ROTHAMSTED RESEARCH

Report for 1948

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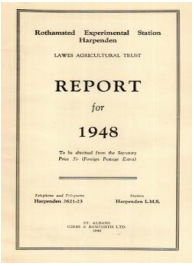

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BOTANY DEPARTMENT

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MINOR ELEMENTS—MOLYBDENUM

Action in nutrient solutions

Work on the response of the plant to molybdenum under varied nutrient conditions has been continued, attention being chiefly focused on alterations in (1) pH value and (2) nitrogen supply.

(1) The uptake of molybdenum is known to be greater from alkaline than from acid soils, as it is rendered more available under the former conditions. Theoretically, there should be no molybdenum present in nutrient solutions to become available, but nevertheless some difference in response to the element might be expected with a change in the reaction of the medium. Investigations were carried out to determine if this were the case, using two nutrient solutions of quite different chemical composition and with normal pH values of 5·6 and 6·4 respectively. With these as bases, two series of solutions were prepared, by appropriate addition of acid and alkali so that a pH range of approximately 4·0 to 8·0 was covered. Lettuce and red clover plants were grown in the resulting modified solutions, with and without the addition of 0·2 p.p.m. of Mo., as sodium molybdate. It is common knowledge that once contact with the plant roots has been made, rapid changes in pH values occur, and solutions which at the outset differ widely in reaction, quickly level up and ultimately closely resemble each other. Records made during the present investigation completely confirmed this. The type and amount of growth in each solution, however, was by no means similar, though it was realised that the differences were probably due chiefly to indirect effects, such as availability of iron, rather than to changes in the pH value itself. The results with lettuce and red clover were very similar. Some solutions were more favourable to growth than others, the most acid causing a check to root development in the early stages but ultimately producing some of the best plants. The most alkaline solution was the least satisfactory, the shoot showing the damage in this case. Molybdenum deficiency symptoms were recorded in all types of solution, though they were less marked and sometimes absent altogether in the most alkaline medium. It is not yet clear whether this latter effect was directly attributable to the nature of the solution, or whether, with the concomitant reduction in size and vigour of the plant, its demand for molybdenum was so small, that the original trace probably present in the seed sufficed.

(2) A close association exists between molybdenum and nitrogen nutrition. Investigations have been begun to determine the response of the plant to molydenum in nutrient solutions supplying different levels of nitrogen. The behaviour of a leguminous crop, red clover, with and without inoculation is being compared with a non-leguminous crop, lettuce.

Toxicity of molybdenum in different soils

Studies of the effect of toxic dressings of molybdenum on flax and red clover were continued, with special reference to manganese deficient soils. Flax was grown in small glazed pots as before, but

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the red clover was sown in deeper ones following the experience of 1947 when the plants became pot-bound by the end of their first season.

Three soils were used. The fertile sandy Woburn and the manganese-deficient fen soil were the same as in 1947, and a clay soil from Tring was introduced as an example of a soil different from the fen, but showing similar deficiency of manganese on analysis. Both the manganese-deficient soils were used with and without added manganese.

Growth of both crops in fen soil with and without added manganese was similar to that of the previous year, acute symptoms of manganese deficiency appearing unless manganese had been added. The plants in fen soil with manganese were not as good as those in Woburn soil, which were very tall and sturdy and much quicker in developing.

Plants in Tring soil behaved quite differently from those in fen, showing hardly any symptoms of manganese deficiency and consequently little benefit from added manganese. Flax in Tring soil was slow in starting and by harvest was considerably smaller than in Woburn soil; in the presence of manganese it was slightly smaller than in fen soil. Red clover in Tring soil made reasonably good growth after a slow start.

Molybdenum was given at three rates as soon as the plants were established, and half of these treated plants received a second dressing at half the original rate later in the season.

Molybdenum toxicity was more severe in Woburn soil than in 1947, the highest dressings killing many plants of both crops and the lower dressings producing typical brownish-orange discoloration of stems and leaves and reduction of size of plant. Plants in the other two soils were less severely affected by the molybdenum. In the fen soil without manganese the plants were so poor that molybdenum toxicity was almost masked, and where manganese was added the symptoms were much less acute than in Woburn soil. Tring soil either with or without manganese showed very little effect of molybdenum. Symptoms were very late in appearing and were confined to slight yellowing and slight reduction in size of plants.

No interaction of molybdenum with manganese deficiency was noted in flax, but in clover a month after the second cut plants grown in fen soil without manganese but receiving molybdenum began to show a slight improvement in colour over the corresponding no molybdenum set. This is similar to the effect observed in the winter of 1947. No such effect has shown in Tring soil, but as the plants did not show symptoms of manganese deficiency it was hardly to be expected. The final results will not be available for some time.

Effect of molybdenum on tomatoes with different basal dressings of manure

Tomatoes grown in a molybdenum experiment in 1947 produced many fruits with hard core and blossom-end rot, so an experiment was set up to see if this could be avoided by any modification of the fertilizer used.

Tomato plants were grown in large earthenware pots of Woburn soil with two different basal dressings. One consisted of hoof meal and dry fertilizers given when the plants were finally potted up, and

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the other of nutrients given in solution at 10-day intervals. Both were used in conjunction with three levels of potash.

The most striking result was the healthy colour of plants, high yield and freedom from blossom-end rot in fruits of the set having hoof and dry fertilizers contrasted with the others. Unfortunately this otherwise good set produced a far bigger proportion of fruits with hard-core than did the set receiving a nutrient solution at regular intervals. Effects of level of potash were much less noticeable than those due to type of fertilizer.

Effect of root temperature on growth of plants in water culture

The investigations outlined in the 1947 report were extended using the same apparatus and solutions. Continuous shading was discontinued and further attention was given to the effects of controlling root temperature under the normal glass-house practice of shading only on very sunny days.

Three controlled root temperatures were used—high and low as before, plus an intermediate one—and plants were also grown on the bench with fluctuating temperature. Peas and flax were grown again as the varieties used had proved satisfactory, but buckwheat was discontinued as no pure line or named variety was available and the replicates were very uneven. A preliminary experiment with radishes suggested that they were considerably affected by root temperature and would be good subjects for further studies.

Weed Investigations

The estimation of the vitality of buried weed seeds in the soil samples taken from Broadbalk wheat field in 1945 have been completed. Data are now available to compare the results with the 1940 sampling from the same plots and thus to determine the effects of another 5-year fallowing cycle on the weed flora.

Observational records on the weeds present on Broadbalk and Hoos fields during the cropping period have been made as usual.

The long term pot experiments on dormancy of wild oat seeds continued, but very few seedlings appeared. This suggests that most of the viable seeds had germinated during the previous three years. Another third of the deep-sown wild oat pots were tipped out into seed boxes in the autumn, but at the time of writing no seedlings have appeared.

Suggestions for the control of wild oats continue to come in from farmers and others, and are being noted with a view to setting up a field experiment on this problem in the near future.

Park Grass and Highfield

The botanical analyses of hay from certain selected plots on Park Grass have been continued. A start has been made in working up the data accumulated since 1919 with a view to incorporating it in a new edition of the monograph "Manuring of Grassland for Hay". All the information available to date will be thus brought into line together.

In view of the changes about to be made in the nature of the investigation on Highfield, which will involve ploughing up of the grassland, only the three plots needed to complete the data from the original experiment were sampled this year.

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