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ROTHAMSTED RESEARCH

Report for 1969 - Part 1

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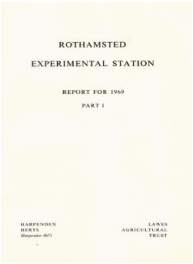

The Farms : Rothamsted

J. R. Moffatt

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THE FARMS

J. R. MOFFATT

ROTHAMSTED

Despite a late start with spring crops, this was a satisfactory year. A wet May produced much grass which made excellent hay and silage in a dry and sunny June. The summer was mainly hot and dry, but the 68 hours of sunshine more than average during June and July were more than counter-balanced by a deficit of 106 during August and September. The 5 months June–October had less rain than average, giving a deficit of 6·8 in. Although loose smut was prevalent, the cereals yielded well, especially wheat; potatoes and grass aftermaths, where not irrigated, and beans, gave small crops.

October and early November were remarkably mild, and the mean air temperature for October was 5·7°F above average. The dry ground facilitated the lifting of potatoes and sugar beet and the control of weed grasses in arable fields, but ploughing and land preparation for winter corn was difficult. Germination was slow and irregular.

Rain in November and December delayed land work but this was completed by the end of the year.

In February a fire, probably started inadvertently by children, destroyed most of a timber barn and cattle shelter erected in 1968, on Scout Farm. Almost 70 tons of straw were burnt.

The effect of weather on crops

January was very wet but mild; rain fell on 21 days and the mean air temperature was 3·9°F above average. The wet ground stopped land work, except for some ploughing by tractors on steel wheels.

February was cold, with mean air temperature 5·8°F less than average and 24 frosts. Rain fell on 15 days, and there were two falls of snow, each of about 3 in. Ploughing was finished but no other land work was done.

Severe night frosts in early March followed by a wet spell allowed only one day's work before 24 March. Then the ground worked down readily and beans and spring cereals were drilled by 4 April, about 2½ weeks later than in 1968. Germination was encouraged by a fine, hot spell early in April but cold weather then slowed growth. Sugar beet was drilled in a good seedbed; potato planting started on 19 April, about 2 weeks later than usual, and finished on 5 May, just before a long wet spell.

May was very dull and wet; rain fell on 20 days and was 1·04 in. above average. Cereal spraying, sugar-beet singling and grass cutting were all delayed but cereal crops grew rapidly.

Long sunny spells in June gave 46 hours of sunshine above average; however, the mean air temperature was 1·5°F below average. Conditions were good for making silage and hay. Cereals, beans and potatoes grew rapidly but rain on 23 June laid several areas of barley and washed aphids off some unsprayed beans.

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July was mainly fine, sunny and warm. Rain fell on 8 days and sunshine hours were 22 more than average. Much of the grassland was irrigated early in the month and potatoes after mid-July. A second hay crop was taken from one irrigated area. Cereals continued to grow well and began to turn colour, but beans made little growth.

Early August was hot and dry but the second half was dull and showery. Hours of sunshine were 57 less than average and rain fell on 15 days, most during the second half of the month. Harvest started on 11 August, about a week earlier than usual, and cereals were finished on 4 September. Beans were cut about a week later. The first part of September was dry but later became dull and damp with much fog. There was only 0·41 in. of rain in 10 days, and although the mean air temperature was 1·1°F above average, hours of sunshine were 48 fewer. A late hay crop was taken from two irrigated fields. The haulm of the potatoes grown for seed was destroyed early, and lifting started on 3 September.

October was remarkably dry and warm. Only 0·24 in. of rain fell and the mean air temperature was 5·7°F more than average; however, the sunshine hours were only four more than average. After 5 months with less than average rain the ground became extremely hard. Some areas were too hard to plough and others, ploughed early, could not be broken down. However, conditions were ideal for controlling weed grasses and volunteer corn; about 160 acres were sprayed with paraquat, others were deep cultivated or rotavated. Potato lifting continued unchecked until it was finished on 21 October; there was little soil to cushion the tubers on the web of the lifters. Many tubers from non-irrigated areas were mis-shapen or cracked but there was no blight. Sugar beet was loosened by a sub-soiler and the roots were much cleaner than usual.

Most of the seedbeds for winter wheat had to be forced by disc harrows or rotavators, but some areas had to wait for rain. Best seedbeds were on ground deep-tine cultivated after potatoes.

The dry spell lasted into November but rain then fell on 18 days giving a total of 3·52 in. There were 16 ground frosts. The last of the winter wheat was drilled and this germinated far more quickly and evenly than that sown before the rain. In mid-December most of the early-sown areas had a very uneven plant and some seeds had become soft and mouldy. Replanting was considered but this was not needed as the crop much improved by the end of December, which was mainly dull and wet, with 21 ground frosts. Rain on 20 days gave about average total. The arable work was finished during frosty weather after Christmas.

Field experiments

There were 3519 full-scale plots from which yields were taken and 264 from which they were not. There were also 351 plots largely managed by departments and 855 micro plots, giving a total slightly fewer than in 1968.

The winter experiments were sown earlier than usual and within a short space of time; spring experiments were sown later than usual. Most basal fertilisers and some treatment fertilisers were applied by a fertiliser distributor. One experiment with winter rape failed because it was sown late.

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On Broadbalk paraquat was used in 1968 to clean the wheat and bean stubble, and 'Prebane' (except on the Section 8 which gets no sprays) to control blackgrass (*Alopecurus myosuroides*). This was very successful and also killed many broadleaved weeds. Until this year some control was obtained by encouraging blackgrass seeds to germinate early and destroying the seedlings by cultivations. This meant sowing was late and often under poor conditions, which affected yields. For the 1969 crop the wheat was drilled in mid-October using, for the first time, seed dusted with an insecticide. The crop was favoured by the weather and looked extremely well throughout the year; there was no lodging. Although nearly 10% of the ears were affected by loose smut (*Ustilago nuda*), yields on some plots were 20 cwt more than average; this can, in part, be ascribed to early drilling. The time spent in pulling wild oats is recorded each year but now that infestation is small, and all plots are rogued at least twice, a small variation in the time spent is not a true reflection of the number of wild oats present.

The bean seed-rate on some plots was inadequate because the seed was insufficiently dried after inoculating with *Rhizobium*. Simazine was not used, and weeds between the rows were controlled mechanically. The plants on differently manured plots ripened at different times.

The potato variety was changed to King Edward; a linuron/paraquat spray was used for the first time to control weeds but it failed to control horsetails (*Equisetum*) which were hand-pulled twice. There was a good, even plant and the largest yield (19 tons/acre) was given by FYM and 86 lb nitrogen.

The wheat and bean stubbles were rotavated to encourage the germination of weeds and volunteer corn, which were then destroyed by ploughing in.

The Great Hoos barley stubble was sprayed in 1968 with paraquat and ploughed during December. Maris Badger was grown for the last time, and the few wild oats were hand-pulled. There was little lodging and yields exceeded those in 1968. The stubble was sprayed with paraquat and ploughed in November 1969. The bean plants were sparse on all plots because too few seeds were sown. Simazine was not used, and the weeds in the rows were controlled mechanically. King Edward potatoes replaced Majestic and weeds were satisfactorily controlled by a linuron/paraquat spray.

The 1968 Exhaustion Land stubble was rotavated and later sprayed with paraquat to combat couch grass. The barley grew well; some plots gave twice the yield of 1968 and the mean was 30·5 cwt/acre compared with 19·6 cwt in 1968. However the mean straw yield was only 12·7 cwt/acre (a grain/straw ratio of 1/0·4) compared with 19·3 cwt in 1968. The stubble was treated as in 1968.

The wheat after fallow on Hoosfield gave a satisfactory plant and produced slightly more grain than in 1968.

Barnfield, in the second year of its revised cropping (*Rothamsted Report for 1967*, 232), grew root crops for the first time in 5 years, and each plot was split for sugar beet and potatoes. The seedbed for sugar beet was prepared by one stroke of the reciprocating harrow, when it was levelled

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and rolled before drilling. The two dung strips were sprayed with 'Betanal' to control weeds before singling, but wet weather delayed this and the chickweed was too big for complete control. The few weeds on the other strips were controlled by one mechanical hoeing and sidehoeing after singling. There was some damage to the edge rows from the potato spray used alongside but these were not needed for harvest yields. Yields ranged from 3 to 19 tons/acre of washed beet according to fertiliser treatment, and the sugar content from 17·9 to 21·4%.

The potato ground was prepared by one rotavation to the ploughed surface, which produced an excellent seedbed for the King Edward potatoes. Weeds were controlled by a linuron/paraquat spray, followed by rotoridging. Yields, except where mineral fertilisers were not given, were satisfactory, and exceeded 22 tons/acre with FYM and nitrogen.

Beans were grown for the third successive year on Series 'O' and all plots were split for simazine *vs* mechanical cultivations for weed control. In June the plants on the simazine plots were about 2 in. shorter than the others but there was little other evidence of simazine damage. However, the sprayed plots yielded only about half as much as the unsprayed except on the FYM strips where yields on sprayed and unsprayed were about equal. Yields were less than in 1968, perhaps partly because stem eelworm (*Ditylenchus dipsaci*) was present on nearly all plants. The bean stubble of the two dunged strips was sprayed with paraquat to kill weeds.

In the Ley-Arable experiments Cappelle winter wheat was replaced by Joss Cambier, which gave excellent yields on all plots (see page 285).

On the Cultivation/Weedkiller rotation experiment the mean wheat yield of 57 cwt/acre was 20 cwt more than in 1968 and the mean barley yield of 44 cwt/acre 8 cwt more, but slightly less than in 1967. The different primary cultivations had no effect on yield. Spring beans yielded more than in 1968 and there was little evidence of simazine damage except possibly on the tine-cultivated plots. Pentland Dell potatoes gave disappointingly small yields (mean 11·9 tons/acre) and ploughing did not give the expected increase. The 'C' plots in this experiment, which were ploughed each year and held in reserve, were allocated treatments that are usual farm practice for each crop.

In several experiments Joss Cambier winter wheat replaced Cappelle but in two experiments where these were compared Cappelle yielded slightly more. On a site largely free from soil-borne pathogens Maris Beacon yielded more than 71 cwt/acre. The mean yield from three experiments with Kolibri spring wheat was 42·5 cwt/acre.

Maris Badger barley was grown in long-term experiments but as it yields less than some newer ones and no longer resists mildew, it will be replaced in 1970 by Julia. Zephyr was grown in most annual experiments. Yields about equalled those of 1967 which were about 10 cwt more than in 1968, and there was little lodging. 'Milstem' tested for mildew control increased the yield of three susceptible varieties by about 2 cwt/acre, but had no effect on Sultan, a resistant variety.

Spring beans in annual experiments gave rather poor yields of about 23 cwt/acre. Controlling aphids by sprays or granules increased yield by about 2 cwt/acre. With broadcast fertilisers yields were similar with rows

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5½ in. and 21 in. apart. Fertiliser injected 3–4 in. deep gave about 3 cwt more grain than broadcast fertiliser and the increase was slightly more at the closer spacing.

In most experiments growth of potatoes was retarded by lack of water and yields were 2–3 tons less than usual, which was the increase obtained by irrigation, which did not affect the proportion of ware tubers. There was no blight and lifting was easy in the dry autumn. Barley showed no benefit from irrigation.

Cropping

Of the 653 acres farmed 455 were under arable crops or fallow, 85 under short-term leys or lucerne and 113 under permanent grass. The main crops were wheat (128 acres), barley (200 acres), beans (46 acres), potatoes (36 acres) and a small acreage of sugar beet, swedes and oats. Thirty-three acres were fallowed, and 6½ sown with spring oilseed rape.

There were fewer wild oats than usual, largely because 'Avadex BW' was used on the worst-infested areas. All the cereals were rogued against this weed.

A power-driven reciprocating harrow, a crumbler unit fitted to a spring-tined cultivator and coverers fitted to the drill, produced a seedbed with fewer operations than needed previously, and gave less soil consolidation.

The fallows to control twitch grasses were worked many times during the summer, mainly by a rotary cultivator, with occasional deep-tine cultivations. The dry summer restricted the growth of grass weeds in cereals and, after harvest, the weakened plants were brought to the surface by cultivations or rotavating, or were sprayed with paraquat. These areas were the last to be ploughed. During the autumn several areas were sub-soiled.

Much of the farm is worked on a 7-year rotation of two cereals, a 'break' crop, two cereals and two 'break' crops, so as to give a choice of sites with different probabilities of attack by soil-borne pathogens. Several fields are outside the rotation, as they are kept acid or deficient in phosphorus or potash to provide sites for fertiliser experiments; most of these are under long-term leys or fallow, but some grow cereals.

Cereal diseases and pests. Loose smut (*Ustilago nuda*) was common on most wheat and barley varieties, except Julia barley; a tested sample from this variety had no infection on 995 embryos examined. Most of the barley seed kept for sowing in 1970 will be treated with a 'Vitavax'/organo-mercury compound to control this and other seed-borne diseases. However, it may be less severe in 1970, for its prevalence this year probably reflects the long wet period at time of flowering in 1968.

Mildew (*Erysiphe graminis*) was widespread but much less severe than in 1968. Ergot (*Claviceps purpurea*) was common in Kolibri spring wheat, the first time it has been common for years. Eyespot and take-all were prevalent on some areas but affected yield less than expected. Wheat Bulb fly (*Leptohylemyia coarctatis*) caused negligible damage. Stem eelworm (*Ditylenchus dipsaci*) attacked several bean crops. The severity seemed to

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depend on the frequency with which the land has been cropped with beans, but it also varied within fields. It probably caused some loss of crop. Bean aphids (*Aphis fabae*) colonised the bean crops but a bad attack was averted by spraying most areas with 'Metasystox'. Chocolate spot (*Botrytis fabae*) was rare.

Crops

Wheat. Winter wheat was sown during October 1968, and drilling finished just before a long spell of wet weather. The acreage was divided equally between Cappelle and Joss Cambier. Over 40 acres of Kolibri was sown in spring, finishing on 16 April after lifting the last of the 1968 potato crop. The winter wheat looked rather yellow early on but greened before the end of April. Top dressings of nitrogen were given in April and the crops looked well throughout the summer. There was little lodging. Yields ranged from 37 to 60 cwt/acre and the quality was good. Kolibri grew well, did not lodge and yielded about 40 cwt/acre.

Barley. Most of the barley was drilled during the third week of March, mainly Zephyr, but Maris Badger in some experiments and Sultan and Julia in one field each. Julia, grown for seed after two break crops, yielded 40 cwt/acre. Some crops lodged early and although Sultan was badly lodged it yielded 38 cwt; Zephyr averaged about 40 cwt/acre.

Oats. The small acreage of Manod oats grown in the Ley-Arable experiments yielded 40–47 cwt/acre, much more than in 1968.

Beans. Maris Bead spring tick was the main variety but Tarvin was grown in some experiments. They were drilled at the end of March and weeds were controlled by simazine. The plants grew well in May and June and most areas were sprayed with 'Metasystox' in mid-June; a mild aphid infestation on an unsprayed field was removed by heavy rain. The dry weather restricted growth and lessened the number of flowers per stem which led to more even ripening but a poor yield of about 20 cwt/acre. The crop was harvested under good conditions.

Oil-seed rape. A small area of Victor winter rape was sown in October, but the plant grew slowly and had almost disappeared by early spring and the crop was abandoned. The two areas of Nilla spring rape grew well; a malathion spray to one controlled the many pollen beetles. Flowering was restricted to a short period resulting in fairly even ripening. Combined direct, some seed was lost by shedding. One experiment gave a mean yield of 20·5 cwt/acre; in another, yield was 17·9 with 1·0 N/acre but only 15·4 cwt/acre with 1·8 cwt N.

Sugar beet, swedes. These germinated quickly and uniformly; the beet grew well in the wet May and warm June. Aphids were controlled by a spray in June. Later growth of both crops was restricted by lack of water. The sugar content averaged 19% and the dirt tare was very small.

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Potatoes. The last of the 1968 potato crop was harvested early in April but so many tubers were damaged by frost or birds that all were fed to stock.

In 1969 King Edward was the main variety with small areas of Majestic and Pentland Dell. Planting started on 9 April and finished on 5 May. Rothamsted-grown seed tubers were used for ware crops; all were chitted. Stock seed from Northern Ireland was grown to provide seed for 1970; all varieties were given an 'H' certificate. On most areas weeds were controlled by a linuron/paraquat spray and a late ridging with a rotoridger. In June growth was rapid but became slow in July where not irrigated, and test liftings at the end of the month indicated a yield of 8 tons/acre compared with 12 tons in 1968. Three preventive sprayings were given against blight (*Phytophthora infestans*), with 'Metasystox' in one spray to control aphids (mainly *Macrosiphum euphorbiae*), but there was no blight. About 4½ in. of water were given in two or three applications during July and August to non-experimental crops, which grew more vigorously and were brighter green than the un-irrigated.

The seed crop had 1½ in. of water in mid-July; the haulm was destroyed mechanically on different occasions during August and early September. The tubers, lifted between 3 and 15 September, were of nice size and shape but the skins of many were broken because there was little soil on the lifter web.

The lifting of the main crop started in mid-September from very dry soil and continued without interruption until it was finished on 21 October. The yield of the irrigated King Edward was about 17 tons/acre and the tubers were of good size and shape. Many of those from areas not irrigated were mis-shapen or cracked and yielded 2–3 tons less.

Grass. A high-nitrogen compound fertiliser was given to some grassland in early March, to provide grass for the ewes, and later to the remainder. The cold weather in April retarded growth and the yarded cattle were not turned out until 13 May. The grass grew rapidly during May and as it was not cut for silage until June, yields were about average. Grass or hay was cut and bruised quickly and efficiently by a flail mower in June. Most was baled within 72 hours of cutting and, being in excellent condition, it was carted and stacked immediately. Yields of about 43 cwt/acre were less than average. All the hay stubbles and pastures were top-dressed with 'Nitro-Chalk' and many fields were irrigated during the summer. One field gave a second hay crop in July and a third crop in late September; this was finished in the barn by the Dutch cold air system. All the grazed land was topped by a rotary mower.

Livestock

Cattle. In December 1968 31 cattle were brought into covered yards and fed on hay, silage, brock potatoes and home-grown concentrates. Most were sold from the yards, but a few off grass during the summer. Forty-six smaller cattle were out-wintered at Scout farm on a similar ration without concentrates but with barley straw, and they maintained their live weight.

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They fattened readily on the ample grass during summer and autumn, gaining about 2 lb/day. Altogether 107 cattle were fattened, of which 37 were from Woburn and finished at Rothamsted.

One hundred and twenty-six yearling Hereford Cross bullocks were bought. In November 22 of the most forward were brought into covered yards to be sold as they became ready. Of the remainder, 29 were yarded in December 1969 for fattening, and 90 are out-wintering and feeding on hay, silage, potatoes and barley straw.

All the young stock were treated in autumn with an organo-phosphorus insecticide against warble fly; all bought cattle were dosed against liver fluke.

Sheep. In October 1968, 264 ewes, mainly Scotch Half-breds but including 50 Half-bred and home-bred gimmers, were mated, after flushing on seeds, to Suffolk rams. Hay was fed from when snow fell on 24 December and concentrates from the end of the year, as the ewes were in rather poor condition. Lambing started on 6 March and proved disappointing. The ewes were affected by the very wet weather and many lambs were born dead or died soon after birth. Only 312 lambs were alive in early May, giving a lambing percentage of only 118; the lambs grew well but were slow to finish. The first were sold on 2 June and about half were sold fat, the remainder as stores at autumn sales.

The ewes were injected before lambing with a combined vaccine to protect them and their lambs against clostridial diseases. Ewes and lambs were sprayed against sheep maggot fly, and lambs were dosed regularly against worms. Despite this several lambs died from lung-worm infection, and as there is no clean pasture it seems impossible to maintain them in a satisfactory state of health. The need for the ewe flock no longer exists as lambs are not now used in grazing experiments, so as it adds greatly to labour problems, the ewes were sold in the autumn.

Buildings

An insulated potato store was built with fan and central surface duct with laterals for ventilation. Thermistors placed at different points in the heap record temperatures on dials.

A new timber-framed barn, isolated from the main block of buildings, was built to store baled hay. A fan and metal surface ducting was installed in part so that up to 140 tons of hay with a moisture content of up to 30% can be dried in four batches by cold air, using the Dutch system.

WOBURN

At Woburn crops were less satisfactory than at Rothamsted. After a late start they grew rapidly at first but later suffered from lack of rain, especially those on the light soils; some potato and bean yields were particularly disappointing. Rain was less than average in each of the 5 months June to October, giving a deficit of 5·3 in. Hay yields were small but quality was

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