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Efficacy of Region Specific *Azotobacter* Strain on Vegetative Growth and Yield of *Solanum melongena*, *Lycopersicon esculentum* and *Capsicum annum*

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Effect of *Azotobacter* inoculation on vegetative growth and yield of three different vegetable crops viz. *Solanum melongena*, *Lycopersicon esculentum* and *Capsicum annum* was investigated. Inoculation of region specific *Azotobacter* strains increased the biomass, height of plant, leaf number, and flower number of the three crops. The yield of *L. esculentum*, *S. melongena* and *C. annum* due to the *Azotobacter* application was higher by 17%, 23.7% and 28.8% respectively over control.

Key words: *Azotobacter*, region specific, *Solanum melongena*, *Lycopersicon esculentum*, *Capsicum annum*, growth, yield.

Imprudent use of chemical fertilizers and pesticides has resulted in the deterioration of the soil health and also caused harmful effects on living organisms. Hence such agroinputs are neither economically feasible nor environmentally desirable on a long term basis (Mishra *et al*., 2006). So the improvement of the crop yield by inoculation with diazotrophs like *Azotobacter*, *Rhizobium*, *Azospirillum* has been suggested as a ecofriendly technology[1]. Reports have shown that these diazotrophs can decrease the use of urea nitrogen, and reduce the environmental problems to a considerable extent[2]. In agriculture one of the limiting factor is providing plant nutrients, particularly nitrogen and phosphorous. In the rhizosphere, a group of plant beneficial bacteria referred to as plant growth promoting rhizobacteria are constantly occurring in good soil and have been proven beneficial to plants[3].

Azotobacter is a free-living, gram negative, aerobic diazotroph found in soil. Increasing number of reports has showed that the *Azotobacter* act as PGPR and helps in plant growth and contributing fixed nitrogen fixation to soil[4]. Besides nitrogen fixation *Azotobacter* has been reported to synthesize anti-fungal substances that inhibit the growth of soil borne plant pathogens[5]. The present work was undertaken to find out the effect of inoculation of region specific *Azotobacter* on the vegetative growth and yield of three different important vegetable crops e.g. *Solanum melongena*, *Lycopersicon esculentum* and *Capsicum annum*.

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MATERIAL AND METHODS

Isolation of *Azotobacter* sp. from rhizosphere

Five strains of *Azotobacter* were isolated from different cultivated lands in southern region of Orissa. Samples were collected from adhering soils of uprooted plants and used for isolation of strains through serial dilution and plating techniques[6], using the *Azotobacter* isolation media containing Sucrose-20.0 (g/l), K_2HPO_4-1.0 (g/l), $MgSO_4.7H_2O$-0.5 (g/l), Na_2MoO_4-0.001 (g/l), $FeSO_4$. $7H_2O$-0.01(g/l) and $CaCo_3$- 2.0 (g/l), pH 7.0-7.2. The cultures were incubated at 30^0C for 4-5 days. Totally 5 *Azotobacter* strains were isolated and all of them grew well in nitrogen free agar medium at 28°C. The colonies produced were white, translucent, circular shape basing on higher growth rate and tolerance to different environmental variables one strain of *Azotobacter* (UU AZ-1) was selected for use as biofertilizer.

The *Azotobacter* was transferred to 100 ml conical flask containing sterile liquid medium and grown for 5-7 days. This starter culture was inoculated into a 500ml flask with the bacterial suspension 10^5 C.F.U/ml and grown in rotary shaker at 120 rpm for 5 days at 30°C. For field experiments 20 days old healthy seedlings of *S. melongena*, *L. esculentum* and *C. annum* were taken and the roots were dipped in bacterial culture suspension for 20-30 min for proper attachment of microbes and then planted in a 3'dia, 10" high circular cemented pots containing non sterile garden soil for the experiments (Plate-1, Fig. A-F). The controls were treated with normal water. The experiments were conducted during May to August 2007. Height of plant, leaf number, flower number, fruit number, fruit weight/plant and total yield/pot were recorded. Taking into account of the area coverage per circular pit, total harvest of fruit per acre were calculated and presented in the text. Values represent mean of 10 determinations ± SD.

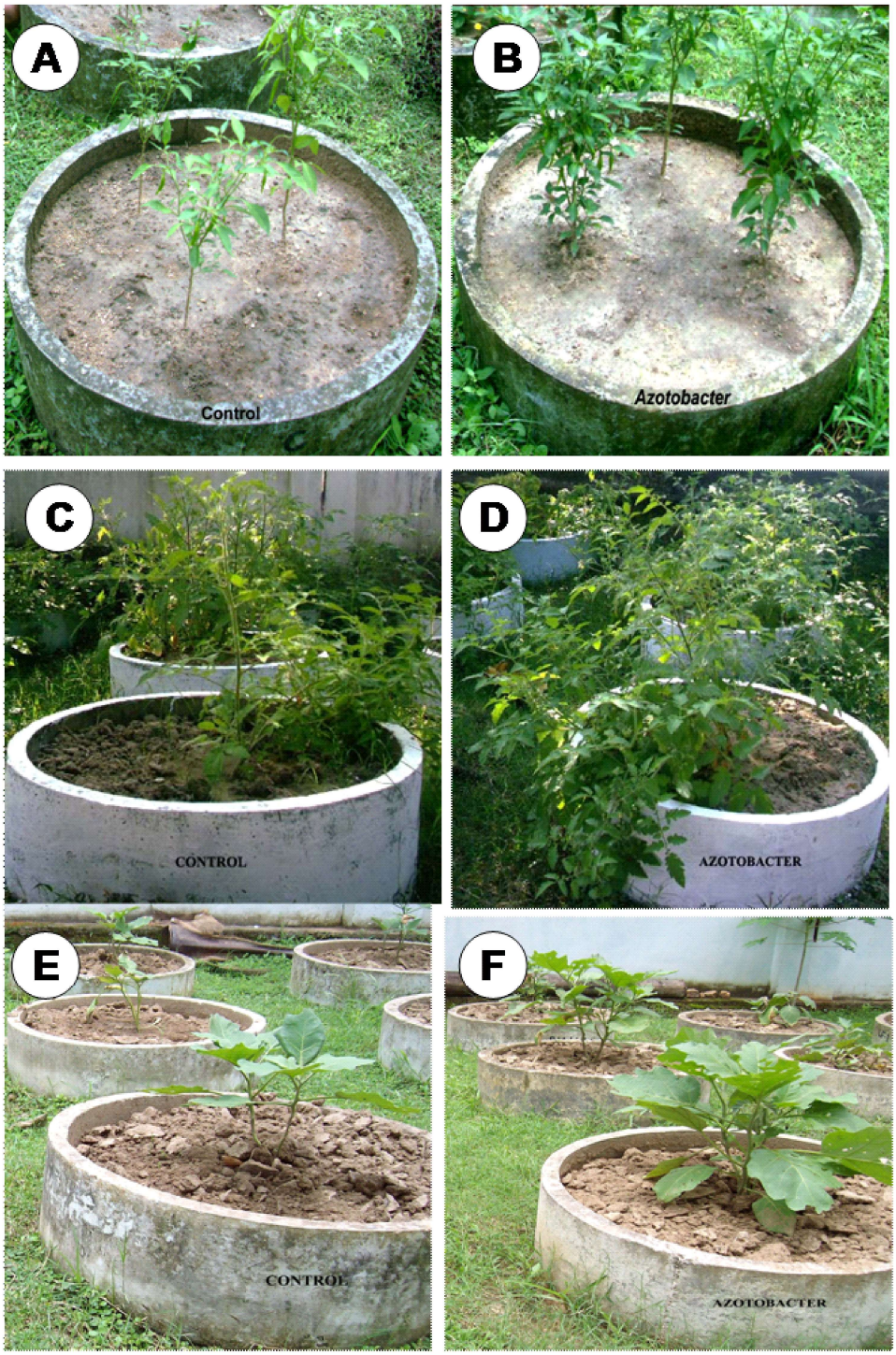
RESULTS AND DISCUSSION

Azotobacter (strain UUAZ-1) applied as root treatment to *Solanum melongena*, *Lycopersicon esculentum* and *Capsicum annum* showed a positive influence on the vegetative growth as well as the yield of the all the three vegetable crops. Visual appearance of the control and Azotobacter treated plants of the experimental

Table 1. Effect of *Azotobacter* sp. on vegetative growth and yield of *Solanum melongena*

	Days after Planting					
	30		60		90	
Parameters	Control	Treated	Control	Treated	Control	Treated
Height of plant (cm)	47±8.6	62±8.6 (31)	62±9.9	76±11.6 (22)	89±8.8	103±9.9 (16)
Leaf number	7±0.9	9±1.0 (28)	22±2.7	30±4.8 (36)	49±6.6	52±8.7 (7)
Flower number	2±0.6	5±1.1 (150)	9±1.1	13±1.0 (44)	16±2.2	22±2.7 (37)
Fruit number			6±0.6	11±1.1 (133)	11±1.7	17±2.4 (57)
Fruit wt./plant (g)			84±12.9	109±13.6 (30)	325±20.8	440±28.8 (36)
Total yield/pot (kg)					0.97±0.12	1.2±0.09 (24)
Total yield/acre (kg)					5980.0	7398.7 (24)

Values in parenthesis indicate percent increase over control
Date of Experiment: 08-05-2007 to 08-08-2007



C. annum: A- Control, B- Azotobacter treated
L. esculentum: C- Control, D- *Azotobacter* treated
S. melongena: E- Control, F- *Azotobacter* treated

Plate 1. Photographs showing Control and *Azotobacter* treated *Capsicum annum, Lycopersicon esculentum* and *Solanum melongena*

Table 2. Effect of *Azotobacter* sp. on vegetative growth and yield of *Lycopersicon esculentum*

	Days after Planting									
	20		40		60		80		100	
Parameters	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated
Height of Plant (cm)	32±2.8	42±2.9 (31)	46±6.6	55±6.2 (19)	100±8.9	122±11.2 (22)	133±11.6	152±12.4 (14)	134±9.8	169±11.2 (26)
Leaf Number	24±1.4	38±3.8 (58)	40±3.3	70±8.6 (75)	109±9.2	125±9.8 (14)	139±13.2	152±12.4 (10)	139±9.6	158±13.4 (13)
Flower Number		1±0.2	3±0.4	5±0.2	22±2.1	28±6.2 (27)	24±1.4	30±4.8	6±0.2	6±0.4 (25)
Fruit Number/Plant				2±0.3	5±0.4	10±1.2	11±0.6	16±3.2	14±1.4	18±1.9 (28)
Fruit wt./plant					81±7.2	101±8.1	141±7.9	171±9.4 (17)	241±12.6	281±13.3 (14)
Total yield/pot									721±22.3	841±19.9 (17)
Total yield/acre									4441.8	5182.8 (17)

Values parenthesis indicate percent increase over control

Table 3. Effect of *Azotobacter* sp. on vegetative growth and yield of *Capsicum annum*

	Days after Planting									
	20		40		60		80		100	
Parameters	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated
Height of Plant (cm)	16±1.2	19±2.8 (18)	22.3±4.4	30.4±6.8 (36)	45.5±8.0	51.5±8.6 (13)	68.6±6.9	73.7±5.68 (7)	0.8±12.6	87.5±9.8 (8)
Leaf Number	12±1.5	18±2.4 (50)	25±3.5	34±6.7 (36)	81±8.6	97±8.5 (19)	92±10.5	118±15.2 (28)	148±20.2	193±25.2 (30)
Branch Number	4±0.9	6±1.0 (50)	12±1.2	13±1.4 (18)	15±1.8	21±1.3 (40)	26±2.4	32±7.2 (23)	36±3.9	53±3.6 (47)
Flower number					5±0.9	6±1.0 (20)	19±3.2	20±2.1 (5)	12±3.2	18±2.9 (50)
Fruit number					2±0.3 (150)	5±0.4	9±1.2	15±1.6 (66)	22±6.2	26±6.9 (18)
Shoot weight (dry, g)									25±7.8	35±7.7 (40)
Root weight (dry, g)									3.8±1.1	5.4±1.4 (42)
Shoot wt/Root wt									6.6	6.4 (-3.2)
Fruit wt/plant (g)									16±2.8	39±4.6 (143.7)
Total yield/pot (g)									45	58 (28.8)
Total yield/acre (kg)									278	358 (28.8)

Values parenthesis indicate percent increase (+) or decrease (-) over control

crops depicted in Plate 1, Fig. A-F showed positive influence of the microbial inoculants for their growth. Upon treatment with *Azotobacter* it increased the biomass, height, number of leaf, number of flower, fruit number and fruit weight per plant over control (Table 1-3). Similarly yield was 17 and 24% higher over control in case of *L. esculentum* and *S. melongena* after 90 days and 28.8% yield was recorded in 100 days in *C. annum* with *Azotobacter* treatment. The results are in agreement with the earlier reports of[7]. It has also been reported that *Azotobacter* is capable of stimulating plant growth and yield by production of hormones, nitrogen fixation and phosphate mobilization[8]. Hence all these attributes might have contributed to enhancement of productivity of tested crops due to *Azotobacter* biofertilizer application as seedling treatment.

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