ROTHAMSTED RESEARCH

Report for 1958

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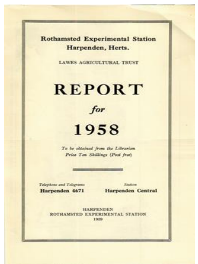

Dunholme Field Station

R. Hull

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DUNHOLME FIELD STATION

R. HULL

W. J. Byford was appointed in March to the vacant post of plant pathologist.

R. A. Dunning attended the meeting of the Virus Committee of the International Institute of Sugar Beet Research in Holland in January. S. N. Adams attended the Summer Congress in Belgium in June, and visited research centres in Belgium and Holland.

Sugar-beet yellows

More information has been collected on which to base advice about the time to spray sugar-beet crops with systemic insecticide to control yellows. The winter hosts of sugar-beet aphids were examined during March and April, and during May, June and July the agricultural staff of the British Sugar Corporation counted aphids in about 2,000 fields each week. A summary of this information was distributed each week to National Agricultural Advisory Service and the British Sugar Corporation staff. Spraying was recommended when local infestations of green aphids were detected or the population reached an average of 0·2–0·3 green aphids/plant in any area. Warnings to spray were posted to growers by the factory staffs, and most growers in the Eastern Counties had received a warning by late June. About 100,000 acres were sprayed, although spraying was curtailed by wet weather in some areas. At the end of September the incidence of yellows was two to three times more in unsprayed fields than in sprayed ones in the same localities.

Few *Myzus persicae* were found in spring on brassica crops or weeds; the heaviest infestation encountered was on *Lepidium campestre* near Bury St. Edmunds. *M. persicae* were common on clamped mangolds, and on occasional sugar-beet plants in sheltered places. Aphids from beet and mangold were the only ones which, when transferred to glasshouse plants, caused severe (necrotic) yellows. *Myzus ascalonicus* was the most common aphid on weeds, especially *Stellaria media*. Some beet to which they were transferred in the glasshouse developed mild yellows. (Dunning and Hull.)

At the end of April aphids were found in thirteen of twenty-eight mangold clamps examined, and the number of times the various species were recorded were: *Myzus ascalonicus* 3, *M. persicae* 8, *Rhopalosiphoninus staphyleae* 11, *Aulacorthum solani* 3. These species and *Macrosiphum euphorbiae* were found on sugar beet in the field during May and June. In the glasshouse their relative ability to colonize sugar beet was, in descending order, *Aphis fabae* and *M. ascalonicus*, *A. solani* and *M. persicae*, *M. euphorbiae* and *R. staphyleae*. (Dunning.)

A few *M. persicae* were found on wild beet growing on the Shotley peninsula in Suffolk in December 1957, but not later though at least 200 shoots were examined weekly during April, May and

June, and less frequently in July, August and September. Sticky-traps caught flying aphids above the sugar-beet crop from the first week in May, whereas no aphids were trapped above wild beet until 2 weeks later. *M. persicae* was first found on nearby sugar-beet crops in the first week of June, and a fortnight later the aphid population was, on average, 0·5 aphids/plant.

Healthy sugar beet in pots were placed among wild beet, and left exposed there for two weeks, when they were returned to the glass-house and replaced by fresh plants. Over the 10-week period starting in the second week of April, only one of the 600 plants exposed developed yellows and three developed mosaic.

Yellows appeared in sugar-beet crops near the wild beet during the second week of June, but no plants showed mosaic until late June. 60–80 per cent of the nearby wild beet showed mosaic and 30–50 per cent yellows.

In two sugar-beet crops adjacent to sea-walls colonized by wild beet, the proportion of plants with yellows increased with distance from the sea-wall. In the spring and summer of 1958 there was no detectable spread of yellows from wild beet on the Shotley peninsula to nearby sugar beet. (Gibbs.)

Yellows was prevalent in seed crops, as was expected from examining steckling beds in the autumn of 1957. On average, 10 per cent of sugar-beet seed plants and 31 per cent of mangold seed plants had yellows in June, the highest incidence since the steckling certification scheme started in 1951. Crops planted with stecklings raised in isolated areas, or under a cover crop, had respectively, 1·4 and 3·4 per cent of plants with yellows; those from open beds depending for yellows control on spraying with systemic insecticide had 23·6 per cent. Only spraying has yet been used for mangold stecklings, which accounts for the greater incidence of yellows. Aphids did not colonize seed crops in the spring and obvious spread from seed crops to root crops was rare.

The 1958 stecklings were comparatively free from yellows; in October all sugar beet and 95 per cent of mangold steckling beds had less than 1 per cent affected plants. (Dunham and Hull.)

Varieties selected at Dunholme for tolerance to yellows were tested in the field at Harkstead, near Ipswich, where yellows became prevalent during August. Some of the selected varieties had fewer plants with yellows at first, and looked greener than the commercial varieties throughout the season. Variety 57/6/5 yielded 21 per cent and Variety 57/21/2 yielded 15 per cent more sugar per acre than the best of four commercial varieties.

At Dunholme the number of *M. persicae* infesting plants of sixty varieties in July varied greatly and was directly related to the proportion with yellows. The slower spread of the disease in tolerant varieties may be partly due to their relative unsuitability for *M. persicae*; also they show symptoms more slowly when infected with yellows.

Most of the varieties used at Harkstead were also tested at Kirton, near Boston, where downy mildew (*Peronospora schachtii*) was prevalent. The experimental varieties were more susceptible to this disease than commercial varieties, and in early July half of the plants on some plots were infected. This reduced yield, and variety 57/21/2,

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for instance, here gave only 68 per cent of the sugar yield of the commercial varieties instead of outyielding them as at Harkstead. No experimental variety outyielded the commercial varieties at Kirton.

Production of seed and testing of other selections was continued at Dunholme. Both downy mildew and powdery mildew (*Erysiphe* sp.) were prevalent and varied strikingly between the varieties. (Hull.)

When *M. persicae* were offered the choice in the glasshouse of healthy or diseased sugar-beet leaves, they preferred those with severe yellows to mild yellows and these to healthy. They preferred young to mature leaves of healthy plants, but from infected plants they preferred whichever leaves showed most severe symptoms. They multiplied quicker and lived longer on infected than on healthy sugar beet, so three factors contribute to making infestations on infected plants greater than on healthy. *M. ascalonicus*, *Aphis fabae* and *Aulacorthum solani* behaved similarly.

Differences in preference of *M. persicae* for healthy plants of various inbred lines of sugar beet disappeared or were reversed when the lines were infected with yellows. Increases in preference and reproduction rate caused by spraying leaves of healthy plants with sucrose, casein hydrolysate or caffeine, or detaching the leaves from the plant, were small compared with those caused by infection with yellows. (Baker.)

Twelve field experiments done in conjunction with the British Sugar Corporation determined the effect of two times of spraying with " Metasystox " on yellows incidence and on yield, and checked the timing of the spray warnings issued to farmers. Yield responses depended on the incidence of yellows on the unsprayed plots and ranged from nil at some sites to an increase of 5·7 tons/acre of roots and 1 per cent in sugar content on the twice-sprayed plots at the Norfolk Agricultural Station. Sprays in early or late June mostly gave similar effects; this contrasts with results in 1957, when only early sprays were effective, but parallels results in most previous years. A second spray had only a small additional effect where an earlier one had been given, although it often paid.

Sugar beet grew luxuriantly in the mild, moist autumn. Samples taken from the spraying experiment at Sprowston showed a yield increase between 25 September and 6 November on unsprayed and sprayed plots respectively, of 1·8 and 2·9 tons/acre of roots and 7·8 and 12·9 cwt./acre of sugar. Spraying to control yellows augmented this autumn growth, and commercially spraying 100,000 acres doubtless contributed to achieving a record yield of sugar beet forecast in 1958. (Dunham, Dunning and Hull.)

Insecticides

Several insecticides were tested at Swaffham, Norfolk, to control yellows' vectors. All were applied on 20 June in 60 gallons/acre of water; the amount of active insecticide per acre and the percentage of plants with yellows in September were: 15 oz. DDT, 22 per cent; 6 oz. " Ekatin M " 30 per cent; 8 oz. " Megatox " (fluoroacetamide) 16 per cent; 6 oz. " Metasystox " 13 per cent; 2 oz. " Phosdrin " 16 per cent; 5·1 oz. " Rogor " 18 per cent; unsprayed 32 per cent. Yellows incidence was roughly inversely proportional to the degree

N

of aphid control achieved in June and July. In the autumn at Dunholme stecklings sprayed with fluoroacetamide and "Ekatin M" were colonized by *A. fabae* more rapidly than those sprayed with "Metasystox" and "Rogor". The effect of these sprayings at 2-, 3- or 4-week intervals on yellows incidence will be assessed on the transplanted seed crop next spring.

"Phosdrin" at 4 oz./acre, "Metasystox" at 6 oz./acre and fluoroacetamide at 6 oz./acre each gave good control of aphids when sprayed in 50 gallons/acre of water on to mangolds in the field on 12 November 1957. "Phosdrin" killed the aphids fastest, and fluoroacetamide slowest. DDT (15 oz./acre) and γ-BHC (1·8 oz./acre) reduced the number of aphids 3 days after spraying, but 12 days later they were as numerous as on the unsprayed plots.

The amount of fluoroacetamide fell from a maximum of 8 p.p.m. in the mangold leaves shortly after spraying to $<$0·1 p.p.m. in any part of the mangold in April 1958; the equivalent figures for γ-BHC were 1·2 and 0·1–0·4 p.p.m.

The systemic insecticides "Disyston", "Thimet" and "Rogor" were tested as seed dressings on rubbed and on natural sugar-beet seed, at various rates averaging respectively 0·625, 2·5 and 0·78 per cent active ingredient. The rubbed seed was sown at 8 lb./acre and the natural at 16 lb./acre. All dressings, and especially "Disyston", caused cotyledon-tip scorch, but even the highest rates had negligible effect on final plant stand. Granular "Thimet" (0·25–1 lb./acre) and "Disyston" (0·5–2 lb./acre) drilled along with the seed gave a similar phytotoxic effect, but not when broadcast. The higher rates of seed dressing with "Thimet" and "Disyston", and all soil treatments, gave complete control of *Pegomyia betae* larvae mining in the leaves up to 7 weeks after sowing. The broadcast soil treatments halved the incidence of yellows in September.

Seed treated with "Disyston" (2·5 per cent w/w active ingredient) or with "Thimet" (0·625 per cent) was sown at sixty-one sites distributed throughout beet-growing areas; rubbed seed was sown at 8 lb./acre or natural seed at 16 lb./acre. On average "Thimet" had no effect on emergence or growth, but "Disyston" reduced both slightly. Both treatments reduced attacks of mangold fly, flea beetle, black and green aphids. Seed treatment with systemic insecticides gave the best initial kill of aphids on stecklings during August and early September, but granular "Disyston" applied to the seedbed at 1½ lb./acre of active ingredient had a more persistent effect. A combination of seed and soil treatment produced the lowest incidence of yellows in early November, 1·5 and 1·7 per cent for "Thimet" and "Disyston" respectively, as compared with 5·6 per cent on the untreated plots.

The incidence of yellows in a seed crop was reduced from 47 to 32 per cent by sowing, in the autumn of 1957, seed treated with "Thimet"; "Disyston" was slightly less effective. Spraying the stecklings with "Metasystox" lowered yellows incidence still further. (Dunning.)

Seed treatment

A three-year series of seed-dressing trials, arranged in conjunction with the British Sugar Corporation field staff on seventeen to nine-

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teen widely scattered sites each year, was ended. The seed treatments tested were steeping seed for 20 minutes in 40 p.p.m. ethyl mercury phosphate solution, dusting with γ-BHC, dieldrin or aldrin at 0·67 per cent w/w, and also commercial combined organo-mercury/insecticide dusts. The treatments affected the rate of delivery of seed from the seed-drills, so seedling counts have been adjusted for seeding rate, but counts of final plant stand after singling have not.

EMP-steeped seed gave, on average, 39 per cent more seedlings than untreated seed, and 7 per cent more plants in the final stand. The corresponding increase over organo-mercury dust treatments were 11 and $2\frac{1}{2}$ per cent respectively. EMP plus dieldrin gave the same increase in seedlings over untreated seed as did EMP alone; EMP plus γ-BHC and EMP plus aldrin depressed the number of seedlings by 3 and 6 per cent respectively compared with EMP alone. Neither aldrin nor γ-BHC affected the final plant stand, but dieldrin gave a 3 per cent increase. The commercial organo-mercury dry dressings containing dieldrin gave a slightly greater final stand of plants than one containing γ-BHC, which was itself slightly greater than one containing aldrin. (Dunning and Gates.)

Satisfactory emergence of seedlings was obtained in the field from seed steeped in 10 p.p.m. EMP solution. Emergence fell off with concentrations between 80 and 160 p.p.m. and, with concentrations greater than 240 p.p.m., emergence was less than with the untreated control. EMP sprayed on to seed gave no consistent effect up to 8 per cent v/w of an EMP concentration of 0·3 per cent, or 2 per cent v/w at a concentration of 0·8 per cent EMP. Methoxy ethyl mercury acetate (MEMA) applied as a spray at 2 per cent v/w was almost as good as when applied as a 60-p.p.m. steep, but neither treatment was as effective as 40-p.p.m. EMP steep.

The quantity of fungicide on individual seeds and regularity of distribution obtained by spraying was assessed by a *Stemphylium*-agar-plate method. A distribution of fungicide most nearly approaching that given by soaking was obtained by applying slowly 6 per cent v/w of 0·2 per cent EMP solution.

Batches of seed giving poor germination in laboratory tests responded more to EMP steep than seed of good germination, and when seed of a batch heavily infected with *Phoma betae* was graded for size small seed responded more to EMP steep than large.

Treating EMP-soaked seed with " Phygon " or TMTD depressed seedling emergence. The antibiotic seed treatment " Rimocidin " depressed emergence when used as a steep at 200, 400 or 800 p.p.m. for 16, 8 or 4 hours respectively. Seed treated with a dust containing griseofulvin and an organo-mercury compound gave seedling emergence comparable to that obtained with EMP steep. (Byford.)

" Docking disorder " was unusually prevalent in 1958, not only at Docking itself, but also at other places in Norfolk, Suffolk, Lincolnshire, Shropshire and Yorkshire. At each place sugar beet grew poorly on patches of sandy soils of high pH. The leaves often showed signs of nitrogen or magnesium deficiency, were thickened, cupped and had xeromorphic characteristics. The tap roots were stunted and laterals, or tap root, sometimes grew horizontally only a few inches under the soil surface. Especially after rain many fresh adventitious rootlets grew; later their tips stopped growing, swelled and the rootlets died. This sequence was often repeated, so main roots acquired a beard of dead and dying rootlets.

The soil in the affected patches was structureless and slaked completely when moistened; it showed the following differences from that in which normal beet grew near by: (1) a higher coarse-sand fraction; (2) a lower clay content; (3) a lower organic matter content; (4) a lower base-exchange capacity; (5) a lower active carbonate content.

The roots of affected beet contained no more fungi, bacteria or nematodes, nor a different range of species of these organisms, than did roots of unaffected beet. No virus could be isolated by sap inoculation from affected roots on to *Chenopodium amaranticolor*. Affected beet from the field, replanted into pots of John Innes compost and kept in the glasshouse, recovered completely and produced normal leaves and roots.

Beet raised from seed in pots of affected soil grew poorly and had dead rootlets. In affected soil mixed with an equal weight of John Innes compost they grew as well as in compost alone or in unaffected soil from the field. Heating the affected soil in an autoclave for ½ hour only very slightly increased growth.

These results suggest that the trouble is not caused by a pathogen (see *Rep. Rothamst. exp. Sta. for 1954*, p. 95; 1955, p. 106; 1956, pp. 119–120) but by the unusual soil type. (Gibbs.)

Other diseases

Two sprays in April with "Agrimycin 100" (streptomycin) "Agrimycin 500" (streptomycin and copper) or with Bordeaux Mixture did not effect the incidence of downy mildew in four Lincolnshire sugar-beet seed crops, where it varied from 3 to 11 per cent.

Pleospora betae, previously recorded only on *Beta vulgaris*, was found in April on dried stems of *Beta trigyna* at Dunholme. (Cornford.)

Sugar-beet Manuring

The main work is a series of field trials conducted in co-operation with the field staffs of the British Sugar Corporation. The harvesting of these trials is not completed until December and the analyses for sugar content until early in the New Year. This report gives the results of the 1957 experiments and indicate the trends from the few 1958 results yet available.

NPK–dung trials

Sixteen 3^3 factorial experiments tested 0·6, 1·2 and 1·8 cwt. N/acre as sulphate of ammonia; 0, 0·5 and 1·0 cwt. P_2O_5/acre as superphosphate and 0·8, 1·6 and 2·4 cwt. K_2O/acre as muriate of potash. In thirteen of these trials the mineral fertilizers were tested in the presence and in the absence of dung.

Without dung, the best dressings were 0·6 cwt./acre N, 0·5 cwt./acre P_2O_5 and 0·8 cwt./acre K_2O; and higher rates depressed sugar yield. In the presence of dung, 0·6 cwt./acre N was still the best dressing, but the dung provided all the P and K needed. High rates of nitrogen in the presence of dung depressed sugar yield considerably.

Dung gave an extra 2·2 cwt. sugar when only 0·6 cwt./acre N was applied, but this advantage was largely eliminated by more nitrogen.

These optimum dressings are lower than is usually thought desirable for sugar beet. Most seasonal factors in 1957, however, operated against high fertilizer responses. The 1956–57 winter was drier than average, the spring of 1957 was exceptionally dry, and there was a particularly early and severe attack of virus yellows.

Ploughing down of P *and* K *trials*

Nine experiments compared seedbed application of 1·0 cwt. P_2O_4/acre as superphosphate and 1·5 cwt. K_2O/acre as muriate of potash with the same fertilizers applied in the previous autumn and ploughed in. Responses to phosphate were very small, whether it was broadcast or ploughed down. Broadcast potash increased yield by 2·8 cwt./acre sugar, compared with 1·7 cwt. for potash ploughed down. At seven out of nine centres broadcasting was better than ploughing down.

Comparison of forms of nitrogen fertilizers

Nine experiments compared the effect of 0·6 cwt./acre N applied as sulphate of ammonia, calcium nitrate or urea in the seedbed or as a top-dressing at the time of the last hoeing. Treatments of an additional 0·6 cwt./acre N applied either in the seedbed or as a top-dressing were also included.

Top-dressing raised the sugar yield less than the same quantity put on the seedbed, and there was no advantage in splitting the heavier dressing. Calcium nitrate and urea differed little from sulphate of ammonia in their efficiency for sugar production.

Trends in the 1958 experiments

Early results from the 1958 NPK–dung experiments suggest that responses to nitrogen have been higher this year. 1·2 cwt. N/acre has given a higher sugar yield than 0·6 cwt. N at six out of eleven sites where dung was not applied. 1·8 cwt. N/acre, however, gave less sugar than 1·2 cwt. N at all eleven sites. In the presence of dung, the highest sugar yield was always given by 0·6 cwt. N.

0·5 cwt. P_2O_5/acre seems to be the optimum level of phosphate, both with and without dung, and there has been no advantage in exceeding 0·8 cwt. K_2O/acre. These results are similar to 1957, except that in that year dung provided all the phosphate needed by the crop.

The ploughing-down trials are showing the same trends as last year; in five out of six trials broadcast P and K gave more sugar than ploughing down.

Early results of the types of nitrogen experiments indicate that there was no advantage in splitting the nitrogen dressing even in this abnormally wet spring.

The effect of salt and potash on sugar beet on the Lincolnshire Limestone soils

A series of 2^2 factorial experiments on the Jurassic Limestone soils of Lincoln Edge is testing the effect on sugar beet of 1·5 cwt. K_2O/acre as muriate of potash and its chemical equivalent of salt ($1\frac{3}{4}$ cwt./acre). All plots received 1·0 cwt. N/acre as sulphate of ammonia and 0·5 cwt. P_2O_5/acre as superphosphate. There were six experiments in 1957 and five in 1958. The results expressed in yield of sugar/acre are shown in Table 1.

Table 1

Effect of salt and potash on sugar yield (cwt./acre)

	1957, mean of 6 trials	1958, mean of 5 trials
N, P only	36·4	42·1
N, P + salt	40·8	47·8
N, P + potash	40·1	45·7
N, P + salt + potash	40·6	49·7

In 1957 salt and potash were equally effective in raising sugar yield. When salt was applied, there was nothing to be gained from using potash, and *vice versa*.

In 1958 salt gave an average yield response of 5·7 cwt. sugar, compared with a response of 3·6 cwt. sugar to potash. Even when potash was applied, salt gave a response of 4·0 cwt. sugar. Potash in the presence of salt gave a yield increase of 1·9 cwt./acre, which is just profitable.

Chemical work is in progress to see if the response at individual sites can be related to soil K and Na.

Growth analysis of sugar beet receiving different levels of nitrogen fertilizer

High rates of nitrogen cause sugar beet to produce more top, but the plant is normally unable to use this extra leaf to increase its sugar yield. To obtain more information on this effect of excessive nitrogen, a growth analysis was conducted on beet at Dunholme receiving 0, 0·6, 1·2 and 1·8 cwt. N/acre. Sub-plots were harvested nine times throughout the growing season, and both fresh and dry weights of leaves, petioles and roots and total leaf areas were determined.

A dressing of 1·8 cwt. N/acre is normally excessive for sugar production, but the site chosen was exceptional in that yield responses were obtained up to the highest level of N. No dressings were therefore excessive, and the main object of the trial was not achieved. It was of interest that leaf area and dry-matter accumulation on plots receiving 1·8 cwt. N/acre were depressed in the early months. Not until August did the leaf area of the 1·8 cwt. N treatment exceed that of the 1·2 cwt. N, and the superiority in dry-matter production did not appear until September.

Effect of sowing and lifting date on response to fertilizer

An experiment was carried out at the Lindsey Farm Institute in 1958 to see if the dates of sowing and lifting affect the response of sugar beet to fertilizer. All plots received a basal dressing of 5 cwt. kainit/acre, and half received in addition 8 cwt. "Fison's 32" (12 : 9 : 9)/acre. There were three sowing dates: 15 April, 29 April and 13 May; and three lifting dates: 2 October, 30 October and 3 December.

Late sowing depressed sugar yield, but did not affect response to fertilizer. Results from the three lifting dates show a remarkable increase in sugar production in October, but delayed lifting did not affect response to fertilizer. (Adams.)

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