc. Certain enzymes in the cell act on the protein, breaking it down to simpler bodies less useful as food. Both these types of change are destructive ; the conditions seem to preclude all constructive change. The rise of temperature is a result of the respiratory changes, and is in itself convincing evidence of the loss of dry matter. These changes are fundamental, and take place in every silo, no matter how perfect the conditions may be.

In practice, however, the mass is never sterile, and certain bacteria (but not moulds) produce decompositions which lead to further loss. The softer tissues are broken down and converted into a number of acids ; the nitrogen compounds are further decomposed and rendered less valuable as plant food. These secondary changes can be kept down, but cannot in practice be entirely avoided.

The net result is a loss of dry matter which may vary from 20 to 40 per cent., and a loss of feeding value which is even greater. The process is therefore not economical as compared with other methods for preserving fodder in use in this country, and should only be resorted to when these methods fail.

"*On the strength and development of the Grain of Wheat*," by Miss W. E. BRENCHLEY, Ann. Bot., Jan. 1909. Experiments were undertaken from the biological standpoint to find out whether the varying "strength" or bread-making capacity of the same or different varieties of wheat, grown under the same or differing conditions, is in any way associated with changes in the structures of the cells forming the grain during the process of developmeut and ripening, but only negative results were obtained.

The development of the wheat grain was then investigated right up to maturity. Special care was taken in collecting the material to ensure that the grains should be comparable as to age. After passing through the early stages of development the endosperm or starchy reserve tissue is laid down, forming the bulk of the grain. The starch fills into the cells in a regular manner, appearing first at the end of the grain furthest from the germ, and gradually proceeding upwards till the whole of the tissue is involved. As maturity approaches the nuclei of most of these endosperm cells become disorganised by the pressure of the starch grains, and appear in the form of networks. The embryo or germ develops normally alongside the endosperm.

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## CROPS GROWN IN ROTATION. AGDELL FIELD.

### PRODUCE PER ACRE.

| Year. | CROP. | | O. Unmanured. 5. Fallow. | O. Unmanured. 6. Beans or Clover. | M. Mineral Manure. 3. Fallow. | M. Mineral Manure. 4. Beans or Clover. | C. Complete Mineral and Nitrogenous Manure. 1. Fallow. | C. Complete Mineral and Nitrogenous Manure. 2. Beans or Clover. |
|---|---|---|---|---|---|---|---|---|
| **LAST COMPLETE COURSE (15th), 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 |
| **CURRENT COURSE (16th), 1908- .** | | | | | | | | |
| 1908 | Roots (Swedes) ... | Cwt. | 21·6 | 6·4 | 179·0 | 235·8 | 395·4 | 314·0 |

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

## METEOROLOGICAL RECORDS, 1908.

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

| | Rain. | | | Drainage through soil. | | | Bright Sunshine. | Temperature. | |
|---|---|---|---|---|---|---|---|---|---|
| | Total Fall. | | No. of Rainy Days. | | | | | | |
| | 5-inch Funnel Gauge. | $\frac{1}{1000}$th Acre Gauge. | $\frac{1}{1000}$th Acre Gauge. | 20 ins. deep. | 40 ins. deep. | 60 ins. deep. | | Max. | Min. |
| | Inches. | Inches. | No. | Inches. | Inches. | Inches. | Hours. | °F. | °F. |
| January .. ... | 1·484 | 1·581 | 12 | 1·241 | 1·331 | 1·245 | 66·5 | 41·0 | 27·8 |
| February ... | 1·325 | 1·339 | 16 | 0·486 | 0·615 | 0·451 | 68·6 | 46·9 | 34·7 |
| March ... ... | 3·410 | 3·399 | 19 | 2·182 | 2·342 | 2·185 | 114·6 | 45·8 | 32·8 |
| April ... ... | 2·938 | 3·281 | 17 | 1·869 | 2·274 | 1·934 | 145·8 | 49·7 | 35·5 |
| May ... ... | 1·794 | 1·886 | 15 | 0·607 | 0·832 | 0·679 | 198·5 | 63·2 | 46·2 |
| June ... .. | 1·626 | 1·675 | 9 | 0·039 | 0·074 | 0·054 | 250·8 | 67·9 | 48·4 |
| July ... ... | 2·319 | 2·434 | 15 | 0·446 | 0·432 | 0·361 | 205·1 | 69·4 | 51·6 |
| August ... ... | 2·863 | 3·012 | 14 | 0·638 | 0·458 | 0·460 | 202·0 | 66·8 | 49·8 |
| September ... | 1·456 | 1·559 | 20 | 0·501 | 0·558 | 0·525 | 158·0 | 62·7 | 46·8 |
| October ... ... | 2·221 | 2·257 | 16 | 1·249 | 1·117 | 1·072 | 119·8 | 60·0 | 44·8 |
| November ... | 0·753 | 0·821 | 12 | 0·314 | 0·258 | 0·236 | 78·1 | 51·4 | 38·8 |
| December ... | 2·012 | 2·065 | 19 | 1·482 | 1·515 | 1·512 | 30·0 | 43·1 | 33·2 |
| Total or Mean | 24·201 | 25·309 | 184 | 11·054 | 11·806 | 10·714 | 1637·8 | 55·7 | 40·9 |

## SWEDES, AFTER MANGOLDS, FAILED. BARN FIELD, 1908.

*(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. **11·69** | **12·73** | **11·05** | **10·98** | **9·73** |
| | | L. 6·39 | 9·49 | 10·21 | 11·66 | 10·37 |
| 2 | Dung, Super., Potash | R. **13·01** | **12·49** | **11·94** | **11·19** | **10·36** |
| | | L. 6·78 | 10·42 | 10·63 | 12·04 | 10·58 |
| 4 | Complete Minerals | R. **4·07** | **11·19** / **12·06** | **11·48** | **11·55** | **11·03** |
| | | L. 1·51 | 7·06 / 7·65 | 5·63 | 10·94 | 7·04 |
| 5 | Superphosphate only | R. **3·91** | **9·30** | **6·42** | **5·45** | **5·16** |
| | | L. 1·53 | 7·34 | 6·90 | 8·76 | 5·79 |
| 6 | Super. and Potash | R. **3·53** | **8·03** | **10·07** | **9·52** | **9·26** |
| | | L. 1·31 | 6·21 | 5·58 | 10·53 | 6·43 |
| 7 | Super., Sulph. Mag. & Chloride Sodium | R. **8·76** | **8·76** | **10·84** | **9·53** | **9·43** |
| | | L. 7·17 | 7·17 | 6·27 | 10·73 | 6·58 |
| 8 | None ... ... | R. **1·34** | **2·79** | **2·53** | **4·61** | **4·22** |
| | | L. 0·80 | 2·68 | 2·66 | 7·46 | 5·38 |

## HAY. THE PARK GRASS PLOTS, 1908.

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

| Plot. | Manuring. | Yield of Hay per Acre. 1st Crop. | 2nd Crop. | Total. |
|---|---|---|---|---|
| | | Cwt. | Cwt. | Cwt. |
| 3 | Unmanured ... ... ... ... | 11·5 | 2·3 | 13·8 |
| 12 | | 15·3 | 3·8 | 19·1 |
| 2 | Unmanured (1) ... ... ... | 15·6 | 2·0 | 17·6 |
| 1 | Ammonium Salts alone (1) ... ... | 22·5 | 5·0 | 27·5 |
| 4-1 | Superphosphate of Lime .. ... | 14·8 | 1·5 | 16·3 |
| 8 | Mineral Manure without Potash ... | 17·8 | 3·7 | 21·5 |
| 7 | Complete Mineral Manure ... ... | 36·8 | 10·5 | 47·3 |
| 6 | As 7, 1869 and since (2) ... ... | 34·1 | 11·2 | 45·3 |
| 15 | As 7, 1876 and since (3) ... ... | 36·5 | 11·9 | 48·4 |
| 5 | Superphosphate and Potash, 1898 and since ... ... ... ... | 19·5 | 3·7 | 23·2 |
| 17 | Nitrate of Soda alone... ... ... | 20·6 | 3·4 | 24·0 |
| 4-2 | Superphosphate and Amm.-salts ... | 34·3 | 2·0 | 36·3 |
| 10 | Mineral Manure (without Potash) and Amm.-salts ... ... ... | 35·7 | 4·6 | 40·3 |
| 9 | Complete Mineral Manure and Amm.-salts ... ... ... ... | 51·1 | 6·6 | 57·5 |
| 13 | Dung and Fish Guano, once in 4 yrs. | 28·5 | 6·9 | 35·4 |
| 11-1 | Complete Mineral Manure and extra Amm.-salts ... ... ... | 60·0 | 14·4 | 74·4 |
| 11-2 | As 11-1, and Silicate Soda ... ... | 62·7 | 15·9 | 78·6 |
| 16 | Complete Mineral Manure and Nit. Soda=43 lb. N. ... ... ... | 38·2 | 9·3 | 47·5 |
| 14 | Do. do. do. and Nit. Soda=86 lb. N. ... ... ... | 54·3 | 7·2 | 61·5 |

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 yrs., 1856-63. (3) Nitrate of Soda alone previously.
(2) Ammonium salts alone, previous to 1869.

## BOTANICAL COMPOSITION, PER CENT.

### First Crop, 1908.

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

| Plot. | Manuring. | Gramineæ. | Leguminosæ. | Other Orders. |
|---|---|---|---|---|
| | | Per cent. | Per cent. | Per cent. |
| 3 | Unmanured ... ... ... ... | 55·6 | 12·7 | 31·7 |
| 4-1 | Superphosphate of Lime ... ... | 56·5 | 9·7 | 33·8 |
| 8 | Mineral Manure without Potash ... | 43·8 | 20·3 | 35·9 |
| 7 | Complete Mineral Manure ... ... | 56·0 | 28·8 | 15·2 |
| 6 | As 7, 1869 and since (2) ... ... | 50·8 | 33·9 | 15·3 |
| 15 | As 7, 1876 and since (3) ... ... | 59·0 | 21·2 | 19·8 |

## WHEAT. BROADBALK FIELD, 1908.

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

| Plot. | Manuring. | Dressed Grain. | | Straw. |
|---|---|---|---|---|
| | | Yield. | Weight per Bushel. | |
| | | Bushels. | lbs. | Cwt. |
| 2 | Farmyard Manure ... ... ... | 38·6 | 64·9 | 32·2 |
| 3 | Unmanured ... .. ... ... | 12·4 | 63·5 | 7·7 |
| 5 | Complete Mineral Manure ... ... | 16·2 | 64·8 | 10·9 |
| 6 | As 5, and single Amm.-salts ... | 22·0 | 64·9 | 19·0 |
| 7 | As 5, and double do. ... ... | 33·3 | 64·7 | 30·2 |
| 8 | As 5, and treble do. ... ... | 47·5 | 63·4 | 43·9 |
| 9 | As 5, and single Nitrate Soda ... | 31·7 | 65·0 | 26·7 |
| 10 | Double Amm.-salts alone ... ... | 21·8 | 64·0 | 15·3 |
| 11 | As 10, and Superphosphate... ... | 21·0 | 62·9 | 19·4 |
| 12 | ,, and Super and Sulph. Soda... | 32·9 | 64·6 | 24·2 |
| 13 | ,, and Super and Sulph. Potash | 36·0 | 63·9 | 29·6 |
| 14 | ,, and Super and Sulph. Mag. | 26·1 | 63·8 | 21·4 |
| 15 | Double Amm.-salts in Autumn and Minerals ... ... ... ... | 32·3 | 63·4 | 25·7 |
| 16 | Double Nitrate and Minerals ... | 38·1 | 64·0 | 35·8 |
| 17 | Minerals alone, or Double Amm.-salts alone, in alternate years | *33·2 | *63·9 | *28·9 |
| 18 | | †14·8 | †63·6 | †10·2 |
| 19 | Rape Cake alone ... ... . | 28·2 | 63·4 | 21·2 |

* Produce by Ammonium Salts. † Produce by Minerals.

## BARLEY. HOOS FIELD, 1908.

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

| Plot. | Manuring. | Dressed Grain. | | Straw. |
|---|---|---|---|---|
| | | Yield. | Weight per Bushel. | |
| | | Bushels. | lbs. | Cwt. |
| 1 O | Unmanured ... ... ... ... | 7·2 | 53·1 | 4·9 |
| 2 O | Superphosphate only ... ... | 14·8 | 53·9 | 6·4 |
| 3 O | Alkali salts only ... ... ... | 9·7 | 54·5 | 6·3 |
| 4 O | Complete Minerals ... ... .. | 13·1 | 55·2 | 9·0 |
| 1 A | Amm.-salts only ... ... ... | 18·5 | 53·0 | 11·4 |
| 2 A | Superphos. and Amm.-salts ... | 22·6 | 53·6 | 12·9 |
| 3 A | Alkali salts and Amm.-salts ... | 22·4 | 54·8 | 14·4 |
| 4 A | Complete Minerals and Amm.-salts | 39·1 | 55·4 | 20·1 |
| 1 N | Nitrate of Soda alone ... ... | 27·3 | 54·0 | 13·9 |
| 2 N | Superphos. and Nitrate Soda ... | 33·5 | 54·4 | 16·2 |
| 3 N | Alkali Salts and Nitrate Soda ... | 26·7 | 54·7 | 13·8 |
| 4 N | Complete Minerals and Nitrate Soda | 39·2 | 55·4 | 18·6 |
| 1 C | Rape Cake alone ... ... ... | 34·7 | 54·7 | 16·5 |
| 2 C | Superphos. and Rape Cake .. ... | 31·4 | 55·0 | 14·5 |
| 3 C | Alkali Salts and Rape Cake ... | 35·2 | 55·2 | 17·5 |
| 4 C | Complete Minerals and Rape Cake | 42·1 | 55·2 | 19·0 |
| 7-1 | Unmanured (after Dung, 1852-71)... | 20·7 | 55·0 | 13·5 |
| 7-2 | Farmyard Dung ... ... .. | 52·6 | 55·8 | 27·7 |

## BARLEY. HOOS FIELD, 1908.

(Previous cropping: Potatoes, 1876-1901; Barley, 1902 and 1903; Oats, 1904; Barley, 1905 and 1906.

(*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 ... ... ... | 6·8 | 54·6 | 3·4 | 800 |
| 2 | Unmanured 1882 to 1901, previously Dung only ... | 7·8 | 54·5 | 5·5 | 1097 |
| 3 | Dung 1883-1901 ... ... | 20·2 | 55·2 | 11·4 | 2484 |
| 4 | Dung 1883-1901 ... ... | 22·6 | 55·0 | 12·7 | 2771 |

## WHEAT AFTER FALLOW (without manure 1851 and since).

## HOOS FIELD, 1908.*

(*See "Guide," page* 41, *Table* 20).

| | |
|---|---|
| Dressed Grain ... ... ... | Yield—7·2 bushels.<br>Weight per bushel—63·6 lbs. |
| Straw ... ... ... ... | 5·3 cwt. |
| Total Produce ... ... ... | 1083 lbs. |

* The young plants of wheat were much damaged by hares in the spring.

# LITTLE HOOS FIELD, 1904-08.

## 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. | Mang'lds 1906. | Spring Wheat 1907. | Swedes 1908. |
|---|---|---|---|---|---|---|
| | | Tons. | lbs. | Tons. | lbs. | Tons. |
| A 1 | Unmanured ... ... ... | 10·3 | 2323 | 17·1 | 3650 | 14·0 |
| 2 | Dung (ordinary), 1904 and 1908 | **13·1** | 4649 | 18·2 | 4673 | **19·1** |
| 3 | ,, ,, 1905 only ... | 8·8 | **3501** | 17·5 | 5393 | 14·5 |
| 4 | ,, ,, 1906 ,, ... | 8·8 | 2269 | **18·2** | 5471 | 15·5 |
| 5 | ,, ,, 1907 ,, ... | 9·8 | 2402 | 14·9 | **6903** | 17·3 |
| B 1 | Dung (cake-fed), 1904 and 1908 | **15·7** | 4177 | 19·4 | 4319 | **22·4** |
| 2 | Unmanured .. ... .. | 10·0 | 2417 | 16·2 | 4025 | 14·3 |
| 3 | Dung (cake-fed), 1905 only ... | 9·5 | **5530** | 18·5 | 5497 | 14·2 |
| 4 | ,, ,, 1906 ,, ... | 11·4 | 2772 | **25·6** | 6489 | 16·9 |
| 5 | ,, ,, 1907 ,, ... | 9·4 | 2649 | 14·4 | **9407** | 19·0 |
| C 1 | Shoddy, 1904 and 1908 ... ... | **14·7** | 3656 | 21·0 | 4667 | **19·7** |
| 2 | ,, 1905 only ... ... | 11·1 | **4363** | 23·6 | 4550 | 16·3 |
| 3 | Unmanured . ... ... | 10·6 | 2588 | 17·7 | 4334 | 15·1 |
| 4 | Shoddy, 1906 only ... ... | 10·7 | 2512 | **24·2** | 6231 | 19·1 |
| 5 | ,, 1907 ,, ... . | 10·3 | 2615 | 16·9 | **7495** | 22·2 |
| D 1 | Guano, 1904 and 1908 ... ... | **14·6** | 2550 | 20·1 | 4056 | **20·9** |
| 2 | ,, 1905 only ... ... | 11·0 | **5176** | 19·7 | 4165 | 15·3 |
| 3 | ,, 1906 ,, ... ... | 10·9 | 2857 | **25·6** | 4846 | 15·9 |
| 4 | Unmanured .. ... ... | 10·6 | 2985 | 18·7 | 4618 | 17·4 |
| 5 | Guano, 1907 only ... ... | 10·6 | 2680 | 17·4 | **7375** | 15·7 |
| E 1 | Rape-cake, 1904 and 1908 .. | **14·1** | 2674 | 17·8 | 3887 | **19·7** |
| 2 | ,, 1905 only ... ... | 11·2 | **4185** | 17·9 | 4326 | 15·1 |
| 3 | ,, 1906 ,, ... ... | 9·5 | 2645 | **22·7** | 4584 | 14·5 |
| 4 | ,, 1907 ,, ... ... | 10·5 | 2734 | 19·4 | **6619** | 15·2 |
| 5 | Unmanured ... ... ... | 10·8 | 2769 | 19·5 | 4527 | 14·7 |
| F 1 | Unmanured ... ... ... | 11·7 | 3132 | 22·9 | 4749 | 14·1 |
| 2 | Superphosphate, 1904 and 1908 | **12·2** | 3025 | 23·2 | 5064 | **16·9** |
| 3 | ,, 1905 only ... | 10·2 | **3949** | 23·6 | 4956 | 14·6 |
| 4 | ,, 1906 ,, ... | 9·7 | 3913 | **24·1** | 5419 | 16·0 |
| 5 | ,, 1907 ,, ... | 9·7 | 4221 | 23·6 | **5698** | 16·4 |
| G 1 | Bone Meal, 1904 and 1908 .. | **12·9** | 3176 | 23·1 | 5203 | **16·7** |
| 2 | ,, ,, 1905 only ... ... | 10·1 | **3636** | 22·1 | 5821 | 14·3 |
| 3 | Unmanured ... ... ... | 10·2 | 3495 | 20·6 | 5491 | 12·7 |
| 4 | Bone Meal, 1906 only ... ... | 9·9 | 3450 | **22·6** | 6043 | 14·2 |
| 5 | ,, ,, 1907 ,, ... ... | 9·2 | 3525 | 22·1 | **6276** | 19·9 |
| H 1 | Basic Slag, 1904 and 1908 ... | **11·8** | 4400 | 20·5 | 6285 | **13·8** |
| 2 | ,, ,, 1905 only ... ... | 10·4 | **4002** | 21·3 | 5930 | 13·6 |
| 3 | ,, ,, 1906 ,, .. ... | 9·4 | 3662 | **21·4** | 5860 | 13·6 |
| 4 | ,, ,, 1907 ,, ... ... | 9·1 | 3624 | 17·0 | **5816** | 14·4 |
| 5 | Unmanured ... ... ... | 8·6 | 3293 | 17·4 | 5933 | 11·4 |

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

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