

The Effect of Inoculation with *Azotobacter* on the Growth of Wheat and Tomato Plants

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Much of the interest in the non-symbiotic nitrogen fixing bacteria of the genus *Azotobacter* is due to the possibility of introducing it into soil and rhizosphere, by inoculation, to increase plant yield. Stimulation in rates of seed germination, root growth and plant development as a result of inoculation were reported by several investigators (1,3,5,7). Significant responses to azotobacter inoculation on yield of cereals and vegetable crops were also obtained (2,6).

The objective of the present study was to test, under greenhouse conditions, the effect of *Azotobacter* inoculation on growth of wheat and tomato plants.

Four strains of *Azotobacter chroococcum* Beijerinck isolated from the soil of the farm of Faculty of Agriculture, Tripoli, were used for preparing the inoculum. Pure cultures of the strains were grown in screw cap bottles on nitrogen-free sucrose agar medium of the following composition: K_2HPO_4 0.5 g, $MgSO_4 \cdot 7H_2O$ 0.2 g, NaCl 0.2 g, $CaCl_2 \cdot 2H_2O$ 0.1 g, $NaMoO_4 \cdot 2H_2O$ 0.01 g, $MnSO_4 \cdot 4H_2O$ trace, $FeCl_3$ trace, sucrose 10 g, Agar 20 g, dist. water 1,000 ml.

After 10 days incubation at 30°C the surface growth formed was harvested by washing with sterile water and shaken to form a milky suspension of the azotobacter cells and cysts. Equal volumes of the suspensions of the four *Azotobacter* strains, adjusted to the same optical density, were mixed together to prepare the inoculum used.

The experiments were conducted under greenhouse conditions in pots each containing 2 kg soil. The sandy soil used had a pH of 8.1 and contained 24.8% $CaCO_3$ and 0.5% organic matter. Before planting, 3 g of superphosphate (20% P_2O_5) were added to each pot and mixed thoroughly with the soil. One transplant of tomato (cultivar Homstead 24) or twenty seeds of wheat (cultivar Sidi El-Mesri 1) were planted in each pot. Azotobacter inoculation was made at the time of planting by pipetting one drop of inoculum on each seed of wheat or one ml per tomato transplant added directly to the roots before covering with the soil. Plants from uninoculated pots served as check (control). Five replicates were planted from each treatment in case of wheat and 8 replicates in case of tomato.

After 5 weeks of growth, during which the pots were irrigated only with tap water, the plants were washed out with their roots, and length, fresh and dry weight of the plants of each pot were determined. The results obtained are presented in Tables 1 and 2.

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Table 1 Effect of seed inoculation with *Azotobacter chroococcum* on growth of wheat plants.

Treatment	Mean length of plants cm	Mean fresh wt. of plants g	Mean dry wt. of plants/pot g
Uninoculated (control)	18.5	1.94	0.21
Inoculated	24.5	2.65	0.40
L.S.D. at 5% level	2.08	0.325	0.113
L.S.D. at 1% level	2.99	0.468	0.162

Table 2 Effect of root inoculation of tomato transplants with *Azotobacter chroococcum* on growth of the plants.*

Treatment	The increase in length of plant at end of expt. cm	Fresh wt. of plant g	Dry wt. of plant g
Uninoculated (control)	43.2	61.5	6.2
Inoculated	35.7	56.5	7.0
L.S.D. at 5% level	n.s.	n.s.	n.s.

*Each value is an average of 8 replicates.



Fig. 1. Wheat plants from seeds uninoculated and inoculated with *Azotobacter chroococcum* strains, at the age of 5 weeks.

Wheat Plants

Azotobacter inoculation of wheat had highly significant effects on length, fresh, and dry weights of the plants. The mean increases in these growth measurements of inoculated plants over the control amounted to 24, 36 and 100%, respectively. The inoculated plants also showed improved root growth compared with the control plants. Figure 1 shows the differences in plant growth of two uninoculated and two inoculated replicates at the age of 5 weeks.

Improvement in wheat growth by *Azotobacter* inoculation was reported by Rovira (7), and significant increases in yield of wheat were also obtained by Brown *et al.* (2) in pot and field experiments.

Tomato Plants

Root inoculation of tomato plants at the time of transplanting did not significantly affect plant growth. Probably, the response to azotobacter inoculation may occur at the early stages of plant development (5). Clark (4) and Rovira (7) showed that inoculated *Azotobacter* strains were not established in the rhizosphere of tomato plants.

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