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ROTHAMSTED RESEARCH

Rothamsted Report for 1966

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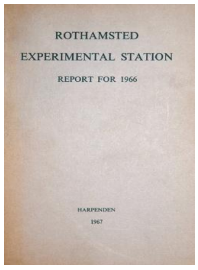

Methods of Sowing and Manuring Winter Wheat and Spring Barley Rothamsted and Woburn, 1964-66

J. R. Moffatt and F. V. Widdowson

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have increased the yield of sugar beet and barley whatever amount of nitrogen fertiliser was applied to the test-crops. The site carried early potatoes in 1965, and the test-crop in 1966 was barley.

The design was a 4 × 4 Latin square. On two of the four treatments trefoil was sown in August 1965. In January 1966 the trefoil was forked out (tops plus as much root as possible) and the other plots were forked over. The trefoil grown on plots of one treatment was removed and spread on plots of one of the treatments where no trefoil had grown, and the whole area was dug over with spades. The treatments, and mean yields of grain were:

(i)	No green manure	36·0 ± 0·81 cwt/acre
(ii)	Trefoil grown, removed	37·0
(iii)	No green manure sown, trefoil from (ii) dug in	40·3
(iv)	Trefoil grown and dug in	38·5

The trefoil grew unevenly; on average the material forked out contained about 8 cwt dry matter and 0·24 cwt N/acre. The barley received 0·5 cwt P_2O_5 and 1·0 cwt K_2O/acre as granular fertiliser, but no inorganic N.

As far as it goes, this experiment suggests that trefoil increases yield through some action of the greenstuff incorporated with the soil, not because of any change in the properties of the soil caused by the growing trefoil.

Methods of Sowing and Manuring Winter Wheat and Spring Barley Rothamsted and Woburn, 1964–66

By J. R. Moffatt and F. V. Widdowson

British drills usually sow grain in rows 7 in. apart, and most can be used to combine-drill fertiliser and seed. Scandinavian grain drills have coulters spaced only about 4 in. apart and sow only seed. Combine-drills are costly to maintain and sow fewer acres in a day than the Scandinavian drills, but make better use of fertiliser on infertile soils.

In each year 1964–66 experiments at Rothamsted and Woburn compared yields of winter wheat and spring barley from broadcast seed (by a drill modified to broadcast seed), and from seed sown either in rows 4 in. apart (by a Scandinavian drill) or 7 in. apart (by a British drill). Basal fertiliser was broadcast, and a fourth treatment was included to test combine-drilled fertiliser.

The treatments were:

1. Seed broadcast } basal fertiliser broadcast
2. Seed drilled at 4-in. spacing } basal fertiliser broadcast
3. Seed drilled at 7-in. spacing } basal fertiliser broadcast
4. Seed drilled at 7-in. spacing basal fertiliser drilled

Seed was sown by each method at two rates, to give eight sowing treatments, and each plot was then split to test three amounts of N. There were four blocks in each experiment.

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The basal fertiliser at sowing was 3 cwt/acre of 6 : 15 : 15 granular compound for wheat and 2 cwt/acre of 0 : 20 : 20 granular compound for barley. The three amounts of nitrogen were 0·4, 0·8 and 1·2 cwt N/acre for wheat and 0·4, 0·7 and 1·0 cwt N/acre for barley; it was broadcast as "Nitro-Chalk" in spring. The seeding rates were 140 and 240 lb/acre of wheat; 112 and 224 lb/acre of barley. Both crops were harvested by combine. Minor variations between the experiments (in treatments and basal manuring) are omitted from this summary.

Winter wheat (Cappelle). At Rothamsted the experiments were all on old arable ground, and each year the preceding crop was potatoes, well fertilised. The broadcast seed tended to fall into depressions made by tractor wheels or implements used to prepare the seed-bed, and grew thickly in bands 10–14 in. apart. This uneven establishment became less obvious when the plants came into ear, and did not affect the yield.

TABLE 1

Winter wheat experiments at Rothamsted 1964–66

(cwt grain/acre at 85% DM)
means over 3 years

Effect of sowing method at two seed-rates and at three rates of N

Seed	Broadcast	Drilled: row spacing		
		4 in.	7 in.	7 in.
Basal NPK	Broadcast	Broadcast	Broadcast	Drilled
N top-dressing (cwt/acre)		(±0·75)*	(±0·68)†	
0·4	47·6	47·3	46·0	46·4
0·8	47·6	47·7	47·5	46·4
1·2	45·9	45·0	46·4	44·0
Seed rate (lb/acre)		(±0·72)		
140	48·6	48·0	48·3	47·2
240	45·6	45·4	44·9	44·1
Mean yield (±0·51)	47·1	46·7	46·6	45·6

Effect of nitrogen at two seed rates

	Seed rate (lb/acre)		Mean
	140	240	yield
N top-dressing (cwt/acre)	(±0·53)*	(±0·48)†	(±0·34)
0·4	48·1	45·6	46·8
0·8	48·4	46·2	47·3
1·2	47·6	43·2	45·4
Mean yield (±0·36)	48·0	45·0	46·5

* For use in horizontal and diagonal comparisons.
† For use in vertical and interaction comparisons.

The methods of sowing had little effect on yield, but combine-drilled NPK produced less grain than broadcast fertiliser. Applying 1·2, rather than 0·4, cwt N/acre, lodged the wheat and lessened the yields; increasing the amount of seed sown also decreased yield with all methods of sowing, probably because of lodging.

At Woburn two experiments were on a sandy loam recently ploughed out of grass, and one was on a heavy clay loam ploughed from grass about 10 years ago; each was preceded by well-fertilised potatoes.

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TABLE 2

Winter wheat experiments at Woburn 1964–66

(cwt grain/acre at 85% DM)

Effect of sowing method at two seed-rates and at three rates of N

Seed	Broadcast	Drilled: row spacing		
		4 in.	7 in.	7 in.
Basal NPK	Broadcast	Broadcast	Broadcast	Drilled
N top-dressing (cwt/acre)		(±0·98)*	(±1·04)†	
0·4	50·7	51·6	50·2	50·0
0·8	49·6	49·4	48·4	47·2
1·2	45·2	45·8	43·7	46·4
Seed rate (lb/acre)		(±0·69)		
140	49·7	50·4	48·3	49·1
240	47·2	47·5	46·6	46·6
Mean yield (±0·49)	48·5	48·9	47·5	47·9

Effect of nitrogen at two seed-rates

	Seed-rate (lb/acre)		Mean
	140	240	yield
N top-dressing (cwt/acre)	(±0·69)*	(±0·74)†	(±0·52)
0·4	50·8	50·5	50·6
0·8	50·2	47·1	48·6
1·2	47·2	43·4	45·3
Mean yiled (±0·35)	49·4	47·0	48·2

* For use in horizontal and diagonal comparisons.
† For use in vertical and interaction comparisons.

Broadcast wheat established less well at Woburn than at Rothamsted, but yielded as well as wheat drilled in rows 4 in. apart and more than wheat drilled in rows 7 in. apart. On these fertile soils the plots given most N lodged most and yielded less. The larger yield came from the smaller seed-rate, however the wheat was sown.

Spring barley (Maris Badger). At Rothamsted the experiments were all on old arable ground, and were preceded by wheat. In 1964 and in 1966 the barley was sown in a moist seed-bed; yields from all the methods of sowing were the same. In 1965 the soil was dry when the barley was sown, and the broadcast seed established poorly; it yielded 9 cwt less grain/acre than the drilled with 112 lb seed/acre and 4 cwt less with 224 lb of seed. Doubling the seed-rate lessened the yield from the 7-in. spacing with broadcast fertiliser but not with combine-drilled fertiliser; with broadcast seed, doubling the rate increased the yield.

Increasing N from 0·4 to 0·7 cwt/acre increased yield, but yields with 1·0 cwt N were the same as with 0·7 cwt.

At Woburn the 1964 barley experiment was on light land with a long history of arable crops. In 1965 and 1966 the experiments were on light land recently ploughed out of grass; wheat preceded the barley each year.

Broadcast seed gave a less uniform plant than drilled seed, but, except with 112 lb seed/acre in 1964, yields were no less. Each year drilling more seed decreased yield, whereas broadcasting more increased yields a little. Barley drilled at 4-in. spacing gave the largest mean yield. All methods of

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TABLE 3

Spring barley experiments at Rothamsted 1964–66

(cwt grain/acre at 85% DM)

Effect of sowing method at two seed-rates and at three rates of N

Seed	Broadcast	Drilled: row spacing		
Basal PK	Broadcast	4 in. Broadcast	7 in. Broadcast	7 in. Drilled
N to seed-bed (cwt/acre)		(±0·63)*	(±0·57)†	
0·4	46·0	47·2	46·7	47·1
0·7	48·2	48·9	47·7	47·9
1·0	47·2	49·7	48·0	48·2
Seed-rate (lb/acre)		(±0·60)		
112	46·3	48·6	48·4	47·8
224	48·0	48·6	46·4	47·7
Mean yield (±0·43)	47·1	48·6	47·5	47·8

Effect of nitrogen at two seed-rates

	Seed-rate (lb/acre)		Mean yield
	112	224	
N to seed-bed (cwt/acre)	(±0·45)*	(±0·40)†	(±0·28)
0·4	46·5	47·0	46·8
0·7	48·5	47·9	48·2
1·0	48·3	48·2	48·2
Mean yield (±0·30)	47·8	47·7	47·7

* For use in horizontal and diagonal comparisons.
† For use in vertical and interaction comparisons.

TABLE 4

Spring barley experiments at Woburn 1964–66

(cwt grain/acre at 85% DM)

Effect of sowing method at two seed-rates and at three rates of N

Seed	Broadcast	Drilled: row spacing		
Basal PK	Broadcast	4 in. Broadcast	7 in. Broadcast	7 in. Drilled
N to seed-bed (cwt/acre)		(±0·95)*	(±0·95)†	
0·4	39·9	41·8	39·7	39·8
0·7	43·6	43·2	43·5	42·8
1·0	42·2	43·9	43·6	45·3
Seed-rate (lb/acre)		(±0·78)		
112	41·2	44·4	44·0	43·8
224	42·7	41·6	40·4	41·4
Mean yield (±0·55)	41·9	43·0	42·3	42·6

Effect of nitrogen at two seed-rates

	Seed-rate (lb/acre)		Mean yield
	112	224	
N to seed-bed (cwt/acre)	(±0·67)*	(±0·67)†	(±0·48)
0·4	41·2	39·4	40·3
0·7	44·8	41·7	43·3
1·0	44·0	43·4	43·7
Mean yield (±0·39)	43·3	41·5	42·4

* For use in horizontal and diagonal comparisons.
† For use in vertical and interaction comparisons.

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sowing gave a similar big response to N in 1964; the mean yield of plots given 1 cwt N/acre was almost twice that of plots given 0·4 cwt. In 1965 and 1966 increasing the amounts of N decreased yield with all methods of sowing.

Conclusions

The conclusions drawn from these experiments are:

1. Yields of winter wheat were nearly the same, however it was sown; yields of barley were a little larger from 4-in. than from 7-in. rows, and a little smaller from broadcast than from drilled seed, but in 1965, in dry weather, broadcasting gave much smaller yields at Rothamsted.
2. On these fertile soils there was no advantage from combine-drilling NPK fertilisers for winter wheat or PK fertilisers for spring barley.
3. Sowing 140 lb seed/acre always gave a larger yield of winter wheat than sowing 240 lb; yields of barley were also larger with the smaller seed-rate when the seed was drilled, but not when it was broadcast.
4. The largest amounts of N (0·8 and 1·2 cwt N/acre) caused the wheat to lodge (it followed well-manured potatoes) and decreased yield; with barley the best amount of N depended on the previous cropping, but the largest amounts given caused lodging and loss of yield on the most fertile soils.
5. Changing seed-rates and amounts of N affected yield more than changes in methods of sowing.

The Effect of Chalk on Soil pH and the Yield of Beans

By J. R. Moffatt

The acreage of beans in England and Wales is increasing, mainly because of the necessity for "break" crops in rotations where cereals predominate. Most factors affecting their yield have been investigated, and two main reasons for their greater reliability and larger yields are the use of systemic insecticides to control black aphids, and residual weedkillers. Water is important, and in dry seasons irrigation is needed to give good yields, especially on light soils.

Another, less widely recognised, factor affecting the yield of beans is the soil pH, a measure of acidity. A few years ago beans grew poorly in patches at Rothamsted and Woburn where the only known difference from other parts of the field was in the soil pH, though acidity was not thought enough to be the cause. To find whether pH differences within this range affected beans, experiments were done at Rothamsted and Woburn in fields initially acid.

The first experiment at Rothamsted ran for three years (1961–63) on a site where in 1960 pH ranged between 5·9 and 6·3; five pH values were

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