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Potential Effect of Zinc Solubilizing Bacteria on Yield of Onion (*Allium cepa* L.)

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ABSTRACT

Onion (*Allium cepa* L.) is an important bulbous crop cultivated extensively in world belonging to *Alliceae* family and used as important commercial vegetable cum condiment crop. In the present study, six isolates of zinc solubilizing bacteria were isolated from rhizosphere region of onion in Kolhapur District. Two efficient isolates of zinc solubilizing bacteria were identified on the basis of morphological, cultural, microscopic studies and biochemical analysis as *Psuedomonas* sp. and *Bacillus* sp. The results of the yield parameter revealed that, treatment T_{10}, RDF + 100% Rec. dose of zinc + commercial strain of ZSB showed highest yield (312 Q/ha) which was at par with the treatment T_7, RDF + 100% Rec. dose of zinc + ZSB2 has (307 Q/ha), T_4, RDF + 100% Rec. dose of zinc + ZSB1 *i.e.* (303 Q/ha), T_{11}, RDF +75% Rec. dose of zinc+ commercial strain of ZSB *i.e.* (300 Q/ha), T_8, RDF + 75% Rec. dose of zinc + ZSB2 *i.e.* (291 q/ha) and T_5, RDF + 75% Rec. dose of zinc + ZSB1 (289 q/ha) respectively. The treatment T_{10}, RDF +100% Rec. dose of zinc+ commercial strain of ZSB showed maximum plant height (48.97 cm), stem girth (3.90 cm), number of leaves (9.93), diameter of bulb (6.27 cm) at 90 DAT. The treatment T_7, RDF +100% Rec. dose of zinc +ZSB2 *i.e.* plant height (47.23 cm), stem girth (3.84 cm), number of leaves (9.72), diameter of bulb (6.19 cm) which was on par with treatment T_4, RDF +100% Rec. dose of zinc +ZSB1 *i.e.* plant height (47.12 cm), stem girth (3.65 cm), number of leaves (9.49), diameter of bulb (6.04 cm), T_{11}, RDF +75% Rec. dose of zinc+ commercial strain of ZSB, i.e. plant height (46.73 cm), stem girth (3.53cm), number of leaves (9.38), diameter of bulb (5.93 cm), T_8, RDF +75% Rec. dose of zinc +ZSB2 *i.e.* plant height (45.33 cm), stem girth (3.41cm), number of leaves (9.26), diameter of bulb (5.84 cm) and T_5, RDF +75% Rec. dose of zinc +ZSB1 *i.e.* plant height (44.94 cm), stem girth (3.34cm), number of leaves (9.14), diameter of bulb (5.72 cm)

Key words: *Zinc solubilizing bacteria, Onion*

Introduction

Onion (*Allium cepa* L.) is one of the most important commercial bulbous crops cultivated extensively in world and belonging to *Alliceae* family. Origin of onion is Central Asia. Onion contributes additional nutritional value to the human diet and has medicinal properties. It is primarily consumed for its unique flavour that enhance the flavour of other food (Randle, 2000). It is rich source of vitamin C and E and it has medicinal value also (Kumar *et al.*,2010; Bosekeng, 2012). The mature bulbs contains some starch, appreciable quantities of sugar, protein, vitamins A, B and C (Jilani *et al.*, 2010). The modern day intensive crop cultivation requires the use of chemical fertilizer. Use of inorganic fertilizers increases the cost of cultivation that is not affordable for the small and marginal farmers and it also de-

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creased over all the soil fertility causing pollution. Biofertilizers are microorganisms that originates either from root nodules or rhizosphere of the soil and enriches the soil by enhancing the availability of the nutrients to crops also reduces the dose of chemical fertilizers. As a result, an appropriate use of biofertilizer and chemical resource of the input is required to achieve soil fertility and crop quality. Keeping in this view, the present investigation was undertaken to find out the effect of zinc solubilizing bacteria on growth and yield of onion.

Materials and Method

The research was conducted at Plant Pathology and Agricultural Microbiology Section, Rajarshee Chhatrapati Shahu Maharaj College of Agriculture, Kolhapur, during 2022-23. Twenty-three rhizospheric soil samples were collected from different tehsils of Kolhapur District. Out of these, six isolates of zinc solubilizing bacteria were isolated by serial dilution and plating method on Kings B medium. They were identified, screened and selected efficient isolates on the basis of morphological and cultural characteristics (colour and shape), biochemical characterization (catalase, starch hydrolysis, gelatin liquefaction, acid production from carbohydrate, methyl red and H_2S production test). Cultural studies were carried out on Kings B media containing ZnO and $ZnCO_3$, Rovira and Bunt media containing ZnO and $ZnCO_3$ and Nutrient Agar media containing ZnO and ZnCO3. The efficient isolates of zinc solubilizing bacteria were selected for field studies. The experiment was laid out in Randomized Block Design with three replications and thirteen treatments. Seeds of N-2-4-1 were sown on raised beds and seedlings were grown. Roots of healthy seedlings of onion were treated for half an hour by using seedling root deep method. As per the plan of layout treated seedlings are transplanted in respective plots. Data was recorded and analyzed statistically to express the yield.

Results and Discussion

The experimental results (Table 1) revealed a number of features on growth, yield attributing parameters. The data represented in Table 1 specified that the seed germination, plant height, number of leaves, stem girth, diameter of bulb, yield per plot and yield per hectare were significantly increased when seedlings were treated with zinc solubilizing bacteria as compare to uninoculated control.

Per cent germination

The treatment T_{10}, RDF + 100% Rec. dose of zinc + commercial strain of ZSB showed highest (89.43%) germination, followed by treatment T_7 (87.27%), T_4 (84.39%), T_{11}, (83.36%), T_8 (82.6%) and T_5 (81.76%) and found statistically at par with treatment T_{10}. However, the remaining treatments ranging from 70.26% to 78.55%. Minimum germination was ob-

Table 1. Effect of isolates of Zinc solubilizing bacteria on various growth and yield parameters

Tr. No.	Germination %	Plant height (cm)	Stem girth (cm)	Number of leaves	Diameter of bulb (cm)	Yield per plot (Kg)	Yield per Ha (qtls)
T1	78.55	40.22	2.74	8.00	5.43	11.19	279
T2	74.85	38.45	2.27	7.40	5.15	11.00	238
T3	73.67	37.07	2.23	6.73	5.02	10.80	234
T4	84.39	47.12	3.65	9.49	6.04	11.94	303
T5	81.76	44.94	3.34	9.14	5.72	11.44	289
T6	74.47	40.73	2.38	7.80	5.48	10.88	264
T7	87.27	47.23	3.84	9.72	6.19	12.17	307
T8	82.61	45.33	3.41	9.26	5.84	11.58	291
T9	76.27	41.07	2.85	7.80	5.71	11.20	267
T10	89.43	48.97	3.90	9.93	6.27	12.48	312
T11	83.36	46.73	3.53	9.38	5.93	11.67	300
T12	77.47	41.74	3.15	8.13	5.43	11.40	264
T13	70.26	25.04	1.57	4.47	3.45	6.20	155
S.E. ±	2.79	1.38	0.19	0.26	0.19	0.36	8.56
C.D.5%	7.99	4.04	0.57	0.80	0.56	1.05	24.99

served in treatment T_{13}, absolute control (No RDF). The results are in conformity with Sirohi *et al*., (2015), Vachan *et al*., (2017) and Vidyashree *et al*., (2018).

Plant height

The treatment T_{10}, RDF +100% Rec. dose of zinc + commercial strain of ZSB showed highest plant height (48.97 cm) at 90 DAT followed by treatment T_7 (47.23 cm), T_4 (47.12 cm), T_{11} (46.73 cm), T_8 (45.33 cm) and T_5 (44.94 cm) were found statistically at par with treatment T_{10}. However, the remaining treatments ranging from 25.04 cm to 41.74 cm. Similar results were observed in plant height by Aye (2011), Shiferaw *et al*., (2013) and Vidyashree *et al.,* (2018).

Stem girth

Stem girth at 90 DAT, showed treatment T_{10}, RDF +100% Rec. dose of zinc + commercial strain of ZSB maximum (3.90 cm) stem girth followed by T_7 (3.84 cm), T_4 (3.65 cm), T_{11} (3.53 cm), T_8 (3.41 cm) and T_5 (3.34 cm) were found statistically at par with treatment T_{10}. However, the remaining treatments in range of 1.57 cm to 3.15 cm. Acharya *et al.,* (2015) and Shiferaw *et al*., (2013) had observed similar results.

Number of leaves

Number of leaves at 90 DAT, the results found that the treatment T_{10}, RDF +100% Rec. dose of zinc + commercial strain of ZSB with maximum (9.93) number of leaves followed by treatment T7 (9.72), T_4 (9.49), T_{11} (9.38), T_8 (9.26) and T_5 (9.14) were found to be statistically at par with treatment T_{10}. The results are in agreement with Acharya *et al.,* (2015) and Vachan *et al*., (2017).

Diameter of bulb

Treatment T_{10}, RDF +100% Rec. dose of zinc + commercial strain of ZSB, showed maximum (6.27 cm) diameter of bulb followed by T_7 (6.19 cm), T_4 (6.04 cm), T_{11} (5.93 cm), T_8 (5.84 cm) and T_5 (5.72 cm) were found to be statistically at par with treatment T_{10}. Similar results were obtained by Acharya *et al*., (2018) and Sharma *et al.*, (2018).

Yield per plot

The results showed that, the treatment T_{10}, RDF + 100% Rec. dose of zinc + commercial strain of ZSB with maximum yield per plot 12.48 Kg/plot followed by T_7, (12.17 kg/plot), T_4 (11.94 Kg/ha), T_{11} (11.67 Kg/ha), T_8 (11.58 Kg/ha) and T_5 (11.44 Kg/ha) and found to be statistically at par with treatment T_{10}.

Yield per hectare

In case of yield per hectare treatment T_{10}, RDF +100% Rec. dose of zinc + commercial strain of ZSB, showed the maximum (312 q/ha) yield followed by T_7 (307 q/ha), T_4 (303 q/ha), T_{11} (300 q/ha), T_8 (291 q/ha) and T_5 (289 q/ha) were found to be statistically at par with treatment T_{10}. Similar results were obtained by Vidyashree *et al*., (2018), Acharya *et al.,* (2015), Shakeel *et al*., (2023) and Janki and Velu (2010).

Availability of zinc

The results showed that the maximum availability of zinc was 0.78 ppm in treatment T_{10} with RDF of N, P and K along with 100% Rec. dose of zinc and commercial strain of ZSB followed by T_7 (0.76 ppm), T_4 (0.75 ppm), T_{11} (0.74 ppm), T_8 (0.73 ppm) and T_5 (0.73 ppm) were found statistically at par with treatment T_{10}.

Population dynamics

The results in the regards to population dynamics at initial indicated that, treatment T_{10}, RDF +100% Rec. dose of zinc + commercial strain of ZSB, showed the

Table 2. Effect of isolates of Zinc solubilizing bacteria on availability of zinc and population dynamics

Tr. No.	Available Zinc (ppm)	Population dynamics of Zinc solubilizing bacteria (CFU $\times 10^6$ g^{-1} soil)	
		30 DAT	Before harvesting
T_1	0.61	9.05	9.20
T_2	0.53	9.58	8.53
T_3	0.49	7.19	8.32
T_4	0.75	10.91	14.12
T_5	0.73	10.83	13.54
T_6	0.53	8.73	12.69
T_7	0.76	11.26	15.69
T_8	0.73	10.85	13.95
T_9	0.57	10.87	14.31
T_{10}	0.78	11.65	16.15
T_{11}	0.74	10.89	14.06
T_{12}	0.61	9.84	10.56
T_{13}	0.28	6.01	6.8
S.E. ±	0.018	0.29	0.39
C.D.5%	0.06	0.85	1.16

maximum (11.65 × 10^6 CFU g^{-1}) followed by T_7 (11.26× 10^6 CFU g^{-1}), T4 (10.91× 10^6 CFU g^{-1}), T_{11} (10.89× 10^6 CFU g^{-1}), T8 (10.85× 10^6 CFU g^{-1}) and T_5 (10.83 × 10^6 CFU g^{-1}) were found to be statistically at par with treatment T_{10}. After harvesting treatment T_{10} , RDF +100% Rec. dose of zinc + commercial strain of ZSB, showed the maximum (16.15 × 10^6 CFU g^{-1}) followed by T_7 (15.69× 10^6 CFU g^{-1}), T_4 (14.12× 10^6 CFU g^{-1}), T_{11}(14.06× 10^6 CFU g^{-1}), T_8 (13.91× 10^6 CFU g^{-1}), and T_5 (13.54× 10^6 CFU g^{-1}) were found to be statistically at par with treatment T_{10}.

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