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Effect of bio-fertilizers on growth, yield and quality of onion (*Allium cepa*)

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Abstract-
A field experiment was carried out during the winter season of two consecutive years 2006-07 and 2007-08 to study the effect of six combinations of bio-fertilizers and two chemical fertilizers on onion (Pusa variety). The treatments were *Azotobacter*+PSB, *Azotobacter*+VAM, *Azotobacter+Azospirillum*, *Azospirillum*+PSB, *Azospirrilum*+VAM, PSB+VAM, NPK 100%, NPK 50% and Control. The height of the plant was maximum (**40.43cm**) with the application of *Azotobacter*+VAM. Number of leaves, number of inflorescence / plot and bulb diameter were maximum of *Azotobacter+Azospirillum. Azotobacter+Azospirillum* and NPK 100% gave maximum length of bulbs (**6.23cm**). The maximum number of scale per bulb (**9.88**) was counted from NPK 50%. Hence, it is concluded that *Azotobacter+Azospirillum* combination is the better for onion growth as compared to other combination of biofertilisers. Due to this, here the sustainability in production and environmental consideration are concerned.

Key words: Azotobacter, Azospirillum, PSB, NPKand VAM.

Introduction

Onion is one of the important spice and vegetable crops used in cooking every day. Onion having an ability to possess stimulant, diuretic and expectorant properties. It is considered useful in flatulence and dysentery. India, the world's second largest producer of onion crop. The extra use of chemicals shows hazardous effects such as degradation of soil health, erosion of soil and loss of organic matter, nitrate pollution and hence it is health hazardous for human beings.

Azotobacter is heterotrophic and aerobic bacteria**.** It having the ability to fix nitrogen non-symbiotically. Owing to its ability to improve plant health through nitrogen fixation, growth hormone production, phosphate solubilisation, plant disease management and reclamation of better soil health (Sumbul et.al. 2020)

Azospirillum is a Gram-negative, microaerophilic, non-fermentative and nitrogen-fixing bacterial genus. It is a biofertilizer that contains *Azospirillum* bacteria which has the ability to colonize the plant roots and fixing atmospheric Nitrogen (Santos et.al. 2020).

Vesicular-arbuscular mycorrhiza (VAM) is formed by the symbiotic association between certain phycomycetous fungi and angiosperm roots. The fungus colonizes the root cortex forming a mycelial network and characteristic vesicles (bladder-like structures) and arbuscules (branched finger-like hyphae) (Sullia et.al., 1991)

Phosphate solubilizing bacteria (PSB) are a large micro flora that mediate bioavailable soil P. It play a critical role in soil by mineralizing organic P, solubilizing inorganic P minerals, and storing large amounts of P in biomass. The main contributors of plant nutrition in agriculture and play an important role in making soluble phosphorus available to plants (Khan et al., 2010).

For sustainable production and productivity and also maintaining quality, organic farming is the alternative for this. There are different research reports in this regard to find out the effect of bio-fertilizers on onion such as Yadav et al., (2004), Jha et al., (2006), Balemi et al., (2007). However, up to this day no systematic approaches so far been made to utilize the geo-ecological condition and also very little information is available about the organic cultivation of onion crop in our country. Hence, it was considered worthwhile to carry out the present investigation for studying on the growth, yield and quality of onion.

Materials and Methods

The present investigation was undertaken during the winter season (Rabbi) of two years regularly that is 2006-07 and 2007-08 in Ahmednagar Region for studying the effect of different combinations of bio-fertilizer on vegetative part of plant, yield and qualitative character of onion (*Allium cepa* L.). Used biofertilisers are *Azotobacter*, *Azospirillum*, Vesicular-arbuscular mycorrhiza (VAM), Phosphate solubilizing bacteria (PSB).

The soil of the experimental field was a sandy clay-loam texture, good water holding capacity and moderate soil fertility status. The treatments were *Azotobacter* + PSB, *Azotobacter* + VAM, *Azotobacter* + *Azospirillum*, *Azospirillum* +PSB, *Azospirillum* + VAM, PSB + VAM, NPK 100%, NPK 50% and Control. The nine treatments were

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replicated three times in randomized block design in 4.0 × 2.5 m plots.

Recommended dose (Singh, 1991) of Phosphorus and potash were applied at the time of transplanting. Half of nitrogen was applied as basal. Remaining half of N was applied 45 days after planting. Bio-fertilizer was applied, next days after transplanting @ 40g in each plot. Necessary irrigations were given.

Results

The pooled results indicated that, T2 (*Azotobacter* + VAM) has found to produce the highest plant height (**40.43 cm**) followed by T7 (NPK 100%). Results were in agreement with Mandhare et al., (1998). Schmitz et al., (1991) reported that the maximum plant height of onion was found through the application of VAM inoculation.

At 75 days of transplanting, T7 (NPK 100%) produced the maximum number of leaves (**6.25**) and the minimum (**4.88**) was counted from T3 (*Azotobacter* + *Azospirillum*) Maximum of (**7.87**) number of leaves was recorded from T3 (*Azotobacter* + *Azospirillum*) and the minimum of (**5.94**) in T4 (*Azospirillum* + PSB) at 180 days of sowing (**Table-1**).

In case of, bulb length the maximum number of **6.23 cm** was obtained from T7 (NPK 100%) and the minimum of **5.18 cm** from T9 (control) **(Table-2)**.

So far as the diameter of bulb is concerned T7 (NPK100%) performed the maximum of **13.83cm** and minimum of **10.87 cm** from T4 (*Azospirillum* + PSB) (**Table-2**).

Highest bulb weight of **65.35gm** was observed from T_7 (NPK 100%) and lowest of **38.29 gm** from T_4 (*Azospirillum* + PSB) (**Table-2**). These results may be due to the role of mineral fertilizers on promotion of onion plants growth and the role of biofertilizers on increasing the availability of nitrogen and phosphorus to onion plant absorption which 100% of NPK fertilizers. A Similar result of superiority of chemical fertilizer (NPK100%) was obtained by El Desuki *et al.*,(2006). Maximum scale no of **9.88** was found in T_8 (NPK 50%) and the minimum of **8.78** in T_4 (*Azospirilum* + PSB) (**Table-2**).

The superiority of the treatments T3 (*Azotobacter* + *Azospirillum*) and T7 (NPK100%) may be due to the role of nitrogen fertilizers and bio-fertilizers application on increasing the availability of nitrogen to onion plant. The higher bulb yield may be due to greater root proliferation, more uptakes of nutrients and water, more photosynthesis area and enhance food accumulation. Balemi et.al. (2007) also reported the efficiency of *Azotobacter* strains as a potential supplement to nitrogenous fertilizer in onion.

Observation Tables

Table 1: Effect of Bio-Fertilizers on Plant Height and Number of Leaves of Onion

Plant height(cm)												**No of Leaves per 3m^2 (Pooled)**						
Treatment		**75 DAS**			**105 DAS**			**180 DAS**			**75 DAS**			**105 DAS**			**180 DAS**	
	2006-07	**2007-08**	**Pooled**	**2006-07**	**2007-08**	**Pooled**	**2006-07**	**2007-08**	**Pooled**	**2006-07**	**2007-08**	**Pooled**	**2006-07**	**2007-08**	**Pooled**	**2006-07**	**2007-08**	**Pooled**
T_1	11.97	12.22	12.09	25.96	26.16	26.06	37.45	39.66	38.55	4.98	5.66	5.32	4.01	4.44	4.22	7.05	8.00	7.52
T_2	13.50	13.11	13.30	24.83	24.61	24.72	42.38	44.55	**40.43**	4.86	4.78	4.82	4.55	4.77	4.66	7.11	8.00	7.55
T_3	12.11	13.89	13.00	29.00	29.55	29.27	37.34	38.66	38.00	4.35	5.22	**4.81**	5.00	5.00	5.00	8.12	9.22	**7.87**
T_4	11.69	12.88	12.28	24.08	24.99	24.53	37.34	38.55	37.94	4.94	5.22	5.08	5.00	4.89	4.94	5.40	6.89	**5.94**
T_5	13.44	13.77	13.60	24.50	24.50	24.50	38.08	43.00	40.14	4.92	5.55	5.23	3.60	3.77	3.68	7.34	8.33	7.83
T_6	12.45	12.22	12.33	25.05	25.50	25.27	37.31	39.89	38.60	5.10	5.22	5.16	4.16	4.22	4.19	7.13	7.89	7.51
T_7	17.10	17.11	17.10	29.60	29.44	29.52	38.82	42.66	39.76	5.53	5.78	**6.25**	4.65	4.78	4.71	7.10	8.22	7.66

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T_8	15.26	15.55	15.40	27.01	27.55	27.28	37.93	41.88	39.90	4.84	5.11	4.97	4.25	4.22	4.23	7.00	7.44	7.22
T_9	12.95	13.00	12.97	24.81	24.72	24.76	37.76	39.33	38.54	4.90	4.89	4.89	4.25	4.33	4.29	6.91	8.44	7.67

Table 2: Effect of Bio-Fertilizers on Yield and Yield Attributing Characters of Onion

	Scale (in number)			**Weight of Bulb (gm)**			**Yield (Q/ha)**			**Bulb length (cm)**			**Diameter of Bulb(cm)**		
Treatment	**2006-07**	**2007-08**	**Pooled**	**2006-07**	**2007-08**	**Pooled**	**2006-07**	**2007-08**	**Pooled**	**2006-07**	**2007-08**	**Pooled**	**2006-07**	**2007-08**	**Pooled**
T_1	9.15	9.96	9.55	52.58	52.58	52.58	169.24	175.27	172.25	5.60	5.72	5.66	13.69	13.74	13.71
T_2	9.95	9.66	9.80	49.03	49.50	49.26	154.46	162.77	158.61	5.83	5.95	5.89	13.33	13.29	13.31
T_3	9.33	9.58	9.45	63.08	64.58	63.83	175.01	188.33	181.67	6.06	6.00	**6.23**	13.79	13.85	13.82
T_4	8.91	9.06	**8.78**	38.46	39.25	**38.29**	145.76	154.44	150.10	5.40	5.49	5.44	11.31	11.24	**10.87**
T_5	8.90	9.16	9.03	46.70	47.91	47.30	145.66	159.72	152.69	4.91	5.08	4.99	12.85	12.92	12.88
T_6	8.95	9.58	9.26	42.46	42.00	42.23	133.80	140.00	136.90	5.16	5.27	5.21	12.73	12.69	12.71
T_7	9.00	9.58	9.29	67.00	67.91	**65.35**	218.50	226.38	222.44	6.05	6.02	6.03	14.51	14.56	**13.83**
T_8	9.80	9.83	**9.88**	55.90	56.50	56.20	153.63	215.27	184.45	5.70	5.63	5.66	12.93	12.98	12.95
T_9	9.76	9.33	9.54	45.10	46.33	45.71	119.13	130.83	124.98	4.96	5.00	**5.18**	12.87	12.83	12.85

T_1 = *Azotobacter* + PSB, T_2 = *Azotobacter* + VAM, T_3 = *Azotobacter* + *Azospirillum* , T_4 = *Azospirilum* + PSB, T_5 = *Azospirillum* + VAM , T_6 = VAM + PSB, T_7 = NPK 100% (100:50:100 kg/ha), T_8 =NPK 50%, T_9 = Control

Conclusion

From the results, it concluded that, onion should be incorporated with *Azotobacter* in combination with *Azospirillum* for better growth, yield and quality. Though the recommended dose of NPK fertilizer (100%) produced the best result compared to different combinations of bio-fertilizers, the later may be a certain extent with particular consideration of sustainability in production and environmental safety. It is therefore concluded that application of biofertilizers (*Azotobacter* and *Azospirillum*) along with 100% recommended dose of fertilizers were recommended to obtain the highest bulb yield with better quality of onion bulbs.

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