LEGUME NODULE DEVELOPMENT IN RELATION TO AVAILABLE ENERGY SUPPLY

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THE causes of the variations in nodulation of legumes under more or less usual conditions of growth have been discussed by the writers in three previous papers (1, 2, 3). Particular attention (3) was given to the situation where a decrease in nodulation occurs due to the presence of a liberal supply of combined nitrogen. The general conclusion arrived at was that normally under good cultural conditions the most important, but not the sole, factor in nodulation is the supply of available carbohydrate reaching the nodules. In accord with this view the effect of fixed nitrogen was traced to the decrease in available carbohydrate in the roots caused by it. It was further pointed out (2) that under certain conditions, such as where ineffective bacterial strains are used or where the nitrogen hunger condition occurs, carbohydrate accumulates unless fixed nitrogen is supplied and is not the limiting factor in growth. Other investigators, particularly Fred and Wilson (5), have also emphasized the importance of carbohydrate supply in legume symbiosis. Recently several investigators have published additional data that in our judgment confirm our previous conclusions even though some of these authors regard the carbohydrate supply explanation as inadequate. One author (17, 18) has proposed a similar but distinct and more complicated explanation to take its place. It seems well at this time, therefore, to reexamine the adequacy of our original hypothesis in the light of the new experimental data and the objections that have been raised.

The newer experimental results, like the older ones, indicate that under ordinary growing conditions, where little or no fixed nitrogen is present in the growth medium, a close correlation exists between the quantity of carbohydrate photosynthesized, on the one hand, and the extent of nodulation and nitrogen fixation, on the other. Since in this case the major interrelations are well established and have not been questioned, little further discussion of the point is necessary. Attention will be given, however, to some of the points that have been given special consideration by recent investigators.

EFFECT OF FIXED NITROGEN ON ROOT CARBOHYDRATE AND NODULATION

Considerable new evidence has been presented that supports our previous statements (1, 2, 3) to the effect that additions of fixed nitrogen to the soil inhibit the growth of legumes and nodulation. One author (17, 18) has proposed a similar but distinct and more complicated explanation to take its place. It seems well at this time, therefore, to reexamine the adequacy of our original hypothesis in the light of the new experimental data and the objections that have been raised.

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