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WOBURN EXPERIMENTAL STATION

C. A. THOROLD

H. H. Mann, Assistant Director, Woburn Experimental Station, from 1928 to 1956, died on 2 December. His association with Woburn Experimental Farm began in 1895, when he was appointed to assist Dr. J. A. Voelcker, Consulting Chemist to the Royal Agricultural Society, and he was the first resident research chemist at the laboratory and pot-culture station built in 1898. He left in 1900 to become Scientific Officer to the Tea Association of India, where he was later Principal of the Poona Agricultural College and Director of Agriculture, Bombay State.

Air frost on the mornings of 27 and 28 May (minima -2.2° C., -0.6° C.) damaged the foliage of early and maincrop potatoes. Within the last 10 years, a similar late frost has occurred only in 1956, when early potatoes were affected. Rain in May, June and July was below average (Table 1), but in spite of seemingly unpropitious conditions for crop development, yields in general were satisfactory, except for some early potatoes.

TABLE 1

Monthly mean temperatures (means of maximum and minimum), total rainfall and daily means of bright sunshine for April to October 1961 (departures from long-period means in brackets)

Month	Main temperature ($^{\circ}$ C.)	Rainfall (inches)	Bright sunshine (daily mean) (hours)
April ...	9.7 (+1.7)	2.30 (+0.37)	2.82 (-2.09)
May ...	10.5 (-0.4)	0.63 (-1.57)	6.70 (+0.66)
June ...	14.5 (+0.4)	1.26 (-0.44)	7.19 (+0.58)
July ...	15.4 (-0.9)	1.49 (-0.95)	5.46 (-0.58)
August ...	15.8 (0.0)	2.50 (+0.17)	5.32 (-0.54)
September ...	15.3 (+1.7)	2.31 (+0.28)	4.21 (-0.42)
October ...	10.6 (+0.9)	2.96 (+0.66)	3.83 (+0.44)

FIELD EXPERIMENTS

Continuous wheat and barley land

Strips of winter wheat (Squarehead's Master) were drilled across the "continuous wheat and barley" areas, in the same positions as this crop occupied in 1959 and 1960. The young plants were badly damaged by birds in February, and the dry period in March (0.12 inches rainfall) seemed to check growth and impede recovery. The crop was ploughed in, and the strips were resown with spring wheat (Jufy I) on 22 March. Plumage Archer barley was drilled on 9 March in the strips occupied by barley in 1959 and 1960. Both wheat and barley yielded less than in 1960. Table 2 shows the decline in yields since 1959, the first year after fallowing, and that

N

in each year barley has done better on the old wheat land than on the barley land, and wheat better on the old barley land.

TABLE 2

Mean yields of grain and straw (cwt./acre) in plots 1, 7 and 11b of "continuous wheat" and "continuous barley" areas in 1959, 1960 and 1961

	Continuous wheat area				Continuous barley area			
	Wheat		Barley		Wheat		Barley	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
1959 ...	20.5	27.2	23.1	16.1	26.1	35.1	21.6	13.3
1960 ...	19.6	27.4	21.9	16.8	25.6	36.0	19.9	13.4
1961 ...	10.4	16.3	19.2	10.9	11.0	14.4	14.0	7.5

Take-all (*Ophiobolus graminis*) is now widespread, and barley roots were also attacked by *Fusarium* spp. Because of this, neither wheat nor barley will be grown on the "continuous wheat and barley" areas in 1962, but spring oats, which will be harvested by plots to measure any residual effects of previous cropping with strips of wheat and barley.

Ley and arable rotations experiment

The 1960 Report drew attention to the greater yield response of sugar beet to farmyard manure at 15 tons/acre than to fertiliser providing nitrogen and potash. This happens when sugar beet follows 3 years of arable crops or 3 years of cut lucerne, but not when it follows a 3-year grazed ley. Differences between the amounts or availabilities of potash supplied by fertiliser and by farmyard manure may account for the relative superiority of dung, and this is being tested by attempts to equalise the potash levels of the soils in the treatment and test periods. Only when this is achieved, will it be possible to decide whether other factors are concerned.

The tops of Majestic potatoes were blackened by the air frosts, but it seems they recovered well, because yields were up to average. In 1961 there were eight potato plots in Block 2, constituting the first-year treatment crop of the 3-year arable rotations, which have previously been regularly followed by 2 years of test crops (1st test crop—potatoes in period 1938–55, sugar beet in period 1956–61; 2nd test crop—barley in period 1938–61). The four "continuous arable" plots in Block 2 (No. 17–20) have had nine potato crops (five treatment plus four test crops) in the period 1939–61, and the other four plots, where ley and arable rotations alternate (No. 21, 22, 27, 28), have had seven (three treatment plus four test crops). The eight 1961 plots have not carried potatoes in the period 1957–60. There is no recorded damage to maincrop potato foliage by frost in this experiment, so it is worth comparing the 1961 yields with the means for the period 1939–56, in an attempt to assess effects of frost on tuber production. The mean yield of the eight plots in 1961 was 12.4 tons/acre, and the general mean for these plots from 1939 to 1956 was 11.0 tons/acre. Only one plot (No. 17) yielded less in 1961 (9.6 tons/acre) than the mean in the preceding period (9.8 tons/acre). On 30 May 1961 this plot was noted as having leaves severely

damaged by frost, but another plot (No. 18) in a similar state yielded 11.9 tons/acre in 1961, the same as the mean yield for this plot in 1939-56. Yields of the other six plots (No. 19-22, 27, 28) damaged by frost in 1961 exceeded their past mean yields.

Although the yields of Majestic were not obviously affected by frost damage to foliage, those of Ulster Chieftain in the Green-Manuring Experiment almost certainly were. The mean yield of this early variety was less than 2 tons/acre, and no plot yielded more than about 2½ tons/acre. Plots after both ryegrass and trefoil green-manure crops which had been undersown in the preceding barley crop yielded slightly more (0.23 tons/acre) than others.

Irrigation experiment

The twenty-four plots of Arran Pilot potatoes in the Irrigation Experiment were not uniformly affected by frost. Eight at one end of the area were little harmed, when foliage in the other plots was severely "scorched" or blackened, but these differences did not affect tuber yields detectably. However, this may be because responses to irrigation, fertiliser and cultivation treatments were large. Table 3 shows the mean yields of irrigated and unirrigated plots at two levels of nitrogen.

TABLE 3
Mean yields of potatoes (tons tubers/acre) with and without irrigation, at 0.6 and 1.2 cwt. nitrogen/acre

Cwt. N/acre	Without irrigation	With irrigation	Mean
0.6	5.31	10.26	7.78
1.2	5.93	12.64	9.29
Mean	5.62	11.45	8.54

Usual cultivations for potato crops were compared with minimum cultivations plus simazine weedkiller applied at 2 lb. in 40 gallons/acre on 31 March, 2 weeks after planting. As in 1960, plots which received "normal cultivations" yielded better, this time on average 3 tons tubers/acre more.

The irrigated plots of Italian ryegrass were given "Nitro-Chalk" at 0.3 or 0.6 cwt. nitrogen/acre before each of the six cuts, but unirrigated plots were not given fertiliser before the fifth cut, because the fertiliser seemed unlikely to be taken up without rain or irrigation. Soil moistures at three depths (0-3 inches; 3-9 inches; 9-18 inches) were measured on one irrigated grass plot and on one nearby unirrigated grass plot in March, before irrigation started and after each cutting. Only the measurements at 9-18 inches, where moisture changes are particularly interesting, will be considered now. Table 4 shows that growth of the grass without irrigation declined after the second cutting on 15 May, and was negligible (2 cwt./acre) between 15 June and 14 July. Within this period the rainfall was 1.41 inches, and soil moisture at 9-18 inches was only 4.8%. Irrigation equivalent to 3 inches of rain maintained the level of production per month at about 13 cwt./acre and increased the soil moisture at 9-18 inches from 8.0 to 10.0%.

The mean yield of the Italian ryegrass, with and without irrigation, was 62.3 cwt./acre, compared with 95.7 cwt./acre in 1960.

TABLE 4

Mean weights (G) of dry Italian ryegrass (cwt./acre) and soil moisture (S/M) as percentage of the weight of samples taken at 9-18 inches, in irrigated and unirrigated plots

Date of cut	Without irrigation		With irrigation	
	G	S/M	G	S/M
18 April	12.8	9.2	11.9	10.4
15 May	19.9	8.4	20.1	9.6
15 June	3.6	4.8	13.3	8.0
14 July	2.0	4.8	13.8	10.0
14 August	3.8	4.4	11.5	10.0
11 September	3.3	4.0	8.7	7.2
Total	45.4		79.3	

Established in the autumn of 1959, some plots deteriorated during 1961, and yields contained from 12 to 39% of their dry weight as *Poa annua*. The plots were therefore ploughed, after the sixth cut on 11 September.

Table 5 shows the response of Herta barley to irrigation and two levels of nitrogen. As previously, increasing nitrogen gave a greater mean response (7.2 cwt. grain/acre) than did irrigation equivalent to 3¼ inches rain (4.9 cwt. grain/acre).

TABLE 5

Mean yields of irrigated and unirrigated barley (cwt. grain/acre) at two levels of nitrogen (0.2 and 0.4 cwt. N/acre)

Cwt. nitrogen/acre	Without irrigation	With irrigation	Mean	Difference
0.2	23.3	29.0	26.2	7.2
0.4	31.3	35.4	33.4	
Mean	27.3	32.2	29.7	

Difference 4.9

Unirrigated spring beans gave a mean yield of 13.3 cwt. grain/acre, compared with 28.8 cwt. grain/acre with "full" irrigation equivalent to 4½ inches rain; the mean yield was 21.3 cwt. grain/acre when 3 inches were applied between 23 June and 1 August, and 18.7 cwt. grain/acre when 1½ inches were applied between 19 May and 7 June. Crops unirrigated or irrigated only between 23 June and 1 August matured earlier than the others, and were harvested by combine on 12 August, 9 days before the others.

Market-garden experiment

An experiment with market-garden crops was started at Woburn in 1942, on light, sandy soil considered to be exhausted and which might be expected to be improved by incorporation of organic materials. Responses to different organic manures were compared with inorganic fertilisers. From 1942 to 1950 there was a 2-year rotation, with leeks after green peas in the first year, and cabbages after globe beet in the second. Peas were omitted in 1951, since when only three crops have been taken in the 2-year rotation. From 1956 onwards, early potatoes replaced cabbages. Manuring has changed from time to time, but since 1956 it and cropping systems have been constant, and so yields in this period can be considered to indicate the general trend of manurial responses.

Four organic manures are compared, namely: farmyard manure alone, and composted with vegetable refuse; sewage sludge alone, and similarly composted. Two levels (10 and 20 tons/acre) of each were applied for every crop, with and without inorganic nitrogen (0.3 cwt. N/acre). Some plots without organic manures receive "Nitro-Chalk" at three levels (0.3, 0.6, 0.9 cwt. N/acre), and all plots receive basal dressings of P and K at 0.3 cwt./acre.

Table 6 shows that organic manures have given higher yields than inorganic fertilisers, particularly of globe beet.

TABLE 6

Mean yields of leeks (dressed), globe beet ("bulbs") and early potatoes (total tubers) in tons/acre, associated with certain manurial treatments in the Woburn Market-garden experiment, in the 5-year period 1956-60

Treatment	Leeks	Globe beet	Early potatoes
Farmyard manure at 20 tons/acre (no "Nitro-Chalk")	5.7	10.9	7.8
Sewage sludge at 20 tons/acre (no "Nitro-Chalk")	5.1	7.3	7.1
"Nitro-Chalk" at 0.9 cwt. N/acre	4.0	4.0	6.4
No "Nitro-Chalk"	2.9	1.7	4.0

Farmyard manure at 20 tons/acre, with or without inorganic nitrogen, gives largest yields, and basal P and K without inorganic nitrogen the smallest.

Analyses made by the Chemistry Department show that much P has accumulated where farmyard manure and sewage sludge have been applied. The farmyard manure plots also have much K, almost a constant amount at three sampling depths within the range 0-24 inches. Therefore the lower yields obtained with inorganic fertilisers may partly reflect inadequate amounts of P and K. The position as well as amount of nutrients may also differ between plots given organic and inorganic manures, for the organic manures are ploughed in, whereas the basal fertiliser and "Nitro-Chalk" are broadcast after ploughing. The experiment has now been re-designed, to test higher rates of fertilisers applied both before and after ploughing, and future results should show whether factors other than the nutrients in farmyard manure improve the crops. Because sewage sludge is inferior to farmyard manure, it will be omitted from the comparison, and no more sewage sludge or sludge compost will be given.