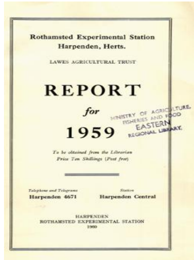
Report for 1959

Full Table of Content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LAWES AGRICULTURAL TRUST

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Combine-drilling Nitrogen for Spring Cereals

H. V. Garner

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Barnfield

In spite of a very dry spell at the time of drilling, a good plant was established on all plots, rather slowly on plots without farmyard manure. The crop later suffered from drought, and wilting was greatest on the well-manured plots where the leaf area was relatively high. Virus yellows was severe; spraying against the aphid vectors was not possible because of the risk that drifting insecticide would affect an adjacent experiment on an insect pest.

Ley–arable experiments

As in recent years, the plots of 3rd-year lucerne were poor, especially on Highfield. Of the two lucerne plots which reached their 3rd year in 1958 one was ploughed up early in that season because of the heavy attack of wilt (*Verticillium*). The wheat grown in 1959 on these two plots differed greatly in the degree of lodging; after 2 years lucerne and a 1-year fallow lodging was severe, but after 3 years lucerne only about 10% of the area was lodged. The yield of grain was higher after the 1 year's fallow.

Combine-Drilling Nitrogen for Spring Cereals

by H. V. Garner

The advantages of combine-drilling phosphorus and potassium fertilisers with the seed of cereals was clearly shown in field experiments during and after the War. The practice was so convenient and successful that it has since become almost standard on the better-equipped corn-growing farms. If nitrogen was put through a combine-drill at all it was in the form of a mixed fertiliser with a strict limit on the maximum content of sulphate of ammonia, usually not more than 0·2 cwt. N/acre. This was quite suitable for winter cereals because most of the nitrogen would not be applied till the spring, but spring cereals presented a problem because the new varieties needed far more than 1 cwt. of sulphate of ammonia/acre, and it would be convenient to apply the whole of the nitrogen through the combine-drill with the phosphate and potash, rather than to go over the ground first with the phosphate and potash and later with the nitrogen. Experiments on spring wheat and barley were therefore made at Rothamsted and Woburn similar to those initiated by G. W. Cooke and F. V. Widdowson in 1954.

The design and rates of dressing were the same for all experiments. A basal dressing of 0·54 cwt. P_2O_5 and 0·54 cwt. K_2O was applied as granular fertiliser by combine-drill. Sulphate of ammonia was applied at four levels (0·00, 0·22, 0·54, and 0·72 cwt. N/acre) either through the combine-drill as part of a granular NPK fertiliser (whose PK provided the basal dressing) or broadcast immediately after sowing the seed. In spite of careful calibration, the scheduled amounts of nutrients could not always be exactly applied, but the discrepancy was seldom large. The broadcast nitrogen was always made equal to the nitrogen drilled. The

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granular fertilisers used were 0 : 16 : 16 * at 3·4 cwt.; 5 : 12½ : 12½ at 4·3 cwt.; 8 : 8 : 8 at 6·8 cwt.; and 12 : 9 : 9 at 6·0 cwt./acre.

TABLE 1

Rainfall and cultivations; spring wheat and barley, 1957–59, Rothamsted (R) and Woburn (W)

Centre and Year	*Spring wheat* Sowing date	Previous crop	*Barley* Sowing date	Previous crop	Rainfall (inches) Oct.–Feb.	March + April	Deviation from mean
R. 1957	2 April	Spring wheat	1 April	Barley	11·18	1·58	−2·25
R. 1958	3 April	Spring wheat	3 April	Spring wheat	13·30	3·11	−0·70
R. 1959	19 March	Winter wheat	19 March	Winter wheat	11·97	5·10	+1·30
W. 1957	—	—	23 March	Potatoes	9·06	1·57	−1·94
W. 1958	11 April	Fallow	3 April	Fallow	11·75	3·07	−0·44
W. 1959	21 March	Spring wheat	20 March	Barley	10·04	4·39	+0·88

At Rothamsted Koga II spring wheat was grown and Herta barley, except in 1959, when it was Proctor. At Woburn the spring wheat was Peko and the barley Herta.

The spring cereals were sown on dates well within the normal range on both farms. In 1957 seedbeds were poor, as the previous winter was free from frost. Germination was uneven and early growth slow. Later the crops were affected by the long spring drought. The crops of 1958 had a much better start, for the spring seedbeds were the best for many years, but from June onwards the weather was dull and wet, with very difficult harvest conditions. In 1959 there was plenty of moisture in the seedbeds and early growth was good; this was followed by a long, bright summer. In all three seasons there were full, even plants, giving low standard errors. Nitrogen effects were very striking. There was no lodging at Rothamsted even in the wet summer of 1958, but at Woburn the heaviest dressings of sulphate of ammonia lodged the barley in 1958. The factor most likely to influence the result of a heavy dose of soluble salts drilled with the seed was the moisture in the soil at sowing and for a few weeks afterwards. The total rainfall for the months of March and April roughly indicate this. There was a big range: in 1957 these months were particularly dry showing a deficit of 2·25 inches at Rothamsted and 1·94 at Woburn; 1958 was near the average; but in 1959 these two spring months were wetter than usual by 1·30 and 0·88 inches respectively. It happened therefore that the manures were tested in dry and in wet springs, and on a heavy and a light soil. The Rothamsted experiments were scored for general appearance when the crops were in full vegetative growth, usually in early June, and again just before harvest. The most obvious effects were responses to nitrogen; the plants without nitrogen were short, thin and pale green; the first level of nitrogen improved growth considerably, but was clearly insufficient, for in all experiments the plots receiving the second level of nitrogen looked still better. In 1959 the plots with the most nitrogen looked by far the best. These early differences persisted till harvest, but on a somewhat reduced scale, and were reflected in the yields.

At Rothamsted also the plots with combine-drilled nitrogen always looked as well and mostly better than those with the same quantity of broadcast nitrogen. At Woburn in 1957, the only year when the observation was made, barley was visibly depressed by the

* The first figure is the percentage of nitrogen (N), the second phosphorus as P_2O_5, the third potassium as K_2O.

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heaviest dose of nitrogen combine-drilled. Table 2 shows the effect of increasing doses of nitrogen, averaging both methods of application.

TABLE 2

Spring wheat and barley, responses to nitrogen, Rothamsted (R) and Woburn (W), grain cwt./acre, 1957–59

(Rates of dressing N_1 0·22 cwt., N_2 0·54 cwt., N_3 0·72 cwt./acre. Mean of both methods of application)

Centre and Year	Yield No N	Response to N_1–N_0	N_2–N_1	N_3–N_2
Spring wheat:				
R. 1957	15·1	+5·4	+1·6	0·0
R. 1958	9·9	+5·8	+6·8	−0·8
R. 1959	13·1	+6·3	+6·5	+4·6
Mean	12·7	+5·8	+5·0	+1·3
W. 1958	12·6	+5·0	+1·6	+1·4
W. 1959	9·9	+9·4	+6·0	+2·6
Mean	11·2	+7·2	+3·8	+2·0
Barley:				
R. 1957	20·6	+6·2	+3·8	+1·4
R. 1958	19·0	+6·4	+11·3	+0·1
R. 1959	14·1	+8·0	+9·0	+7·6
Mean	17·9	+6·9	+8·0	+3·0
W. 1957	21·6	+3·1	+6·4	+1·2
W. 1958	20·0	+7·8	+7·4	−1·0
W. 1959	12·7	+10·0	+7·6	+3·9
Mean	18·1	+7·0	+7·1	+1·4

Both crops on both farms responded well to nitrogen. A notable feature was the low yield of spring wheat without nitrogen, only 12 cwt./acre on the average of the 5 experiments; barley grown on the same fields yielded more than the wheat and averaged 18 cwt./acre. The smallest dressing of sulphate of ammonia, 0·22 cwt. N/acre, gave large and approximately equal returns with both cereals, a mean increase of 6·7 cwt. The further response to the second dose of nitrogen was also substantial; the extra 0·32 cwt. N. gave an additional 5·0 cwt. of wheat and 8·0 cwt. barley at Rothamsted, and 3·8 cwt. of wheat and 7·1 cwt. of barley at Woburn. The final increment of 0·18 cwt. N gave much smaller returns, except in 1959, when the responses ranged from 2·6 to 7·6 cwt. grain/acre. Yet even this final 0·18 cwt. N on the average more than paid for its extra cost.

In 1957 and 1958 some of the responses to nitrogen may have reflected the control of take-all, caused by *Ophiobolus graminis*, but there was little of this disease in 1959.

The very large nitrogen effects and the small errors allow the effectiveness of sulphate of ammonia when combine-drilled and when broadcast on the seedbed to be assessed. Table 3 gives the differences between the two for each rate of application.

At Rothamsted combine-drilling sulphate of ammonia gave larger yields of both crops in every year. In 1958 on wheat and in

TABLE 3

Spring wheat and barley, Rothamsted (R) and Woburn (W), 1957–59

(Combine-drilled sulphate of ammonia *minus* broadcast)
Grain (cwt./acre)

	Nitrogen applied (cwt./acre) 0·22	0·54	0·72	S.E.	Mean of all rates	S.E.
Spring wheat:						
R. 1957 ...	+0·7	+1·0	+2·3	1·30	+1·4	0·75
R. 1958 ...	+5·3**	+4·8**	+3·1**	0·65	+4·4**	0·38
R. 1959 ...	+1·2	+0·8	+1·5*	0·64	+1·2**	0·37
Mean ...	+2·4	+2·2	+2·3		+2·3	
W. 1958 ...	−0·3	−5·0**	−2·9**	1·00	−2·8**	0·58
W. 1959 ...	+0·1	−1·1	−0·8	0·92	−0·6	0·53
Mean ...	−0·1	−3·0	−1·8		−1·7	
Barley:						
R. 1957 ...	+1·3	−1·1	+0·1	1·46	+0·1	0·84
R. 1958 ...	+0·8	+1·2	+0·8	1·60	+0·9	0·92
R. 1959 ...	−0·3	+4·4**	+1·8	1·19	+2·0**	0·69
Mean ...	+0·6	+1·5	+0·9		+1·0	
W. 1957 ...	+0·2	−0·9	−3·7*	1·53	−1·4	0·88
W. 1958 ...	+0·3	+2·6	+1·6	1·26	+1·5	0·73
W. 1959 ...	+0·6	+1·8	+3·4*	1·20	+1·9*	0·69
Mean ...	+0·4	+1·2	+0·4		+0·7	

1959 on both crops the advantage from combining the fertiliser was on the average nearly 2·5 cwt. grain/acre and the individual values were statistically significant. In the other three experiments the differences between methods of application were generally small.

At Woburn, where spring wheat was grown in two seasons only, combine-drilling 0·54 cwt. or 0·72 cwt. of N gave lower yields than broadcasting in both years, and in 1958 the difference was highly significant. Barley gave less-consistent results. In the dry seed-beds of 1957 combine drilling at the two higher rates was inferior to broadcasting, but in the conditions of 1958 and 1959 the advantage was with combine drilling. Even when the higher rates were injurious, sulphate of ammonia drilled at 1 cwt./acre was always at least as efficient as when broadcast.

To see whether soluble salt drilled with the seed affected germination and early growth, plants were counted when tillering began. The best determined values were at Rothamsted in 1958 and on both farms in 1959. Seedbeds were fairly moist in both these seasons, and spring rainfall was also up to average. The mean plant population of spring wheat was 1·2 millions/acre; sulphate of ammonia broadcast at any of the three rates lowered the plant number; the mean of all experiments was a 6% decrease below the controls, although the fertiliser more than doubled the yield of grain. Only at Woburn did the population on the drilled and broadcast plots differ significantly. At the highest level of nitrogen the broadcast plots had 27% more plants than the drilled, but the yield difference was only 0·8 cwt. grain/acre. Barley averaged 1·0 million plants/acre; broadcast nitrogen affected plant numbers much less than with wheat. Plant population was not consistently affected by broadcast nitrogen, and drilled nitrogen was not noticeably harmful; only one big effect was obtained, and this was in favour of drilling.

In 1957, a dry year, plants were counted at Rothamsted. The effects were less well determined than in the other years, but sulphate of ammonia drilled at the highest rate gave fewer wheat plants than when broadcast; on barley, effects were smaller and in favour of drilling.

For both spring wheat and barley at Rothamsted sulphate of ammonia was generally more effective when combine-drilled than when broadcast. At 3½ cwt./acre, the highest rate tested, the mean advantage in favour of combine drilling was +2·3 cwt. of wheat grain and 0·9 cwt of barley, even though the plant populations were sometimes decreased by combine-drilling. At Woburn combine-drilling was less favourable, particularly in the dry year 1957, when the heaviest dressing of drilled nitrogen gave a yield of barley significantly below that given by broadcast nitrogen; in 1958 the same happened with spring wheat. In the wet spring of 1959 barley benefited from drilling even the heaviest dressing of nitrogen. Combine-drilling a small dressing (0·2 cwt. N) was never harmful at Woburn.

Farmyard Manure and its Interactions with Fertilisers

by H. D. Patterson & D. J. Watson

Eight experiments of uniform design were made to measure the responses of crop yield to increasing dressings of farmyard manure and how they depend on fertiliser applications, and from these relationships to assess how far the effects of farmyard manure can be ascribed to the plant nutrients it supplies. Another purpose was to compare the use of farmyard manure on potatoes and sugar beet, so experiments with both crops in the same field were made at Rothamsted and Woburn in 1956 and 1957. The treatments were all combinations of:

Farmyard manure: 0, 5, 10, 20 tons/acre ploughed in during the winter;
N: ammonium sulphate at 0 and 0·9 cwt. N/acre;
P: superphosphate at 0 and 0·75 cwt. P_2O_5/acre;
K: potassium chloride at 0 and 1·5 cwt. K_2O/acre;
and for sugar beet only,
S: agricultural salt at 0 and 5 cwt./acre.

The NPK fertilisers were broadcast in the seedbed and the salt was broadcast some weeks earlier. Each experiment had 4 randomised blocks of 16 plots (i.e., two replicates for potatoes and a single replicate for sugar beet).

Tables 1 and 2 show the mean yields of potatoes and sugar beet over the 2 years and distinguishes between rates of farmyard manure and rates of those fertilisers that were effective. The tables also give responses to manure of 10 tons farmyard manure/acre, averaged over the whole range of rates of application, for each fertiliser treatment.