COMPETITION OF RHIZOBIUM STRAINS IN NODULE-FORMATION

by

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1. INTRODUCTION.

A remarkable phenomenon which is observed when inoculation experiments are conducted with leguminous plants is the resistance caused by the nodules first produced by one strain of Rhizobium against later infections by other strains. We have made use of this phenomenon in order to obtain ,,control plants" for pot experiments in the greenhouse, i.e., plants which do not receive atmospheric nitrogen through the activity of the root nodules. If an uninoculated pea is planted to a pot containing quartz sand and watered with N-free nutrient solution, effective nodules appear gradually on the roots — though not so rapidly as on the inoculated plants — and the ,,control plant" begins to grow. This is not prevented by sterilization of sand and seed prior to experiment because the danger of infection is particularly great in a greenhouse where experiments with legumes have been carried on for years. If, on the other hand, pea is inoculated with our ineffective strain H VIII, which is as rapid a nodule-producer as the effective strains, in most cases the pea does not grow at all. Only white round H VIII nodules are then found on its roots. In numerous carefully arranged experiments the said strain is proved to be completely ineffective (1).

The above phenomenon has already been treated earlier in literature. HILTNER (2) felt that a certain degree of immunity is set up by the entrance of the rhizobia into the plant and that only bacteria of a higher ,,virulence" than those already present can effect secondary invasion. ISRAILSKY (3) came in his studies to the conclusion that the infection of the plant by one strain results in an immunity which inhibits infection by other strains. Miss LÖHNIS (4) observed that after a poorer strain had formed nodules
a more effective strain could still induce further nodulation. The reverse was not true. Dunham and Baldwin (5) succeeded in securing simultaneous nodulation by effective and ineffective strains on the same plant. If a certain strain had already formed nodules on the roots, it was found much more difficult to induce nodulation by a different strain, although it sometimes succeeded. The degree of effectiveness did not effect the results. Nicol and Thornton (6) disclaim altogether the immunizing effect of the first strain. In their careful experiments they have arrived at the result that the cause of the apparent immunity is simply ascribable to the fact that each strain is able to form a certain number of nodules in the root system. This number is formed rapidly by one strain and slowly by the other. After the roots have been "saturated" with nodules the same or a different strain is no longer able to form nodules on them. The experiments of Nicol and Thornton were made with pea and soya bean. The plants were inoculated successively with two different strains. The first inoculation was made at the time of sowing, the second on pea 6 weeks after the first and on soya bean 9 weeks after the first inoculation.

2. Own experiments.

Without knowing the results obtained in Rothamsted we undertook during the war studies on the resistance caused in the roots by the first nodule-forming strain. In order to prevent with certainty all contaminations by foreign strains we performed these

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Fig. 1. Sterile culture system. Cultivation of sterile seedling (I—II) and transfer to culture flask (III—IV).