Nodules were removed carefully from each plant and cleaned and counted. Fresh weight of the nodules (ten plants in each treatment) was determined on an electrical microbalance. Afterwards, the nodules were dried at 80°C for three days before recording their dry weight. The height of each plant was measured from soil level to the tip of the stem. At harvest, grain yield per plot was recorded and analysed. The yield per plot was converted into yield per hectare.

The data are shown in table 1. In the uninoculated plants there was virtually no nodulation in pre-flowering or early pod formation stage of the crop. There were no significant differences in nodule number between treatments with *Rhizobium* alone and with *Rhizobium* in association with insecticides. The maximum number of nodules was recorded with *Rhizobium* in association with quinalphos. The results agree with those reported by Mundade *et al.*[6] who observed increased nodulation in peanut (*Arachis hypogea*) treated with *Rhizobium* association with carbofuran.

A significant increase in nodule fresh weight was recorded with *Rhizobium* + quinalphos at the pre-flowering stage and with *Rhizobium* + phorate at early pod formation stage.

Rhizobium in association with insecticides had the beneficial effect of increasing plant height at pre-flowering stage. A significant increase in height was however, recorded only when *Rhizobium* was in association with phorate, quinalphos or mephosfolan insecticides. At early pod formation stage, no significant difference in height was observed.

All these findings indicate the effectiveness of the combination of *Rhizobium* culture and insecticides.

Rhizobium inoculated seeds recorded an increase of 19.4% yield over uninoculated seeds but significantly higher yield (43.20%) was recorded when *Rhizobium*-inoculated seeds were sown in association with phorate. The reason for this may be significantly greater number of nodules as well as higher nodule fresh and dry weight at early pod formation stage. These observations reveal that seeds inoculated with *Rhizobium* culture can be safely sown in association with these granular insecticides, preferably with phorate-10.

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AZOTOBACTER CHROOCOCCUM IN ROOT, STEM AND LEAF TISSUES OF CELLS OF *TRITICUM AESTIVUM* L. AND *TRITICUM DURUM* L.

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NITROGEN fixation by free-living bacteria associated with plants had received a good deal of attention[1]. It is known that efficiency of nitrogen fixation is more common in symbiotic associations of bacteria and plants but Parker[2] suggested that it should not be confined to root nodules and that other existing associations for nitrogen fixation must not be ignored. In this context the intracellular detection of *Azotobacter chroococcum*, a free-living nitrogen fixer, in root, stem and leaf tissues of *Triticum aestivum* L. and *Triticum durum* L. and its probable role in the nitrogen economy of wheat are presented.

Wheat genotypes of RAJ-1555 and Kiran of *T. durum* L., and APAU-1577 and DWR-16 of *T. aestivum* L. were obtained from Wheat Breeder, AICRP on Wheat, Dharwad. They were surface-sterilized following the method of Bhide and Purandare[3] and grown aseptically on Trelease and Trelease agar media[4] in 2 l conical flasks. After 10 days of growth, transverse sections of roots, stem and leaves were observed under a phase contrast microscope.

At higher magnifications parenchymatous cells of the root cortex (figure 1a), the parenchymatous cells of the leaf sheath, especially those near the peripheral region of the stem (figure 1b), and the

Figure 1a–c. Photomicrographs of T. S. of (a) roots (×1500), (b) stem (×900) and (c) leaves (×675) of *Triticum* showing *Azotobacter chroococcum* within the cells of the tissues.

mesophyll region of leaf (figure 1c) were found to be teeming with microbodies, both single and pairs. Movement was arrested by adding 75% ethanol. Morphologically the microbes appeared coccoidal.

The presence of bacteria inside the above tissues was confirmed by placing aseptically prepared sections on nitrogen-free Norris glucose agar. At 30°C brown-pigmented bacteria appeared around leaf, stem and root sections. The colonies were raised, smooth, cream-white initially, mucoid, and on prolonged incubation formed pigment. They were capsulated, nonsporulating, aerobic, motile and gram-negative. The isolates could utilize glucose, mannitol, sucrose and starch but not rhamnose. Following Bergey's Manual[5], the isolates have been identified as a variant of *Azotobacter chroococcum*. Pure cultures obtained from the host tissue fixed nitrogen (2.9 to 3.8 mg N/g of glucose as estimated by the micro-Kjeldahl method). It remains to be investigated whether nitrogen fixation occurs at the sites where the bacteria were localized, and if so, its intensity and benefit to the host plant. These results and those of others[6,7] support the presence of *Azotobacter* in the cortical cells of the host.

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ANTIBACTERIAL ACTIVITY OF A POLYCATION

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POLYCATIONS are linear and contain aromatic, aliphatic and quaternary salt units. The simpler