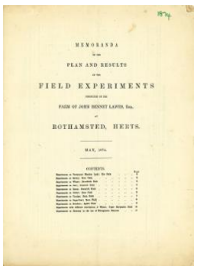
Memoranda of the Field Experiments at Rothamsted May 1874



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Rothamsted Research

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1874

MEMORANDA

OF THE

PLAN AND RESULTS

OF THE

FIELD EXPERIMENTS

CONDUCTED ON THE

FARM OF JOHN BENNET LAWES, Esq.,

AT

ROTHAMSTED, HERTS.

MAY, 1874.

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https://doi.org/10.23637/ERADOC-1-238

THE PARK.

Experiments with different Manures on PERMANENT MEADOW LAND.

The Land has probably been laid down with Grass for some centuries. No fresh seed has been artificially sown within the last 40 years certainly; nor is there record of any having been sown since the Grass was first laid down. The experiments commenced in 1856, at which time the character of the herbage appeared uniform over all the Plots. Excepting as explained in the Table and in the foot-notes, the same description of Manure has been applied year after year to the same Plot.

(Area under experiment, about 7 acres.)

1 acre .. .. = (about) 0·40 Hectare .. .. .. or 1·59 Prussian Morgen.
1 lb. (pound avoir.) .. .. = (about) 0·45 Kilogramme .. .. .. or 0·91 Zollverein Pfund.
1 cwt. (hundredweight) = (about) 51·0 Kilogrammes .. .. .. or 1·02 Centner.
1 ton .. .. = (about) 1016·0 Kilogrammes .. .. or 20·33 Centner.
1 lb. per acre .. .. = (about) 1·12 Kilogramme per Hectare or 0·57 Zollv. Pfd. per Pr. Morgen.
1 cwt. per acre .. .. = (about) 125·5 Kilogrammes per Hectare or 0·64 Centner per Pr. Morgen.
1 ton per acre .. .. = (about) 2510·0 Kilogrammes per Hectare or 12·82 Centner per Pr. Morgen.

Plots.	Manures, per acre, per Annum.	Produce per Acre, weighed as Hay. 14th Season; 1869.	15th Season; 1870.	16th Season; 1871.	17th Season; 1872.	18th Season; 1873.	Average per Annum; 18 Years 1856-1873.	Plots.
		Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	
1	1856–63, 8 years, 14 tons Farmyard Manure, and 200 lbs. Ammonia-salts [1]; average produce 49½ cwts. 1864 and since, 200 lbs. Ammonia-salts alone; average produce (10 years, 1864–73) 40⅜ cwts.	61	16¼	43¾	31½	29¾	44¾	1
2	1856–63, 8 years, 14 tons Farmyard Manure; average produce 42⅞ cwts. 1864 and since, unmanured; average produce (10 years, 1864–73) 35⅛ cwts.	55¼	13⅞	33⅞	25¼	18⅞	38⅝	2
3	Unmanured, continuously	33	5¾	25⅜	14⅝	12¼	21⅞	3
4 {1	3½ cwts. Superphosphate of Lime [2]	40½	7½	24⅞	15⅜	13½	23½ [9]	1
4 {2	3½ cwts. Superphosphate of Lime, and 400 lbs. Ammonia-salts	45½	8¼	38¼	28½	26	35⅛ [9]	2 } 4
5	400 lbs. Ammonia-salts	35⅝	5½	29⅝	22½	16⅝	27½	5
[3] 6	1856–68, 13 years, 400 lbs. Ammonia-salts; average produce 30⅛ cwts. 1869 and since, 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos.; av. prod. (5 yrs., 1869–73) 32¼ cwts.	56½	16¼	37½	25½	26	31⅛	6
7	300 lbs. Sulphate Potass, 100 lbs. [4] Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	54⅜	17½	39⅜	37¾	34¾	35½	7
[3] 8	1856–61, 6 years, 300 lbs. Sulph. Potass, 200 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, and 3½ cwts. Superphosphate; average produce 36 cwts. 1862 and since, 250 lbs. [5] Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate; average produce (12 years, 1862–73) 28½ cwts.	46⅜	12¾	30	22⅞	18⅜	31	8
9	300 lbs. Sulphate Potass, 100 lbs. [4] Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate, and 400 lbs. Ammonia-salts	68¾	29⅛	58¾	50½	43¾	52⅛	9
[3] 10	1856–61, 6 yrs. 300 lbs. Sulph. Potass, 200 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos., 400 lbs. Amm.-salts; av. prod. 55⅓ cwts. 1862 and since, 250 lbs. [5] Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos., 400 lbs. Amm.-salts; av. prod. (12 yrs., 1862–73) 43¾ cwts.	57¼	21¼	46½	38⅝	33	47⅝	10
11 {1	300 lbs. Sulph. Potass, 100 lbs. [4] Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosph., 800 lbs. [6] Ammonia-salts	75¼	42⅜	56⅝	63⅝	46¾	60¼	1
11 {2	300 lbs. Sulph. Potass, 100 lbs. [4] Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosph., 800 lbs. [6] Ammonia-salts, and 400 lbs. Silicate Soda [7]	78½	49½	65¾	63⅞	56½	65¼	2 } 11
12	Unmanured continuously	38¾	11¼	26⅜	20⅛	16⅛	24½	12
13	300 lbs. Sulph. Potass, 100 lbs. [4] Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosph., 400 lbs. Ammonia-salts, 2000 lbs. Cut Wheat-straw	77⅝	48	63	62⅝	57	57⅜	13
14	550 lbs. Nitrate of Soda [8], 300 lbs. Sulphate Potass, 100 lbs. [4] Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	76⅛	56¼	61⅞	55½	51¾	57⅜	14
15	550 lbs. Nitrate of Soda	53½	15½	38⅝	32⅝	33⅜	36⅜ [10]	15
16	275 lbs. Nitrate of Soda, 300 lbs. Sulphate Potass, 100 lbs. [4] Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts, Superphosphate	74¼	33⅛	57	40	41⅛	47⅛ [10]	16
17	275 lbs. Nitrate of Soda	54¾	19¼	38½	29⅝	28½	34¾ [10]	17
18	Mixture supplying the quantity of Potass, Soda, Lime, Magnesia, Phosphoric acid, Silica, and Nitrogen, contained in 1 ton of Hay (commencing 1865)	55⅝	14⅝	37⅞	33⅜	26⅛	33 [11]	18
19	275 lbs. Nitrate of Soda, 290 lbs. Sulphate of Potass, and 3½ cwts. Superphosphate (commencing 1872)	..	..	..	40	38⅜	39⅜	19
20	327 lbs. Nitrate of Potass, and 3½ cwts. Superphosphate (commencing 1872)	..	..	..	38½	36	37¼	20

(1) "Ammonia-salts"—in all cases equal parts Sulphate and Muriate of Ammonia of Commerce.
(2) The "Superphosphate of Lime" is, in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid Sp. gr. 1·7 (and water).
(3) Plots 6, 8, and 10, had, besides the Manures specified, 2000 lbs. Sawdust per acre per annum for the first 7 years, 1856–1862, but without effect.
(4) 200 lbs. 1856–63 inclusive.
(5) 500 lbs. in 1862 and 1863.
(6) Only 400 lbs. in 1859–60–61.
(7) The application of Silicates did not commence until 1862.
(8) 550 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 400 lbs. of "Ammonia-salts."
(9) Average of 15 years only, as the manures specified were first applied in 1859 (previously, 1856–7 and 8, Sawdust only).
(10) Average of 16 years only, as these experiments did not commence until 1858.
(11) Average of 9 years only, as the experiment only commmenced in 1865.

HOOS FIELD.

EXPERIMENTS ON THE GROWTH OF **BARLEY** YEAR AFTER YEAR ON THE SAME LAND, WITHOUT MANURE, AND WITH DIFFERENT KINDS OF MANURE.

Previous Cropping—1847, Swedish Turnips, with Dung and Superphosphate of Lime, the Roots carted off; 1848, Barley; 1849, Clover; 1850, Wheat; 1851, Barley manured with Ammonia-salts.

First Experimental Barley Crop in 1852. Barley every year since; and, unless stated to the contrary in the Table, or in the foot-notes, the same Manure has been applied year after year to the same Plot.

(Area under experiment, about 4¼ acres.

1 acre	= (about)	0·40	Hectare	or 1·59 Prussian Morgen.
1 bushel	= (about)	0·36	Hectolitre	or 0·66 Prussian Scheffel.
1 lb. (pound avoir.)	= (about)	0·45	Kilogramme	or 0·91 Zollverein Pfund.
1 cwt. (hundredweight)	= (about)	51·0	Kilogrammes	or 1·02 Centner.
1 bushel per acre	= (about)	0·9	Hectolitre per Hectare	or 0·42 Pr. Scheffel per Pr. Morgen.
1 lb. per acre	= (about)	1·12	Kilogramme per Hectare	or 0·57 Zollv. Pfd. per Pr. Morgen.
1 cwt. per acre	= (about)	125·5	Kilogrammes per Hectare	or 0·64 Centner per Pr. Morgen.

PLOTS.	Manures, per acre, per annum.	PRODUCE PER ACRE. Average per Annum, over 20 Years, 1852–1871. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.	Twenty-second Season, 1873. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.	PLOTS.
		Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	
1 O.	Unmanured continuously	20	52⅜	11¾	14	53½	6⅝	1 O.
2 O.	3½ cwts. Superphosphate of Lime (1)	25½	53¼	13⅜	19⅞	54⅛	8⅛	2 O.
3 O.	200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia	22⅜	53	12¼	15	54⅛	6⅜	3 O.
4 O.	200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	27½	53⅜	14⅜	20⅜	54⅛	9	4 O.
1 A.	200 lbs. Ammonia-salts (4)	32½	52⅛	18½	32⅜	54⅛	14⅜	1 A.
2 A.	200 lbs. Ammonia-salts, and 3½ cwts. Superphosphate	47	53⅜	27⅝	50⅞	54½	24⅜	2 A.
3 A.	200 lbs. Ammonia-salts, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia	35	52¾	20¾	34⅛	55	15¾	3 A.
4 A.	200 lbs. Ammonia-salts, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosphate	46¼	54	28½	46⅞	55⅜	27	4 A.
1 AA.	275 lbs. Nitrate Soda	37	52	22⅛	37⅛	54⅛	16¾	1 AA.
2 AA.	275 lbs. Nitrate Soda, and 3½ cwts. Superphosphate	49¼	53⅜	30½	49	54⅜	25	2 AA.
(5) 3 AA.	275 lbs. Nitrate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia	37⅜	52¼	24⅜	33⅝	54⅛	17	3 AA.
4 AA.	275 lbs. Nitrate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosphate	49⅜	53⅜	32⅜	46¾	54⅜	27¼	4 AA.
1 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda (6)	38¾	52¼	23⅛	45⅜	54⅜	21⅛	1 AAS.
2 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, and 3½ cwts Superphosphate (1)	48⅜	53⅜	30¾	51⅛	54⅜	26¼	2 AAS.
(5) 3 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, and 100 lbs. Sulph. Magnesia	41¼	52⅝	25⅛	44⅛	54⅜	24¼	3 AAS.
4 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia, and 3½ cwts. Superphosphate	50⅜	53⅜	33⅜	51⅜	54⅝	28⅛	4 AAS.
1 C.	1000 lbs. Rape-cake	45¼	53⅜	26⅞	45⅞	54⅝	23⅜	1 C.
(7) 2 C.	1000 lbs. Rape-cake, and 3½ cwts. Superphosphate	46⅜	53⅞	28⅜	48⅜	54⅜	24	2 C.
3 C.	1000 lbs. Rape-cake, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia	43⅜	53⅜	27¼	44⅜	55	22½	3 C.
4 C.	1000 lbs. Rape-cake, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosphate	47⅜	53⅜	29½	46½	55	23⅞	4 C.
(8) 1 N.	275 lbs. Nitrate of Soda	37⅜ (11)	52⅝ (11)	22⅞ (11)	42⅛	54	19⅓	1 N.
2 N.	275 lbs. (9) Nitrate of Soda	41⅜ (11)	52⅝ (11)	26⅛ (11)	44⅞	54⅜	23⅜	2 N.
5 O.	200 lbs. (2) Sulphate of Potass, 3½ cwts. Superphosphate (10)	22⅜ (11)	53½ (11)	12⅜ (11)	17⅛	54⅛	7	5 O.
5 A.	200 lbs. (2) Sulphate of Potass, 3½ cwts. Superphosphate, and 200 lbs. Ammonia-salts	44⅛ (11)	53⅜ (11)	28 (11)	42⅞	54⅜	23⅜	5 A.
M.	100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, and 3½ cwts. Superphosphate	21½ (12)	53¼ (12)	12⅜ (12)	20	53⅜	8½	M.
6 1	Unmanured continuously	22	52½	12⅜	15⅜	53⅝	7⅝	1
6 2	Ashes (burnt soil and turf)	21⅞	52⅝	12⅛	18¼	54⅛	8½	2 6
7 1	Farmyard Manure 14 tons, 20 years, 1852–1871; unmanured since	48¼	54⅜	28¼	47⅞	54¼	22⅛	7
7 2	Farmyard Manure 14 tons, every year				54¼	54½	30½	

(1) The "Superphosphate of Lime" is, in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric acid sp. gr. 1·7 (and water).

(2) 300 lbs. per annum for the first six years, 1852–7.

(3) 200 lbs. per annum for the first six years, 1852–7.

(4) The "Ammonia-salts"—in all cases equal parts Sulphate and Muriate of Ammonia of Commerce.

(5) First 6 years, 1852–7, instead of Nitrate of Soda, 400 lbs. Ammonia-salts per annum; next 10 years, 1858–67, 200 lbs. Ammonia-salts per annum; 1868, and since, 275 lbs. Nitrate of Soda per annum. 275 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 200 lbs. "Ammonia-salts."

(6) The application of Silicates did not commence until 1864; in 1864-5-6 and 7, 200 lbs. Silicate of Soda and 200 lbs. Silicate of Lime were applied per acre, but in 1868, and since, 400 lbs. Silicate of Soda, and no Silicate of Lime. These plots ("AAS") comprise, respectively, one half of the original "AA" plots, and, excepting the addition of the Silicates, have been, and are, in other respects, manured in the same way as the "AA" plots; and, for the sake of comparison with the latter, the *average produce* is given for the whole period of 20 years, 1852–1871.

(7) 2000 lbs. Rape-cake per annum for the first six years, and 1000 lbs. only, each year since.

(8) 300 lbs. Sulphate of Potass, and 3½ cwts. Superphosphate of Lime, without Nitrate of Soda, the first year (1852); Nitrate alone each year since.

(9) 550 lbs. Nitrate of Soda for 1853-4-5-6, and 7; and 275 lbs. only, each year since.

(10) Ammonia-salts also the first year, but not since.

(11) Average of 19 years only.

(12) Average of 14 years only.

BROADBALK FIELD.

EXPERIMENTS ON THE GROWTH OF WHEAT YEAR AFTER YEAR ON THE SAME LAND; WITHOUT MANURE, AND WITH DIFFERENT KINDS OF MANURE.

Previous Cropping—1839, Turnips, with Farmyard Manure; 1840, Barley; 1841, Peas; 1842, Wheat; 1843, Oats; the last four Crops Unmanured.

First Experimental Wheat Crop in 1844. Wheat every year since; and, with some exceptions, nearly the same description of Manure on the same Plots each year—especially during the last 23 years (1852 and since). Unless otherwise stated, the Manures are sown in the Autumn before the seed.

(Area under experiment, about 13 acres.)

		Produce per Acre.						
		Average per Annum, 20 Years, 1852–1871.			Thirtieth Season, 1873.			
		Dressed Corn.			Dressed Corn.			
Plots.	Manures, per acre, per annum.	Quantity.	Weight per Bushel.	Total Straw.	Quantity.	Weight per Bushel.	Total Straw.	Plots.
		Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	
0	Superphosphate of Lime (three times as much as on No. 5 and succeeding Plots)	17¾	58⅜	15¼	15⅝	57⅝	10⅝	0
1	Sulphates of Potass, Soda, and Magnesia (twice as much as on No. 5 and succeeding Plots)	15⅛	58⅛	13⅞	10½	56⅜	8⅝	1
2	Farmyard Manure (14 tons every year)	35⅞	60	33⅞	26¾	58½	22	2
3	Unmanured continuously	14⅛	57½	13	11⅜	57	8	3
4	Unmanured for Crop of 1852, and since; previously Superphosphate (made with Muriatic Acid), and Sulphate Ammonia	15¾	58⅜	13¾	12⅛	57⅛	8⅞	4
5 (*a* and *b*)	200 lbs. [1] Sulphate Potass, 100 lbs. [2] Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate of Lime [3]	17	58⅞	15¼	12¾	56⅞	9⅜	5 (*a* and *b*)
6 (*a* and *b*)	200 lbs. [1] Sulphate Potass, 100 lbs. [2] Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphos., and 200 lbs. Ammonia-salts [4]	26⅜	59⅜	24½	15⅞	57	13⅝	6 (*a* and *b*)
7 (*a* and *b*)	200 lbs. [1] Sulphate Potass, 100 lbs. [2] Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphos., and 400 lbs. Ammonia-salts	35¼	59¼	35⅜	22	57⅛	18	7 (*a* and *b*)
8 (*a* and *b*)	200 lbs. [1] Sulphate Potass, 100 lbs. [2] Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphos., and 600 lbs. Ammonia-salts	38¼	59	41⅜	27½	56⅞	23¾	8 (*a* and *b*)
9 (*a*)	200 lbs. [1] Sulphate Potass, 100 lbs. [2] Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphos., and 550 lbs. Nitrate Soda [5]	36¾	58⅜	41⅛	35⅞	57⅛	35⅛	9 (*a*
9 (*b*)	550 lbs. Nitrate of Soda [5]. (The Nitrate for both 9*a* and 9*b* always sown in the Spring.)	26	56⅜	28¼	21⅞	54⅞	21	9 (*b*
10 (*a*)	400 lbs. Ammonia-salts alone, for 1845, and each year since; Mineral Manure in 1844	22½	57⅛	21⅝	19⅝	56⅛	14⅝	10 (*a*
10 (*b*)	400 lbs. Ammonia-salts alone, for 1845, and each year since (excepting 1846 and 1850); Mineral Manure in 1844, '48, and '50	25⅞	58	24¾	20⅜	56½	14⅜	10 (*b*
11 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate	28	57⅜	26⅜	19¼	55⅝	14⅛	11 (*a* and *b*)
12 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate, and 366½ lbs. [6] Sulphate of Soda	33⅞	59⅛	32⅜	22⅞	56¾	17¾	12 (*a* and *b*)
13 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate, and 200 lbs. [6] Sulphate of Potass	33⅞	59⅜	33⅞	23½	57⅜	18½	13 (*a* and *b*)
14 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate, and 280 lbs. [6] Sulphate of Magnesia	33⅞	59¼	32⅞	24⅛	56¾	19⅛	14 (*a* and *b*)
15 (*a*)	200 lbs. [1] Sulph. Pot., 100 lbs. [2] Sulph. Sod., 100 lbs. Sulph. Mag., 3½ cwts. Superphos. [7]; 400 lbs. Amm.-salts, sown in Spring [8]	32⅞	59⅜	32½	32⅞	57⅜	26⅜	15 (*a*
15 (*b*)	200 lbs. [1] Sulph. Pot., 100 lbs. [2] Sulph. Sod., 100 lbs. Sulph. Mag., 3½ cwts. Superphos. [7]; 400 lbs. Amm.-salts, sown in Spring [9]	34	59¾	33⅞	32⅜	57⅞	28¼	15 (*b*
16 (*a* and *b*)	1852–64, 13 years, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwts. Superphos., and 800 lbs. Ammonia-salts; average produce 39½ bush. Corn, 46⅜ cwts. Straw. 1865 and since, unmanured; average produce (9 years, 1865–73) 17⅞ bushels Corn, 15⅜ cwts. Straw	32⅜	59	36⅛	12⅜	57⅛	10¼	16 (*a* and *b*)
(10) 17 (*a* and *b*)	400 lbs. Ammonia-salts	31⅝ [12]	59½ [12]	31¼ [12]	11¾ [14]	57½ [14]	9⅞ [14]	17 (*a* and *b*)
(10) 18 (*a* and *b*)	200 lbs. [1] Sulphate Potass, 100 lbs. [2] Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	17⅝ [13]	58⅞ [13]	16⅛ [13]	20⅜ [15]	57½ [15]	17 [15]	18 (*a* and *b*)
19	3½ cwts. Superphosphate of Lime [11], 300 lbs. Sulphate of Ammonia, and 500 lbs. Rape-cake	30¾	58⅝	29⅛	20	56¾	16⅝	19
20	Unmanured continuously	15½ [16]	58 [16]	14½ [16]	12½	56⅞	9¾	20
21	200 lbs. [1] Sulph. Potass, 100 lbs. [2] Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos., and 100 lbs. Muriate Ammonia	21⅜	58¾	19½	14⅛	56⅞	11¼	21
22	200 lbs. [1] Sulph. Potass, 100 lbs. [2] Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos., and 100 lbs. Sulphate Ammonia	21	58⅝	19	18⅛	56⅞	14⅞	22

[1] 300 lbs. per annum for Crop of 1858, and previously.
[2] 200 lbs. per annum for Crop of 1858, and previously.
[3] "Superphosphate of Lime"—in all cases, excepting for Plot 19, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric acid sp. gr. 1·7 (and water).
[4] The "Ammonia-salts," in all cases, equal parts Sulphate and Muriate of Ammonia of Commerce.
[5] 9*a* 475 lbs. Nitrate Soda in 1852, 275 lbs. in 1853 and 1854, 550 lbs. each year since; 9*b* 475 lbs. in 1852, 550 lbs. each year since; 550 lbs. is reckoned to contain the same amount of Nitrogen as 400 lbs. "Ammonia-salts."
[6] For 1858, and previously—1½ time as much.
[7] For 1872 and previously, made with Muriatic instead of Sulphuric Acid.
[8] For 1872 and previously, 400 lbs. Sulphate Ammonia, sown in the Autumn.
[9] For 1872 and previously, 300 lbs. Sulphate Ammonia and 500 lbs. Rape-cake, sown in the Autumn.
[10] The Manures of Plots 17 and 18 are, year by year, transposed.
[11] Made with Muriatic instead of Sulphuric Acid.
[12] Average of 20 years' Ammonia-salts, alternated with Mineral Manures.
[13] Average of 20 years' Mineral Manures, alternated with Ammonia-salts.
[14] Plots 17 had the Mineral Manures for the Crop of 1873.
[15] Plots 18 had the Ammonia-salts for the Crop of 1873.
[16] Average of 19 years only; as, in 1868, owing to a mistake in carting, the produce could not be ascertained.

The Plots marked "(*a* and *b*)" are divided into duplicate portions, "*a*" and "*b*," respectively, which are manured alike; excepting that, for the crops of 1864-5-6 and 7, the "*a*" portions of plots 5, 6, 7, 8, 9, 16, and 17 (or 18), received a mixture of soluble Silicates in addition to the other Manures, but, hitherto, without any material effect; and for the crops of 1868, and since, cut straw (that produced in the previous season) has been applied (instead of Silicates) on the "*a*" portions of plots 5, 6, 7, 8, 11, 12, 13, 14, and 17 (or 18).

GEESCROFT FIELD.

EXPERIMENTS ON THE GROWTH OF **OATS** YEAR AFTER YEAR ON THE SAME LAND; WITHOUT MANURE, AND WITH DIFFERENT KINDS OF MANURE.

Previous Cropping—1847 and 1848, Clover, Experimental Manures; 1849—1859, Beans, Experimental Manures; 1860, Fallow; 1861 and 1862, Wheat, Unmanured; 1863, Fallow; 1864, Beans, Dunged; 1865, Wheat, Unmanured; 1866, Beans, Unmanured; 1867 and 1868, Wheat, Unmanured.

First Experimental Oat Crop in 1869.

(Area under Experiment, ¾ acre.)

PLOTS.	MANURES, PER ACRE, PER ANNUM.	PRODUCE PER ACRE.																		
		1ST SEASON, 1869.			2ND SEASON, 1870.			3RD SEASON, 1871.			4TH SEASON, 1872.			5TH SEASON, 1873.			AVERAGE PER ANNUM 5 YEARS, 1869–1873.		
		Dressed Corn.			Dressed Corn.			Dressed Corn.			Dressed Corn.			Dressed Corn.			Dressed Corn.		
		Quantity.	Weight per Bushel.	Total Straw.	Quantity.	Weight per Bushel.	Total Straw.	Quantity.	Weight per Bushel.	Total Straw.	Quantity.	Weight per Bushel.	Total Straw.	Quantity.	Weight per Bushel.	Total Straw.	Quantity.	Weight per Bushel.	Total Straw.
		Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.
1	Unmanured	36⅜	36¾	19¼	16⅜	35	9⅛	20½	38½	11¼	15	36¼	7⅛	10¾	27⅛	5⅜	19⅞	33¾	10⅜
2	200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate of Lime [1]	45	38½	24½	19⅛	35⅛	9⅝	22	35¼	13½	19½	37¾	10⅜	17	28⅜	8⅝	24½	35	13⅜
3	400 lbs. Ammonia-salts [2]	56⅛	37½	36⅞	30	34⅞	17¼	57⅛	36⅜	40⅝	55¾	37½	30⅝	36½	32⅝	16¾	47	35⅞	28½
4	400 lbs. Ammonia-salts, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate ..	75¼	39¼	54	50⅝	36	28⅝	58⅜	35⅜	50	62⅜	39½	45⅛	48¼	34¾	27⅝	59	37	41⅛
5	550 lbs. Nitrate of Soda [3]	62¼	38½	42¾	36½	35½	23	55	36⅜	34¾	42⅙	36⅝	20⅜	39¾	30¼	16½	47⅛	35½	27½
6	550 lbs. Nitrate of Soda, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate ..	69⅜	38½	49⅞	50	35¾	28¾	60¼	33¾	48⅜	44⅝	37¼	24	63⅝	33⅜	24	57½	35¾	35

6TH SEASON, 1874.

Only 200 lbs. instead of 400 lbs. Ammonia-salts to Plots 3 and 4, and only 275 lbs. instead of 550 lbs., Nitrate of Soda to Plots 5 and 6; in all other respects the manures are the same as in previous years, and as stated above.

(1) "Superphosphate of Lime"—in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid sp. gr. 1·7 (and water).
(2) "Ammonia-salts"—in each case, equal parts Sulphate and Muriate of Ammonia of Commerce.
(3) 550 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 400 lbs. "Ammonia-salts."

EXPERIMENTS ON THE GROWTH OF LEGUMINOUS CROPS.

I.—Beans, Peas, and Tares—Geescroft Field.

Experiments on the growth of Leguminous corn-crops (beans, peas, and tares), with different descriptions of manure, were commenced in 1847, about nine acres being devoted to the purpose.

Experiments with Beans were continued for thirteen consecutive seasons, to 1859 inclusive; but, during the later years, the crop fell off very much, and the land became very foul.

In 1860 the land was fallowed.

In 1861 a crop of wheat, without manure, was taken.

In 1862 beans were again sown, but with some variation in the manuring.

In 1863 the land was fallowed.

In 1864, 5, 6, 7, 8, and 9, beans were grown, with much the same manures on the same plots, each year, as in 1862.

In the winter of 1869-70, 5000 lbs. of fresh burnt lime were applied per acre, over all the plots.

In 1870 beans were grown with the same manures on the respective plots as in 1864-69.

In October, 1870, winter beans were sown (without manure), but the plants were to so great an extent destroyed by the severe weather which followed, that, in April 1871, the crop was ploughed up, and the land left fallow.

During the winter and early spring of 1871-2, the land was so wet that it could not be prepared in time for sowing. It was therefore left fallow for 1872, at the end of May subsoiled to a depth of about 12 inches, and re-ploughed in July. The winter and early spring of 1872-3 were also so extremely wet, that it was again impossible to prepare the land in time for sowing; it was, however, ploughed up towards the end of March, again left fallow, and re-ploughed in July and October (1873). On February 2, 1874, the land was again set with Beans, but without manure.

The general result of the experiments with Beans has been, that mineral constituents used as manure (more particularly potass), increased the produce very much during the early years; and, to a certain extent, afterwards, whenever the season was favourable for the crop. Ammonia-salts, on the other hand, produced very little effect; notwithstanding that a Leguminous crop contains two, three, or more times as much nitrogen as a Graminaceous one grown under similar conditions as to soil, &c. Nitrate of soda has, however, produced marked effects. But Leguminous crops grown too frequently on the same land seem to be peculiarly subject to disease, which no conditions of manuring that we have hitherto tried seem to obviate.

Experiments with Peas were soon abandoned, owing to the difficulty of keeping the land free from weeds, and an alternation of Beans and Wheat was substituted; the beans being manured much as in the experiments with the same crop grown continuously as above described. But the wetness of the winter of 1871-72 prevented the sowing of the Beans for the season of 1872; and again the wetness of the autumn and winter of 1872-3 prevented the sowing of the wheat until April 4, 1873, when Nursery wheat was put in, which, however, did not come to maturity, but was cut in the middle of September, yielding about 27 cwts. of gross produce per acre, containing too little corn to be worth thrashing. The land was ploughed in October 1873, and sown with beans February 3, 1874.

In alternating Wheat with Beans, the remarkable result had been obtained, that nearly as much wheat, and nearly as much nitrogen, were yielded in eight crops of wheat in alternation with the highly nitrogenous beans, as in sixteen crops of wheat grown consecutively without manure in another field, and also nearly as much as were obtained in a third field in eight crops alternated with bare fallow.

Experiments with Tares, like those with Peas, were soon abandoned, and for the same reasons. Beans were at first substituted, with some variation in the description of the manures employed; but this experiment has likewise been abandoned for some years.

II.—Red Clover (*Trifolium pratense*)—Hoos Field.

Experiments on the growth of Clover, with many different descriptions of manure, were commenced in 1849, and, with the occasional interposition of a corn-crop, or fallow, have been continued up to the present time.

As with other *Leguminous* crops, the result was, that mineral constituents applied as manure (particularly potass) considerably increased the early crops; whereas ammonia-salts had little or no beneficial effect, and were sometimes injurious. It may be added that, even up to the present time, the beneficial effects of long previous applications of potass are apparent whenever there is any growth at all. To go a little more into detail:—

In the first year, 1849, the crops were throughout very heavy; especially with mineral, and without nitrogenous manure.

In autumn 1849 wheat was sown, and in spring 1850 Red Clover. In 1851 small cuttings were taken; and in 1852, though the crops were not heavy, there was by no means a failure. Since that time, however, all attempts to grow clover year after year on the same land have failed to give anything like a full crop, or a plant which would stand the usual time on the ground. Small cuttings were obtained in the autumns of 1855 and 1859 from seed sown in the spring of those years, and small but rather heavier cuttings in June and August 1865, from seed sown in 1864.

On two occasions (1851 and 1854), heavy dressings of Farmyard dung were applied to some of the plots; and in 1854 some received a dressing of 20 tons of dung, and 5000 lbs. of lime, per acre.

On some portions of the land Clover-seed was sown 10 times during the 23 years, 1848–1870 inclusive, and more frequently alone than with a corn-crop; but in 7 out of the last 8 trials the plant died off in the winter and spring succeeding the sowing the seed.

In view of these failures in the field, it is a fact of much interest, that in 1854 Red Clover was sown in a garden, only a few hundred yards distant from the experimental field, on soil which has been under ordinary garden cultivation for probably two or three centuries, and it has every year since shown very luxuriant growth; and, after re-sowing 4 times during the period, namely, in 1860, 1865, 1868, and 1871, a small cutting was taken in the autumn of 1871, two cuttings in 1872, and two in 1873. Notwithstanding some injury from dodder in 1873, there still remained too much plant to break up; and, accordingly, fresh seed has just (May 4, 1874) been sown between the rows. This, therefore, is the 21st season of the growth of Clover, year after year, on this plot of garden ground.

In reference to the field experiments, it may be added that, in 1864, a portion of the land was trenched 2 feet deep, and one-third of the manure was mixed with the layer from 24 to 16 inches, one-third from 16 to 8 inches, and the remainder from 8 inches upwards. Owing to the characters of the season, the mechanical condition of the land was at first very unfavourable after this treatment; but, although many years have now elapsed, and the excess of constituents supplied was in some cases considerable, the plant has died off as completely on these plots as elsewhere.

Again, in the winter of 1867-8 small portions of the experimental land were dug, some to the depth of 9 inches, some to the depth of 18, some to the depth of 27, and some to the depth of 36 inches, and sown to the respective depths with different mixtures; supplying in some cases very large amounts of potass, soda, lime, magnesia, phosphoric acid, sulphuric acid, nitrate of soda, &c. From other similar sized plots, the soil was removed to the depths of 9, 18, and 27 inches respectively, and replaced by soil taken at the same depths from the garden border, on a portion of which clover had been grown successfully since 1854, as above referred to. In April 1868 clover was sown over the whole of these small plots, and on some other portions of the land not so treated; but the plant for the most part died off during the following winter.

In April 1869 the same portions were re-sown, small quan-

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tities of clover were cut in September of that year, but the plant again died off in the winter.

In April 1870 Clover was sown over the whole of the experimental land, this time in conjunction with Barley; but on those portions which had also been sown in 1868 and 1869 the plant again died off during the winter and early spring; whilst from those which had not been sown in 1868 and 1869 two small cuttings were taken in 1871. In the spring of 1872, the plant being then almost entirely gone, the land was ploughed up. It was again ploughed in July 1872, and in March 1873; the intention being to sow some other leguminous crop; but owing to the wetness and lateness of the season this was not done; the land was again left fallow, and re-ploughed in the beginning of June and the end of July (1873). On May 4, 1874, the land was again ploughed, prepared for sowing, and sown with Red Clover seed May 5, without manure.

In the spring of 1871 the *small* plots in the field were again re-sown, and those of the garden-soil were entirely enclosed, both around and above, by galvanised wire netting. Small cuttings were taken from these small beds in July 1872, and (excepting from the garden-soil plots, which had yielded considerably more than the others in 1872) larger cuttings were taken in July 1873. The produce was the largest where potass and nitrate of soda were employed, and where they were applied in the largest quantity, and at the greatest depths. In April 1874, there was still some healthy plant on all the plots, but it was considered to be too irregular to preserve. It has, therefore, been dug in, the artificially-manured plots remanured as before, but only to the depth of 9 inches, and resown with seed on May 4th. More small plots have also been arranged; on which the manures were dug in, at the various depths, on May 11th to 14th, and the seed sown on May 16th.

The general result of the experiments in the field has been—that neither organic matter rich in carbon as well as other constituents, nor ammonia-salts, nor nitrate of soda, nor mineral constituents, nor a complex mixture, supplied as manure, availed to restore the clover-yielding capabilities of the land; though, where some of these were applied in large quantity, and at considerable depths, the result was better than when they were used in only moderate quantities and applied only on the surface.

On the other hand, it is clear that the garden-soil has supplied the conditions under which clover can be grown year after year on the same land for many years in succession.

The results obtained on the garden-soil seem to show that what is called "clover-sickness," cannot be due to the injurious influence of excreted matters upon the immediately succeeding crop.

That Clover frequently fails coincidently with injury from parasitic plants, or insects, cannot be disputed; but it may be doubted whether such injury should be reckoned as the cause, or merely the concomitant and an aggravation, of the failing condition.

The results of the experiments seem, therefore, to exclude the supposition that the primary cause of failure is either destruction by parasitic plants or insects, injury from excreted matters, or the shade of a corn-crop, and to indicate that it must be looked for in exhaustion of the soil. Still there remain several open questions. Is it exhaustion of certain organic matters rich in carbon, of nitrogenous food, or of mineral constituents? Again: is there an absolute deficiency in the soil of some of the substances in question, or only an unfavourable condition of combination, or, so to speak, of *soil-digestion* of them, for the requirements of Leguminous plants? Or, is there only an unfavourable distribution of them within the soil, considered in relation to the extent and character of the root-range of the crop?

These various suggestions cannot be further considered within the limits of this brief notice, which may be concluded by the following quotation from Rothamsted papers on the subject ('Journal Royal Agricultural Society of England,' vol. xxi. Part I. p. 178; and 'Journal Royal Horticultural Society of London,' vol. iii. p. 86, 1872).

"When land is not what is called 'clover-sick,' the crop of clover may frequently be increased by top-dressings of manure containing potass and superphosphate of lime; but the high price of salts of potass, and the uncertainty of the action of manures upon the crop, render the application of artificial manures for clover a practice of doubtful economy.

"When the land is what is called 'clover-sick,' none of the ordinary manures, whether 'artificial' or natural, can be relied upon to secure a crop.

"So far as our present knowledge goes, the only means of insuring a good crop of Red Clover is to allow some years to elapse before repeating the crop upon the same land."

BARN FIELD.

EXPERIMENTS ON THE GROWTH OF ROOT-CROPS.

Experiments with Turnips were commenced in 1843. Eight acres, divided into numerous plots, were set apart for the purpose; and the crop was grown for ten consecutive years on the same land ("Norfolk Whites" 1843-1848, and "Swedes" 1849-1852); on some plots without manure, and on others with different descriptions of manure. Barley was then grown for three consecutive seasons (1853-1855) without manure, in order to test the comparative corn-growing condition of the different plots, and also to equalize their condition, as far as possible, by the exhaustion of some of the most active and immediately available constituents supplied by the previous manuring. A new series of experiments with Swedes was then arranged, having regard to the character of the manures previously applied on the different plots, and to the results previously obtained. This second series was commenced in 1856, and continued for 15 years—namely, to 1870 inclusive.

It is impossible adequately to state the bearing of the results in a few words, but the following are some of the most characteristic indications:—

1. Without manure of any kind, the produce of roots was reduced in a few years to a few cwts. per acre; but the diminutive plants (both root and leaf) contained a very unusually high percentage of nitrogen.

2. Of "mineral" constituents, phosphoric acid (in the form of superphosphate of lime) was by far the most effective manure; but, when this manure is used alone, the immediately available nitrogen of the soil is rapidly exhausted.

3. Really large crops of turnips can only be obtained when the soil supplies a liberal amount of nitrogenous (and carbonaceous?) matter, as well as mineral constituents; and when they are already available within the soil, or are supplied in the form of farmyard manure, rape-cake, Peruvian guano, ammonia-salts, &c., the rapidity of growth, and the amount of the crop, are greatly increased by the use of superphosphate of lime applied near to the seed.

The land is now devoted to experiments with sugar-beet; for particulars of which see next page.

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EXPERIMENTS ON SUGAR BEET—BARN FIELD.

GROWN YEAR AFTER YEAR ON THE SAME LAND, WITHOUT MANURE, AND WITH DIFFERENT DESCRIPTIONS OF MANURE, COMMENCING 1871.

Previous Cropping:—1843–'48 (6 Seasons), experiments on Norfolk White Turnips, with different descriptions of Manure.
1849–'52 (4 Seasons), experiments on Swede Turnips, with different descriptions of Manure.
1853–'55 (3 Seasons), Barley without Manure (with a view as far as possible to equalise the condition of the Plots).
1856–'70 (15 Seasons), experiments on Swede Turnips, with different descriptions of Manure, in which the arrangement of the Plots was the same, and that of the Manures very similar—in fact, exactly the same during the last 10 years—as in the first year of Sugar Beet, excepting that, during those 10 years, the Alkalies were omitted for the Swedes. For the second and subsequent years of Sugar Beet slight alterations in theManures were made, as will be seen below.

Area under experiment about 8 acres. The experiments are arranged as under, in 5 Series, each of which comprises 8 Plots.

PLOTS.	Manures, per Acre, per Annum. SERIES 1.	SERIES 2. Each Plot as Series 1, and Cross-dressed with 550 lbs. Nitrate Soda.	SERIES 3. Each Plot as Series 1, and Cross-dressed with 400 lbs. "Ammonia-salts."	SERIES 4. Each Plot as Series 1, and Cross-dressed with 2000 lbs. Rape-cake, and 400 lbs. "Ammonia-salts."	SERIES 5. Each Plot as Series 1, and Cross-dressed with 2000 lbs. Rape-cake.

FIRST SEASON, 1871.

		PRODUCE PER ACRE (Roots trimmed as for feeding, not as for Sugar-making).									
		Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
		Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
1	Farmyard Manure (14 tons)	18 3	3 5	27 13	6 19	22 1	5 6	26 4	6 14	28 18	5 14
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate of Lime (1).	14 13	2 14	25 16	5 15	21 15	4 6	25 2	6 7	25 4	5 5
3	Without Manure (for 30 years)	7 11	2 0	22 3	5 12	15 6	4 16	19 18	7 0	20 16	4 12
4	3½ cwts. Superphosphate, 300 lbs. Sulphate Potass, 200 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	7 11	1 5	22 15	4 8	17 10	3 5	22 15	6 3	21 7	3 19
5	3½ cwts. Superphosphate	5 12	1 8	20 19	3 14	15 4	3 19	19 18	7 12	18 19	4 5
6	3½ cwts. Superphosphate, and 300 lbs. Sulph. Potass	5 1	1 4	21 5	3 13	17 4	3 4	23 11	6 11	21 0	3 11
7	3½ cwts. Superphosphate, and 300 lbs. Sulph. Potass, and 36½ lbs. Ammonia-salts (2)	5 18	1 5	20 19	3 18	18 8	4 3	21 0	5 0	21 7	3 17
8	Without Manure 1853 and since; previously part Unmanured, and part Superphosphate	7 10	1 14	21 13	3 16	16 2	4 15	17 19	7 11	20 7	4 9

SECOND SEASON, 1872.

		PRODUCE PER ACRE (Roots trimmed as for feeding, not as for Sugar-making).									
		Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
		Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
1	Farmyard Manure (14 tons)	15 13	4 2	23 9	7 19	22 14	9 0	26 8	9 11	22 5	6 1
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate of Lime (1)	16 0	3 18	24 6	8 16	22 0	7 16	25 9	9 14	20 15	5 11
3	Without Manure (for 30 years)	7 17	1 13	21 7	6 6	15 3	4 13	20 8	10 1	16 3	3 11
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), and 200 lbs. Sulphate Magnesia	6 14	1 10	20 2	5 19	15 10	3 7	23 8	7 13	17 18	3 15
5	3½ cwts. Superphosphate	6 17	1 8	19 6	6 4	14 5	4 13	18 11	10 4	15 18	3 16
6	3½ cwts. Superphosphate, and 500 lbs. Sulph. Potass	6 6	1 5	16 16	5 14	14 7	3 19	22 16	9 9	15 17	3 14
7	3½ cwts. Superphosphate, and 500 lbs. Sulph. Potass, and 36½ lbs. Ammonia-salts (2)	6 15	1 8	17 0	6 1	15 9	3 19	23 9	9 10	15 10	3 15
8	Without Manure 1853 and since; previously part Unmanured, and part Superphosphate	5 4	1 5	15 6	5 19	13 10	4 1	19 12	9 17	15 0	4 6

THIRD SEASON, 1873.

		PRODUCE PER ACRE (Roots trimmed as for feeding, not as for Sugar-making).									
		Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
		Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
1	Farmyard Manure (14 tons)	15 2	5 12	20 5	10 9	22 2	9 18	22 15	12 10	23 10	7 8
2	Farmyard Manure (14 tons) and 3½ cwts. Superphosphate of lime (1)	14 6	5 2	21 10	11 0	19 4	8 9	23 7	13 6	21 18	6 18
3	Without Manure (for 30 years)	5 1	1 11	14 5	6 11	9 3	3 16	15 12	9 11	14 13	4 1
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), and 200 lbs. Sulphate Magnesia	5 2	1 13	16 9	6 11	12 10	3 10	20 3	8 0	16 1	3 8
5	3½ cwts. Superphosphate	5 5	1 11	18 8	5 13	10 19	5 0	14 15	9 8	13 19	4 9
6	3½ cwts. Superphosphate, and 500 lbs. Sulph. Potass	4 12	1 5	15 17	4 4	12 18	3 12	20 2	9 5	14 14	3 11
7	3½ cwts. Superphosphate, and 500 lbs. Sulph. Potass, and 36½ lbs. Ammonia-salts (2)	5 19	1 12	16 14	5 3	13 0	4 15	19 16	9 0	15 17	4 4
8	Without Manure 1853 and since; previously part Unmanured, and part Superphosphate	4 11	1 7	12 9	5 18	8 8	2 19	15 2	9 8	12 2	3 16

FOURTH SEASON, 1874.

For the Crop of 1874 Superphosphate of Lime, Sulphate of Potass, Chloride of Sodium, and Sulphate of Magnesia, applied as in 1872 and 1873; but no farmyard manure, or cross-dressings of Nitrate of Soda, Ammonia-salts, or Rape-cake.

(1) "Superphosphate of Lime"—in all cases made from 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid sp. gr. 1·7 (and water).
(2) "Ammonia-salts"—in each case equal parts Sulphate and Muriate of Ammonia of Commerce.

AGDELL FIELD.

Experiments on an actual Course of Rotation—Turnips, Barley, Leguminous Crop (or Fallow), and Wheat.

These Experiments were commenced in 1848; so that the present crop (1874) is the 27th experimental one, or the third crop of the Seventh Course.
One-third of the land has been continuously unmanured; one-third manured with Superphosphate of Lime alone once every four years, that is for the turnip-crop commencing each course; and one-third manured (also for the turnip-crop only) with a complex manure, as described in the foot-note, No. 2.
In the Second, Third, Fourth, Fifth, and Sixth Courses, instead of clover, half of each plot was sown with beans, and the other half left fallow; for the third crop of the Seventh Course clover was again sown (spring 1873), on half of each plot, the other half being left fallow.
From half of each of the three plots the whole turnip-crop (roots and leaves) was removed; and on the other half the roots were eaten on the land by sheep, and the uneaten leaves spread and ploughed in. In the case of all the other crops, the total produce was removed from the land.
The abstract of the results given below relates to the portions of each plot from which the turnip-crops were entirely removed; and on which, in the second, third, fourth, fifth, and sixth courses, beans (not fallow) replaced the clover.

(Area under experiment, about 2½ acres.)

1 lb. (pound avoir.) per acre .. = (about) 1·12 Kilogramme per Hectare, or 0·57 Zollverein Pfund. per Prussian Morgen.
1 cwt. (hundredweight) per acre = (about) 125·5 Kilogrammes per Hectare, or 0·64 Centner per Pr. Morgen.

Years.	Description of Crop.	Produce per Acre. Plot 1. Unmanured continuously. Corn[3] (or Roots).	Straw (or Leaf).	Total Produce.[4]	Plot 2. Superphosphate of Lime,[1] alone, for the Turnip Crops only. Corn[3] (or Roots).	Straw (or Leaf).	Total Produce.[4]	Plot 3. Complex Manure,[2] for the Turnip Crops only. Corn[3] (or Roots).	Straw (or Leaf).	Total Produce.[4]
1st Course, 1848–51.										
1848	Norfolk White Turnips	65¼ cwts.	45¾ cwts.	111¼ cwts.	225¾ cwts.	106½ cwts.	332 cwts.	218 cwts.	151¼ cwts.	369¼ cwts.
1849	Barley	44⅞ bush.	2983 lbs.	5656 lbs.	29⅝ bush.	2111 lbs.	3841 lbs.	28⅞ bush.	2088 lbs.	3794 lbs.
1850	Clover (calcd. as hay)	..	..	54 cwts.	..	..	57¾ cwts.	..	..	63 cwts.
1851	Wheat	28½ bush.	3431 lbs.	5389 lbs.	28 bush.	3371 lbs.	5253 lbs.	28⅞ bush.	3552 lbs.	5500 lbs.
2nd Course, 1852–55.										
1852	Swedish Turnips	26 cwts.	4¾ cwts.	30¼ cwts.	223¼ cwts.	20¼ cwts.	243½ cwts.	396½ cwts.	36¼ cwts.	433 cwts.
1853	Barley	34⅜ bush.	2430 lbs.	4465 lbs.	28⅝ bush.	1873 lbs.	3560 lbs.	38½ bush.	2604 lbs.	4873 lbs.
1854	Beans	5⅛ bush.	1055 lbs.	1445 lbs.	5⅝ bush.	1105 lbs.	1534 lbs.	9⅝ bush.	1355 lbs.	2065 lbs.
1855	Wheat	35¼ bush.	3619 lbs.	5839 lbs.	35¼ bush.	3325 lbs.	5789 lbs.	37⅜ bush.	3942 lbs.	6371 lbs.
3rd Course, 1856–59.										
1856	Swedish Turnips	32 cwts.	2½ cwts.	34½ cwts.	136 cwts.	7⅞ cwts.	143⅞ cwts.	333⅜ cwts.	12¼ cwts.	346¼ cwts.
1857	Barley	48⅛ bush.	2600 lbs.	5337 lbs.	23¼ bush.	1475 lbs.	3076 lbs.	48 bush.	2435 lbs.	5163 lbs.
1858	Beans	6¼ bush.	1100 lbs.	1515 lbs.	6⅜ bush.	1155 lbs.	1605 lbs.	12⅜ bush.	1520 lbs.	2357 lbs.
1859	Wheat	35¼ bush.	4030 lbs.	6262 lbs.	34⅝ bush.	3930 lbs.	6120 lbs.	39⅝ bush.	4610 lbs.	7154 lbs.
4th Course, 1860–63.										
1860	Swedish Turnips	1 cwt.	(6¼ lbs.)	1 cwt.	29¼ cwts.	1¼ cwt.	30¾ cwts.	87¼ cwts.	3¼ cwts.	90½ cwts.
1861	Barley	38⅜ bush.	2522 lbs.	4718 lbs.	30⅜ bush.	2000 lbs.	3775 lbs.	60⅛ bush.	3940 lbs.	7391 lbs.
1862	Beans	29 bush.	1840 lbs.	3661 lbs.	29⅝ bush.	2150 lbs.	4040 lbs.	43⅛ bush.	3280 lbs.	5990 lbs.
1863	Wheat	44⅝ bush.	3457 lbs.	6330 lbs.	34⅛ bush.	3390 lbs.	5519 lbs.	46⅛ bush.	4597 lbs.	7626 lbs.
5th Course, 1864–67.										
1864	Swedish Turnips	8¾ cwts.	0¾ cwt.	9½ cwts.	68 cwts.	4¾ cwts.	72¾ cwts.	176¼ cwts.	8¾ cwts.	185 cwts.
1865	Barley	39 bush.	2154 lbs.	4182 lbs.	33½ bush.	1615 lbs.	3394 lbs.	47½ bush.	2595 lbs.	5148 lbs.
1866	Beans	10⅛ bush.	1013 lbs.	1689 lbs.	7⅜ bush.	978 lbs.	1463 lbs.	20⅛ bush.	1990 lbs.	3343 lbs.
1867	Wheat	21 bush.	2143 lbs.	3473 lbs.	19¾ bush.	1966 lbs.	3222 lbs.	23¾ bush.	3003 lbs.	4567 lbs.
6th Course, 1868–71.										
1868	Swedish Turnips	Failed, and ploughed up.			Failed, and ploughed up.			Failed, and ploughed up.		
1869	Barley	24⅜ bush.	1948 lbs.	3358 lbs.	28¾ bush.	2025 lbs.	3686 lbs.	42⅞ bush.	3309 lbs.	5800 lbs.
1870	Beans	13⅜ bush.	738 lbs.	1591 lbs.	15⅜ bush.	768 lbs.	1778 lbs.	24⅜ bush.	1056 lbs.	2664 lbs.
1871	Wheat	20⅛ bush.	2793 lbs.	4092 lbs.	23⅝ bush.	3043 lbs.	4521 lbs.	23 bush.	3440 lbs.	4883 lbs.
7th Course, 1872–75.										
1872	Swedish Turnips	34½ cwts.	8¾ cwts.	42⅞ cwts.	170⅛ cwts.	17⅜ cwts.	188 cwts.	339⅜ cwts.	35⅜ cwts.	375⅝ cwts.
1873	Barley	23½ bush.	1343 lbs.	2717 lbs.	20¾ bush.	1565 lbs.	2875 lbs.	31¼ bush.	1723 lbs.	3573 lbs.
1874	Clover			cwts.			cwts.			cwts.
1875	Wheat									
Summary—Average of the First 6 Courses, 1848-1871.										
1848, '52, '56, '60, '64	Swedish Turnips	26¾ cwts.	10½ cwts.	37¼ cwts.	136¼ cwts.	28 cwts.	164½ cwts.	242½ cwts.	42½ cwts.	285 cwts.
1849, '53, '57, '61, '65, '69	Barley	38⅜ bush.	2440 lbs.	4619 lbs.	30 bush.	1850 lbs.	3555 lbs.	44⅜ bush.	2829 lbs.	5362 lbs.
1850, '54, '58, '62, '66, '70	Clover, 1850 (calcd. as hay)	..	..	54 cwts.	..	..	57¾ cwts.	..	..	63 cwts.
	Beans	12½ bush.	1149 lbs.	1930 lbs.	13 bush.	1231 lbs.	2084 lbs.	22½ bush.	1840 lbs.	3284 lbs.
1851, '55, '59, '63, '67, '71	Wheat	30⅞ bush.	3248 lbs.	5238 lbs.	29⅜ bush.	3205 lbs.	5087 lbs.	33⅜ bush.	3874 lbs.	6017 lbs.

(1) First Course—100 lbs. Bone-ash, and 100 lbs. Sulphuric Acid (sp. gr. 1·7); Second Course—160 lbs. Bone-ash, 120 lbs. Sulphuric Acid; Third, Fourth, Fifth, Sixth, and Seventh Courses—200 lbs. Bone-ash, and 150 lbs. Sulphuric Acid, *per acre*.

(2) First Course—100 lbs. Pearl-ash, 100 lbs. Bone-ash, 100 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 1000 lbs. Rape-Cake; Second Course—300 lbs. Sulphate of Potass, 100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 160 lbs. Bone-ash, 120 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 2000 lbs. Rape-cake; Third, Fourth, Fifth, Sixth, and Seventh Courses—300 lbs. Sulphate of Potass, 200 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 2000 lbs. Rape-cake, *per acre*.

(3) The quantities given in *Bushels* represent the *Dressed* Corn only.

(4) The "Total Produce" of the Corn-crops includes Dressed Corn, Offal Corn, and Total Straw.

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Experiments with Different Descriptions of **WHEAT**, in 1874; and Summary of Results obtained in previous Years.

Season 1874. Upper Harpenden Field. 2 Cwts. Nitrate Soda; after Mangolds with Dung 1873, Carted off.	Dressed corn per acre. 1868; Sawpit Field; 1 cwt. Guano, 1 cwt. Wheat Manure; after Clover.	1869; Thirty Acres Field; 2 cwts. Guano; after Clover.	1870; Sawyer's Field; 4 cwts. Guano; after Fallow.	1871; Sawpit Field; 3 cwts. Guano; after Mangolds, carted off.	1872; Foster's Field; 2 cwts. Superphosphate, 2 cwts. Nitrate Soda; after Roots, carted off.	1873; Long Hoos Field; 1½ cwt. Nitrate; after Mangolds (with Dung), carted off.	Average.	Weight per bushel. 1868; Sawpit Field; 1 cwt. Guano, 1 cwt. Wheat Manure; after Clover.	1869; Thirty Acres Field; 2 cwts. Guano; after Clover.	1870; Sawyer's Field; 4 cwts. Guano; after Fallow.	1871; Sawpit Field; 3 cwts. Guano; after Mangolds, carted off.	1872; Foster's Field; 2 cwts. Superphosphate; 2 cwts. Nitrate Soda, after Roots, carted off.	1873; Long Hoos Field; 1½ cwt. Nitrate; after Mangolds (with Dung), carted off.	Average.
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1. White-chaff (Red)	.. ..	.. ..	.. ..	.. ..	.. ..	40⅝	40⅝	.. ..	.. ..	.. ..	.. ..	.. ..	58½	58½
2. Rivett's (Red)	.. ..	.. ..	.. ..	.. ..	.. ..	48⅛	48⅛	.. ..	.. ..	.. ..	.. ..	.. ..	57⅛	57⅛
3. Chubb Wheat (Red)	.. ..	.. ..	.. ..	28⅜	40	35¾	34¾	.. ..	.. ..	.. ..	60¼	61⅞	59⅛	60½
4. Red-chaff (White)	.. ..	.. ..	.. ..	32⅜	37	35¼	35	.. ..	.. ..	.. ..	61⅝	62¼	60¾	61⅛
5. Browick (Red)	.. ..	.. ..	50¼	35½	40⅜	38½	41⅛	.. ..	.. ..	64⅛	60	61⅜	59½	61¼
6. Red Wonder	51⅜	54¾	51	31½	43¾	37⅛	45	63	60½	64¾	59	60⅞	60	61⅜
7. Burwell (Old Red Lammas)	41⅞	48⅛	48⅜	31⅛	41¼	35⅛	41	64	63	65¾	62	63	61⅓	63¼
8. Bristol Red	.. ..	54¾	50	29⅜	44⅜	39½	43⅓	.. ..	61	65¼	60⅞	61½	60½	61¾
9. Red Nursery	41⅞	49¼	45	34⅛	45¼	27⅛	40½	66	65	66⅞	63	65	62	64⅛
10. Red Langham	.. ..	53	49¼	30¾	43⅜	34⅛	42⅛	.. ..	61	65¼	60⅜	61⅓	60½	61⅜
11. Woolly Ear (White)	44¼	52⅜	47⅝	31¼	42⅜	37	42½	64	61½	64⅞	61⅛	62⅛	61⅛	62½
12. Hardcastle (White)	.. ..	.. ..	.. ..	.. ..	46½	42	44¼	.. ..	.. ..	.. ..	.. ..	61⅞	59¾	60¾
13. Golden Drop (Red), Hallett's	.. ..	.. ..	.. ..	39½	49¾	44¼	44¾	.. ..	.. ..	.. ..	61⅜	63	59¾	61¾
14. Victoria White, Hallett's	.. ..	.. ..	.. ..	33¾	45¼	38¼	39⅛	.. ..	.. ..	.. ..	61	62⅝	59¾	61⅛
15. Hunter's White, Hallett's	.. ..	.. ..	.. ..	26⅞	39¾	38⅝	35⅛	.. ..	.. ..	.. ..	59¼	61¾	57¼	59½
16. Original Red, Hallett's	.. ..	.. ..	.. ..	30	35¼	36⅜	33⅞	.. ..	.. ..	.. ..	58⅝	60	56⅛	58¼
17. White Chiddam	49	49⅝	45⅝	26⅞	38¾	31¾	40¼	64⅔	60½	66⅓	62¼	63	59¼	62⅝
18. Red Rostock	46⅝	51¼	.. ..	37	.. ..	46¼	45¼	63½	61¼	.. ..	60⅛	.. ..	56¾	60⅝
19. Casey's White	.. ..	.. ..	50½	29⅞	42⅛	37⅛	40	.. ..	.. ..	64¾	60⅜	61½	58¾	61⅜
20. Golden Rough-chaff (Red)	.. ..	.. ..	.. ..	33	39¼	38⅛	36⅞	.. ..	.. ..	.. ..	61⅝	62¾	59¾	61¼
21. Bole's Prolific (Red)	.. ..	.. ..	53¼	33⅝	42¾	45¼	43¾	.. ..	.. ..	65⅛	61½	62⅝	57½	61⅝
22. Club Wheat (Red)	.. ..	.. ..	.. ..	36	45¾	47½	43⅛	.. ..	.. ..	.. ..	60⅜	61⅞	58¼	60⅛
23. Niagara (Red)	.. ..	43⅛	48½	.. ..	.. ..	.. ..	45⅞	.. ..	60½	65	.. ..	.. ..	.. ..	62¾
24. Clover's Suffolk Red	41¼	.. ..	.. ..	.. ..	.. ..	.. ..	41¼	64	.. ..	.. ..	.. ..	.. ..	.. ..	64
25. Golden Drop (Red)	.. ..	50½	50½	35¾	.. ..	.. ..	45⅝	.. ..	62½	66	61¼	.. ..	.. ..	63¼
26. Maynard's (Red)	.. ..	.. ..	.. ..	31⅜	.. ..	.. ..	31⅜	.. ..	.. ..	.. ..	61⅛	.. ..	.. ..	61⅛
Mean	45⅛	50⅜	49⅛	32¼	42¼	38⅞	41	64⅛	61⅝	65⅜	60¾	62⅛	59¼	61¼

EXPERIMENTS WITH A VIEW TO ECONOMY IN THE USE OF EXPENSIVE NITROGENOUS MANURES.

It is found that generally less than half the nitrogen supplied in such manures as guano, ammonia-salts, or nitrate of soda, is recovered in the increase of the crop for which they are used; that a considerable quantity may remain in the soil in a comparatively inactive state, yielding increase very slowly; and that a considerable quantity may be carried away by drainage, and lost. It seemed desirable, therefore, to commence a series of experiments to determine whether any saving can be effected by applying comparatively small quantities near to the seed, instead of larger amounts in the usual mode of broadcast sowing and harrowing-in.

It is also intended to make experiments with a view to ascertain the best periods of the year for the application of such manures to different crops.

First Season, 1871.—Experiments upon Wheat. Little Hoos Field. Plots ¼ acre each.

Plot No.	Manures per Acre, &c.	Produce per Acre. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.
		Bushels.	lbs.	cwts.
1	Unmanured. Seed 1 bushel, dibbled 6 inches apart in the rows	23¾	59·3	24½
2	146 lbs. Sulphate Ammonia (containing Nitrogen = 15 bushels grain, and its straw). Seed 1 bushel; Holes dibbled 6 inches apart in the rows; manure (mixed with Ashes) put in, and seed above	31½	59·1	36¼
3	292 lbs. Sulphate Ammonia. Seed 1 bushel; Manure (mixed with Ashes) sown broadcast, seed dibbled 6 inches apart in the rows	28¾	58·3	35⅝

First Season, 1871.—Experiments upon Barley. Thirty-acres Field. Plots ½ acre each.

		Bushels.	lbs.	cwts.
1	Unmanured. Seed 3 bushels; drilled	40½	53·9	24⅝
2	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 3 bushels; Manures mixed with Ashes and sown broadcast; seed drilled	49⅞	53·3	30½
3	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 3 bushels; Manures mixed with Ashes and drilled; seed drilled above	49½	53·4	28½
4	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 3 bushels; Manures, Ashes, and Seed mixed, and drilled together	51	53·0	30⅜
5	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 1½ bushel; Holes dibbled, 6 inches apart in the rows; Manures (mixed with Ashes) put in, and Seed above	51¼	53·3	28¼
6	2 cwts. Superphosphate, 2 cwts. Nitrate Soda. Seed 3 bushels; Manures mixed with Ashes and sown broadcast; seed drilled	56¼	51·6	32⅞

Second Season, 1872.—Experiments upon Barley. Thirty-acres Field. Plots ½ acre each.

		Bushels.	lbs.	cwts.
1	Unmanured. Seed 2½ bushels, drilled	33⅛	54·4	19½
2	3 cwts. Superphosphate, 2 cwts. Nitrate Soda. Seed 2½ bushels; Manures made up to 15 bushels per acre with Ashes, and sown broadcast; seed drilled	46½	54·1	30⅛
3	3 cwts. Superphosphate, 2 cwts. Nitrate Soda. Seed 2½ bushels; The Superphosphate mixed with 40 lbs. slaked Lime to neutralize the acid, the Nitrate added, and the whole made up to 15 bushels per acre with Ashes, and sown broadcast; Seed drilled	47⅞	53·6	31⅛
4	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 2½ bushels; Manures and Seed made up to 15 bushels per acre with Ashes, and the whole (Manure, Seed, and Ashes) drilled together	42⅝	54·1	26½
5	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 2½ bushels; Manures and Seed made up to 15 bushels per acre with a mixture of half Lime and half Ashes, and the whole (Manure, Seed, Lime, and Ashes) drilled together	43½	53·1	27

Third Season, 1873.

Some experiments were conducted in which a given quantity of Nitrate of Soda (generally at the rate of 1 cwt. per acre) was, by means of plaster of Paris, and other substances, made to adhere to the seed, forming a coating upon it. Experiments in pots, well watered and kept in a greenhouse, showed that barley so coated germinated well, and gave strong and healthy plants; but owing to the wetness of the weather previously, to the consequent lateness of sowing, and to the scarcity of rain afterwards, the coated seeds sown in the field came up so irregularly, that it was considered not worth while to keep the crop separate at harvest. Even if it had not been so, there are practical difficulties in the way of so preparing the seed, which might render the method inapplicable in ordinary practice.

Fourth Season, 1874.—Experiments upon Barley. Barn Field. Plots ¼ acre each.

Plot. No.	Manures per Acre, &c.	Produce per Acre. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.
		Bushels.	lbs.	cwts.
1	Unmanured. Seed 2 bushels, dibbled 6 inches apart in the rows			
2	1 cwt. Superphosphate, 1 cwt. Nitrate Soda, 2 cwts. Ashes; Seed 2 bushels; All mixed, made into a paste with water, and dibbled 6 inches apart in the rows			
3	1 cwt. Superphosphate, 1 cwt. Nitrate Soda, 80 lbs. slaked Lime; Seed 2 bushels All mixed, and dibbled 6 inches apart in the rows			
4	1 cwt. Superphosphate, 1 cwt. Nitrate Soda, 2 cwts. Ashes; Seed 2 bushels; Manures mixed and sown broadcast; Seed drilled			

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