INTERACTIONS OF AZOTOBACTER WITH RHIZOSPHERE AND ROOT-SURFACE MICROFLORA *

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INTRODUCTION

Azotobacter chroococcum, an aerobic bacterium, is widely distributed in soil, but is usually sparse, and rarely exceeds a thousand per gram. It is not more abundant in the rhizosphere than in the other parts of field soils, but in glasshouse experiments, a rhizosphere effect sometimes shows, depending on the soil type, plant species, and stage of plant growth.

The survival of Azotobacter chroococcum introduced into soils and the rhizosphere of plants has been a subject of controversy. For example Krasilinikov stated that the organism is inhibited in the rhizosphere of wheat and cotton, whereas Zaręmba and Sinyavskaya, found it living close to wheat roots, Federova and Tepper found that the population of introduced Azotobacter chroococcum steadily declined in the rhizosphere of millet; whereas, Timonin found that it not only survived in the rhizosphere of tobacco plants, but moved in soil to a depth of about 15 inches. In the rhizosphere of barley introduced Azotobacter multiplied for longer period than Azotobacter naturally present, but then decreased. However Brown et al. and Patel recovered many Azotobacter cells from the rhizosphere of various crop plants. Microscopic examination of roots emerging from inoculated wheat grain

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showed that the cysts of Azotobacter germinated near the roots and produced micro colonies.

Jensen suggested that antagonists of Azotobacter were mainly responsible for the absence of natural populations in seemingly favourable soils, and Yogina related the toxicity of virgin and cultivated soils to Azotobacter, to the number of antagonists they contained. Nickell and Burkholder showed that actinomycetes from soil were strongly antagonistic to Azotobacter vinelandii. Strzelczyk found that antagonists of Azotobacter chroococcum were more numerous in the rhizosphere of radish, onion and wheat than in the soil and numbers of Azotobacter in the rhizosphere were directly related to the number of antagonists.

We have studied the possible role of antagonists in restricting multiplication of Azotobacter in the rhizosphere of plants. Actinomycetes were isolated from soil and rhizospheres of wheat seedlings of different ages, and tested against Azotobacter chroococcum Strain A6 in agar and in soil. Some isolates of fungi from root surfaces were also tested for their antagonism.

MATERIALS AND METHODS

Wheat cultivar Jufy was grown in the glasshouse in pots of soil from Great Field, Rothamsted. The wheat grain was inoculated with either Azotobacter culture or sterile medium before planting. Procedures for growing Azotobacter and inoculating plants, and for sampling soils and rhizosphere were as already described.

Cultures of actinomycetes

Actinomycetes were isolated on chitin medium, and maintained on oatmeal agar. To assess antibiotic production, the isolates were inoculated to Strzelczyk’s medium and grown for 7 days at 26°C, when they were tested for antagonism, against Azotobacter chroococcum, Strain A6 using the agar-disc method.

Cultures of fungi

The fungi were isolated from washed root segments of wheat, plated on Warcup’s modified Czapek medium using Harley and Waids’ technique. Some selected isolates of Penicillium, Fusarium oxysporum and Cylindrocarpon radicicola and Mortierella were inoculated on Czapek agar slopes, incubated at 26°C for 8 to 10 days, when spores or mycelia were harvested in 5 ml of sterile distilled water and spread uniformly on the surface of 20 ml