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EFFECT OF *AZOTOBACTER* AND PHOSPHATE SOLUBILIZING BACTERIA ON YIELD AND QUALITY PARAMETERS OF WATERMELON

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Abstract– In the present study, eight *Azotobacter* and six phosphate solubilizing bacteria (PSB) isolates were isolated rhizosphere soils of Watermelon from different parts of Kolhapur District and efficient isolate of *Azotobacter* and PSB were tested in field condition. From experimental data it was found that, the treatment comprising, 100% RDF + efficient isolate of *Azotobacter* + efficient isolate of PSB showed the highest average length of fruit (26.77 cm), highest average fruit weight (2.40 kg), highest number of fruits per plant (2.24), minimum days required for first harvest of fruit of watermelon (76.97 days), minimum days for total harvest of fruit of watermelon (91.12 days), highest yield of fruits per plant (5.37 kg/plant), highest average yield of fruit per ha (53.66 t/ha) and highest available N (332.00 Kg/ha), P (33.56 Kg/ha) and K (309.74 Kg/ha) in soil after harvest as compared to the rest of the treatments. Similar trend of result was observed in case of quality parameter, i.e. high percent of TSS (10.30^{0}Brix) as compared to other treatments.

INTRODUCTION

Watermelon (*Citrullus lanatus*), which belongs to the cucurbitaceae family, is an essential warm season vegetable crop that cultivated all over the plains of India. Watermelon is planted for its delicious, juicy fruits, which are typically eaten as dessert in the summer. Watermelon, known by several other names, such as Tarbuj, Kalingad, Kalindi, Matira or Kaniphal, Manthan, Thannir, and Palampanna. This crop is important because it is rich in water, which helps prevent dehydration during droughts, aids in food digestion, and can be used in salads (Sabo *et al*., 2013). Nutrient management is one of the most important factors to improve the productivity of watermelon. The continuous utilization of chemical fertilizers in recent years has severely damaged soil health. Chemical fertilizers cause the degradation of the soil's physical, chemical, and biological properties that's leads to a significant drop in the yield. The solution to these problems can be found in the use of biofertilizer, which are economically rewarding and do not have a negative impact on the environment (Abbas *et al*., 2006). Biofertilizer have been recognized as a suitable alternative to chemical fertilizer, enhancing soil fertility, supplying plant nutrients, and increasing crop production (Khalifa *et al*., 2013 and Saeed *et al*., 2015). *Azotobacter* is a genus of bacteria that are aerobic, free living, gram negative, motile which can fix an average 20 kg N/ha/year. *Azotobacter* also produces biologically active compounds such as phytohormones like auxins thereby stimulating plant growth (Oblisami *et al*., 2005). Phosphate solubilizing bacteria is Gram-negative bacteria. Phosphate solubilizing bacteria (PSB**)** are beneficial bacteria capable of solubilizing inorganic phosphorus from insoluble compounds. Solubilization ability of rhizosphere microorganisms is considered to be one of the important traits associated with plant phosphate nutrition. Nitrogen fixing and phosphate solubilizing bacteria are main biofertilizers for horticultural crops. They promote plant growth by enhancing biotic, abiotic, & plant stress tolerance as well as plant nutrition by fixing atmospheric nitrogen and resolving soil nutrient (Afzal and Bano, 2008). Keeping in this view the present investigation was undertaken to find out effect of *Azotobacter* and phosphate solubilizing bacteria on yield and quality parameters of watermelon.

MATERIALS AND METHODS

The experiment was undertaken at Plant Pathology Section, RCSM College of Agriculture, Kolhapur and on the experimental farm of Regional Sugarcane and Jaggery Research Station, Kolhapur, during the year 2022-2023. Eight isolates of *Azotobacter* and six PSB were isolated from watermelon rhizosphere of Kolhapur District. All isolates were identified on the basis of morphological (gram staining, cell shape, cell arrangement, stain colour, motility test, KOH test), microscopic observations and different biochemical tests viz. methyl red test, catalase test, starch hydrolysis, geletinehydrolyase, H_2S production, oxidase test, N fixing and P solubilizing ability respectively. On the basis of N fixing ability, the most effective strains of *Azotobacter* were designated as (Azob-1) and in case of PSB, on the basis of maximum solubilization index most effective strains of PSB was designated as (PSB-1) were selected for the field studies. The experiment was laid out in RBD with three replications and twelve treatments (Table 1). The watermelon seedlings of variety Melody required for field experiment were raised in Horticulture nursery, Department of Horticulture, RCSM, College of Agriculture, Kolhapur. 25 days old seedlings were used to transplanting these seedlings were treated with *Azotobacter* and Phosphate solubilizing bacterial inoculums using seedling root dip method. As per the plan of layout treated seedlings transplanted in respective plots. Data are recorded and analyzed statistically to express the yield.

RESULTS AND DISCUSSION

The experimental results (Table 1) revealed that, yield and quality parameters of watermelon significantly increased when seedlings were treated with *Azotobacter* and phosphate solubilizing bacteria as compared to single inoculation and uninoculated control. The results concerned with yield parameters revealed that, the plants inoculated with treatment T_{10}, 100% RDF + Efficient isolate of *Azotobacter* + Efficient isolate of PSB showed the highest average length of fruit (26.77 cm), average fruit weight (2.40 kg), number of fruits per plant (2.24), yield of fruits per plant (5.37 kg/plant) and average yield of fruit per ha (53.66 t/ha) which was found at par with treatment T_9, 75% RDF of N & P + 100% RDF of K + efficient isolate of *Azotobacter* + efficient isolate of PSB showed the average length of fruit (26.00 cm), average fruit weight (2.34 kg), number of fruits per plant (2.21), yield of fruits per plant (5.17 kg/plant) and average yield of fruit per ha (51.71 t/ha), T_4, 100% RDF + efficient isolate of *Azotobacter* showed the average length of fruit (25.00 cm), average fruit weight (2.31 kg), number of fruits per plant (2.13), yield of fruits per plant (5.01 kg/plant) and average yield of fruit per ha (50.08 t/ha) and T_7, 100% RDF + efficient isolate of PSB showed the average length of fruit (24.19 cm), average fruit weight (2.26 kg), number of fruits per plant (2.14), yield of fruits per plant (4.84 kg/plant) and average yield of fruit per ha (48.41 t/ha). The minimum average length of fruit (17.42 cm), average fruit weight (1.68 kg), number of fruits per plant (1.17), yield of fruits per plant (1.97 kg/plant) and average yield of fruit per ha (19.77 t/ha) was appeared in the treatment T_{12}, absolute control. Similar results were found by Kharat *et al*., (2021) in watermelon, Prasad *et al*., (2009) and Dudhat*et al*., (2020) in bitter gourd. Days required for 1st harvest of fruits of watermelon (76.97 days) was found significantly less under the treatment T_{10}, 100% RDF + efficient isolate of *Azotobacter* + efficient isolate of PSB. However, days required for 1st harvest of fruit of watermelon (90.16 days) were found significantly high in the treatment T_{12}, which was uninoculated. Similarly, days required for total fruit harvesting of watermelon (91.12 days) was found significantly low under the treatment T_{10}, 100% RDF + efficient isolate of *Azotobacter* + efficient isolate of PSB. However, days required for total fruit harvesting of watermelon (108.55 days) were found significantly high in the treatment T_{12}, absolute control. Early fruit harvesting is due to biofertilizers enhancing the production of growth substances like gibberellic acid, indole acetic acid, dihydrozeatin which had positive influence on the physiological activity of plants. Similar results were found by Kharat *et al*., (2021) in watermelon. The maximum available N after harvesting of watermelon (332.00 Kg/ha) was recorded in soil collected in the treatment T_{10}, which was found statistically at par with the treatment T_9, (329.00 Kg/ha), T_4,(327.00 Kg/ha), T_7 (324.00 Kg/ha) and T_{11}, (323.00 Kg/ha). The lowest available N was recorded in the treatment T_{12} to the tune of 299.01 Kg/ha. The maximum available P in soil after harvesting of watermelon was observed in the treatment T_{10}, (33.56 Kg/ha) which was found statistically at par with the treatment T_9, (32.40 Kg/ha), T_7, (31.20 Kg/ha), T_4, (30.13 Kg/ha) and T_{11}, Control (29.27 Kg/ha). The lowest available P was recorded in treatment

Table 1. Effect of *Azotobacter* and Phosphate Solubilizing Bacteria on yield and quality of watermelon

Tr. No.	Treatment Details	Average length of fruit (cm)	Average fruit weight (kg)	Number of fruits per plant (Kg)	Yield of fruits per plant (Kg)	Average yield of fruit per (t /ha)	No. of days required to initiate first fruit harvest	No. of days required for total fruit harvesting	TSS (° Brix)
T_1	*Azotobacter* + PSB	19.00	1.85	1.37	2.55	25.36	84.44	99.00	8.91
T_2	50 % N + RDF of P & K + Efficient isolate of *Azotobacter*	21.00	1.96	1.65	3.24	32.38	81.57	96.60	9.12
T_3	75 % N + RDF of P & K + Efficient isolate of *Azotobacter*	23.79	2.04	1.84	3.76	37.64	80.00	95.10	9.65
T_4	100 % RDF + Efficient isolate of *Azotobacter*	25.00	2.31	2.13	5.01	50.08	79.50	94.52	10.09
T_5	50 % P + 100% RDF of N & K + Efficient isolate of PSB	20.10	1.94	1.63	3.15	31.53	81.76	96.81	9.26
T_6	75 % P+ 100% RDF of N & K + Efficient isolate PSB	22.60	2.02	1.73	3.50	35.05	80.60	95.66	9.47
T_7	100 % RDF + Efficient isolate of PSB	24.19	2.26	2.14	4.84	48.41	79.00	94.05	10.02
T_8	50% RDF of N & P + 100% RDF of K + Efficient isolate of *Azotobacter* + Efficient isolate of PSB	21.90	2.00	1.67	3.34	33.40	81.00	96.12	9.32
T_9	75% RDF of N & P + 100% RDF of K + Efficient isolate of *Azotobacter* + Efficient isolate of PSB	26.00	2.34	2.21	5.17	51.71	78.68	93.72	10.25
T_{10}	100% RDF + Efficient isolate of *Azotobacter* + Efficient isolate of PSB	26.77	2.40	2.24	5.37	53.66	76.97	91.12	10.30
T_{11}	RDF (Control)	23.39	2.11	2.03	4.29	42.89	79.80	94.84	9.80
T_{12}	Absolute control	17.42	1.68	1.17	1.97	19.77	90.16	108.55	8.30
	S.E.±	0.87	0.09	0.09	0.14	1.56	1.93	2.84	0.15
	C.D. at 5%	2.58	1.85	0.28	0.43	4.60	5.69	8.8.35	0.46

Table 2. Effect of efficient Azotobacter and phosphate solubilizing bacteria on available NPK in soil after harvest

Tr. No.	Treatment Details	Available N (Kg/ha)	Available P (Kg/ha)	Available K (Kg/ha)
T_1	*Azotobacter* + PSB	309.00	21.67	292.72
T_2	50 % N + RDF of P & K + Efficient isolate of *Azotobacter*	314.00	24.92	307.20
T_3	75 % N + RDF of P & K + Efficient isolate of *Azotobacter*	321.00	27.40	307.60
T_4	100 % RDF + Efficient isolate of *Azotobacter*	327.00	30.13	309.40
T_5	50 % P + 100% RDF of N & K + Efficient isolate of PSB	312.00	25.59	307.98
T_6	75 % P+ 100% RDF of N & K + Efficient isolate of PSB	319.00	28.20	308.06
T_7	100 % RDF + Efficient isolate of PSB	324.00	31.20	308.30
T_8	50% RDF of N & P + 100% RDF of K + Efficient isolate of *Azotobacter* + Efficient isolate of PSB	316.00	26.80	307.65
T_9	75% RDF of N & P + 100% RDF of K + Efficient isolate of *Azotobacter* + Efficient isolate of PSB	329.00	32.40	309.17
T_{10}	100% RDF + Efficient isolate of *Azotobacter* + Efficient isolate of PSB	332.00	33.56	309.74
T_{11}	RDF (Control)	323.00	29.27	306.22
T_{12}	Absolute control	299.01	20.86	291.00
	S.E.±	3.56	1.63	8.10
	C.D. at 5%	10.47	4.79	NS

T_{12}, (20.86 Kg/ha). From the data regarding available potassium found that, there was no significant impact on change in available potassium in soil treated with *Azotobacter* and PSB (Table 2).

Similar trend of result was observed in case of quality parameters. Data on quality parameters revealed that, the plants inoculated with treatment T_{10}, 100% RDF + Efficient isolate of *Azotobacter* + Efficient isolate of PSB showed the highest percent of TSS (10.30 ^{0}Brix) which was found at par with treatment T_9, 75% RDF of N & P + 100% RDF of K + efficient isolate of *Azotobacter* + efficient isolate of PSB showed TSS (10.25 ^{0}Brix), T_4, 100% RDF + efficient isolate of *Azotobacter* showed (10.09 ^{0}Brix) and T_7, 100% RDF + efficient isolate of PSB showed (10.02 ^{0}Brix). The lowest Percent of TSS recorded in treatment T_{12}, absolute control (8.30 ^{0}Brix). The integrated application of biofertilizers and inorganic fertilizers may have contributed to improved absorption of major nutrients, including micronutrients, and may have explained the increase in ascorbic acid, TSS, and protein content of fruit in these treatments. Similar results were found by Thriveni *et al.*, (2015) in bitter gourd, Niharika *et al.*, (2023) in Sponge gourd.

CONCLUSION

The results indicate that the treatment T_{10}, 100% RDF + efficient isolate of *Azotobacter* + efficient isolate of PSB showed highest yield parameters and available N, P, K in soil after harvest. The combined application of *Azotobacte*r and Phosphate solubilizing bacteria along with recommended dose of fertilizer leads to significant increase in yield and quality parameters of watermelon. The combined use of *Azotobacter* and phosphate solubilizing bacteria had better effect on yield and quality parameters of watermelon than single.

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Conflict of Interest

None

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