Effect of bio-fertilizers on growth, yield and quality of onion cv. sukhsagar

S. GHANTI AND A.B. SHARANGI

Department of Spices and Plantation Crops, Faculty of Horticulture,
Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur-741252, Nadia, West Bengal

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 cv. Sukhsagar. 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 (43.46cm) with the application of Azotobacter+VAM. No. of leaves, no. of inflorescence / plot and bulb diameter were maximum of Azotobacter+Azospirillum. Azotobacter+Azospirillum and NPK 100% gave maximum length of bulbs(6.03cm). The maximum number of scale per bulb (9.81) was counted from NPK 50%.The plants raised under NPK 100% produced the maximum bulb weight 67.45g. TSS % was found maximum (12.29%) from NPK 100% but the highest reducing sugar (1.420%) and starch percentage (6.27%) were noted from NPK 50%. The total loss of weight (%) upto 60 days, was found minimum (11.5%) from Azotobacter+PSB followed by Azotobacter+Azospirillum (14.32%). It is therefore, concluded that Azotobacter+Azospirillum combination is the bestfor onion as compared to others so far as the sustainability in production and environmental consideration are concerned.

Key words: *Azotobacter, Azospirillum, PSB, starch and VAM..*

Onion is one of the important spice and vegetable crops having enormous use in everyday cooking. It is believed to possess stimulant, diuretic and expectorant properties and is considered useful in flatulence and dysentery. India, the world's second largest producer. The indiscriminate use of chemicals resulted in degradation of soil health, erosion, and loss of organic matter, nitrate pollution and also health hazard for human beings. For sustainable production and productivity as well as quality, organic farming may be the alternative means. Only few researchers like Yadav *et al.*,(2004); Jha *et al.*, (2006); Balemi *et al.*, (2007) studied in this regard to find out the effect of bio-fertilizers on onion. However, till now no systematic approaches so far bean made to utilize the gro-ecological condition of this state and little information is available about the organic cultivation of this crop in the country. Therefore, it was considered worthwhile to carry out the present investigation for studying on the growth, yield and quality of onion cv. Sukhsagar under gangetic alluvial conditions of West Bengal.

MATERIALS AND METHODS

The present investigation was undertaken during the *rabi* (winter) season of two consecutive years i.e., 2006-07 and 2007-08 for studying the effect of different combinations of bio-fertilizer (Azotobacter, Azospirillum, VAM, PSB) on vegetative, yield and qualitative character of onion(*Allium cepa L.*) at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal. The soil of the experimental field was a typical Gangetic alluvial with 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 replicated three times in randomized block design in 2.0 × 1.5 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. The stander method estimations of starch (Hedge and Hofreiter 1962) and reducing sugar (Somogyi, 1952) were followed. The bulbs were harvested at mature stage. The loss of weight of different treatment were recorded at fort night interval upto 60 days. For this purposes, randomly selected bulbs of known weight were kept open in perforated trays by taking 20 from each treatment and kept in room temperature.

RESULTS AND DISCUSSION

The pooled results indicated that, T_2 (*Azotobacter* + VAM) has found to produce the highest plant height (43.46 cm) followed by T_7 (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, T_7 (NPK 100%) produced the maximum number of leaves (5.65) and the minimum (4.78) was counted from T_3 (*Azotobacter* + *Azospirillum*) Maximum of 8.67 number of leaves was recorded from T_3 (*Azotobacter* + *Azospirillum*) and the minimum of 6.14 in T_4 (*Azospirillum* + PSB) at 180 days of sowing (Table 1). In case of, bulb length the maximum number of 6.03 cm was obtained from T_7 (NPK 100%) and the minimum of 4.98 cm from T_9 (control) (Table-2). So far as the diameter of bulb is concerned T_7 (NPK100%) performed the

E mail : dr_absarangi@yahoo.co.in

maximum of 14.535cm and minimum of 11.275 cm from T_4 (*Azospirillum* + PSB) (Table-2). Highest bulb weight of 67.455gm was observed from T_7 (NPK 100%) and lowest of 38.855 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 bio-fertilizers 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 9.815 was found in T_8 (NPK 50%) and the minimum of 8.985 in T_4 (*Azospirilum* + PSB) (Table-2).

Highest yield was recorded from T_7 (NPK 100%) of 222.44 q/ha and the lowest of 124.98 q/ha in T_9 (control) (Table-2). The superiority of the treatments T_3 (*Azotobacter* + *Azospirillum*) and T_7 (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.

Reducing sugar % was found maximum (1.42%) in T_8 (NPK 50%) and minimum of 0.65% in T_4 (*Azospirillum* + PSB). Highest TSS% (12.29 %) was recorded from T_7 (NPK1 00%) of and the lowest (9.23%) from T_2 (*Azotobacter* + VAM). Maximum (6.27 %) starch was found in T_8 (NPK50%) and the minimum (1.22%) in T_7 (NPK100%) (Table-3). The superiority of the T_7 (NPK100%) might be due to the fact that nitrogen has help in vigorous vegetative growth and imported deep green colour to the foliage which favoured photosynthesis activity of the plants resulting in the greater accumulation of food material. These are in conformity with Aswani *et al.*, (2005).

At 15 DAH, maximum and minimum weight loss were observed in T_5 (*Azospirillum* + VAM) and T_3 (*Azotobacter* + *Azospirillum*) but at 30 DAH the maximum and minimum weight loss were recorded in T_7 (NPK 100%) and T_8 (NPK 50%). The over all storage weight loss percentage was found maximum of 35.425 % in T_9 (control) and the minimum of T_1 (*Azotobacter* + PSB) in 11.515 % followed by T_3 (*Azotobacter* + *Azospirillum*) in 14.335 %.

From the results, it appears that onion should be incorporated with *Azotobacter* in combination with *Azospirillum* for better growth, yield and quality. For increasing storability, the combination of *Azotobacter* and PSB is effective. 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.

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Table 1: Effect of bio-fertilizers on plant height and number of leaves of onion

Treatment	Plant height(cm)									No of Leaves per $3m^2$ (Pooled)								
	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	**43.46**	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	**4.78**	5.00	5.00	**5.00**	8.12	9.22	**8.67**
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	**6.14**
T_5	13.44	13.77	**13.60**	24.50	24.50	**24.50**	38.08	43.00	**40.54**	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	**40.74**	5.53	5.78	**5.65**	4.65	4.78	**4.71**	7.10	8.22	**7.66**
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**
SEm (±)	**0.63**	**0.95**	--	**0.12**	**2.77**	--	**0.31**	**3.29**	--	**0.22**	**0.18**	---	**0.09**	**0.39**	---	**0.14**	**0.63**	---
LSD(p=0.05)	**1.90**	**2.85**	--	**0.38**	**8.31**	--	**0.95**	**9.89**	--	**0.67**	**0.56**	---	**0.27**	**1.16**	---	**0.42**	**1.87**	---

Table 2: Effect of bio-fertilizers on yield and yield attributing characters of onion cv. Sukhsagar

Treatment	Scale (in number)			Weight of Bulb (gm)			Yield (Q/ha)			Bulb length (cm)			Diameter of Bulb(cm)		
	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	**6.03**	13.79	13.85	**13.82**
T_4	8.91	9.06	**8.98**	38.46	39.25	**38.85**	145.76	154.44	**150.10**	5.40	5.49	**5.44**	11.31	11.24	**11.27**
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	**67.45**	218.50	226.38	**222.44**	6.05	6.02	**6.03**	14.51	14.56	**14.53**
T_8	9.80	9.83	**9.81**	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	**4.98**	12.87	12.83	**12.85**
SEm (±)	0.13	0.58	---	0.31	1.51	---	4.17	20.67	---	0.09	0.34	---	0.29	0.74	---
LSD(p=0.05)	NS	NS	---	0.93	4.54	---	12.51	61.97	---	0.2953	1.0211	---	0.87	2.22	---

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

Table 3: Effect of bio-fertilizers on quality of onion cv. Sukhsagar

Treatment	TSS (%)			Starch (%)			Reducing Sugar (%)		
	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled
T_1	11.89	11.96	**11.925**	3.89	3.91	**3.90**	0.80	0.81	**0.805**
T_2	9.20	9.26	**9.23**	4.76	4.74	**4.75**	0.84	0.87	**0.855**
T_3	9.90	9.89	**9.895**	3.02	3.10	**3.06**	0.90	0.88	**0.89**
T_4	10.16	10.13	**10.145**	4.10	4.18	**4.14**	0.6	0.71	**0.655**
T_5	10.00	10.80	**10.40**	5.39	5.42	**5.405**	1.05	1.01	**1.03**
T_6	9.90	10.00	**9.95**	2.31	2.38	**2.345**	0.95	0.94	**0.945**
T_7	12.26	12.33	**12.295**	1.23	1.21	**1.22**	0.96	0.98	**0.97**
T_8	10.21	10.80	**10.505**	6.24	6.30	**6.27**	1.43	1.41	**1.42**
T_9	10.10	10.06	**10.08**	3.84	3.91	**3.875**	0.75	0.73	**0.74**
SEm (±)	**0.195**	**0.44**	**---**	**0.08**	**0.26**	**---**	**0.05**	**0.04**	**---**
LSD(p=0.05)	**0.584**	**1.34**	**---**	**0.24**	**0.79**	**---**	**0.17**	**0.12**	**---**

Table 4: Effect of bio-fertilizers on storability of onion cv. Sukhsagar

Treatment	Loss of W eight (%)												Total Pooled Wt Loss (%)
	15DAH			30DAH			45DAH			60DAH			
	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled	
T_1	4.10	4.45	**4.275**	2.74	2.87	**2.80**	1.90	2.18	**2.04**	2.25	2.54	**2.395**	11.515
T_2	4.14	4.54	**4.34**	4.94	5.17	**5.05**	2.40	2.53	**2.46**	2.50	2.90	**2.70**	14.56
T_3	2.80	3.29	**3.04**	2.28	2.45	**2.36**	3.52	3.64	**3.58**	5.25	5.44	**5.345**	14.335
T_4	3.95	4.21	**4.08**	3.65	3.87	**3.76**	7.30	7.52	**7.41**	4.06	4.49	**4.275**	19.525
T_5	6.00	6.56	**6.28**	6.18	6.45	**6.31**	7.36	7.44	**7.40**	3.80	3.28	**3.54**	23.535
T_6	3.97	4.24	**4.10**	4.00	4.17	**4.08**	4.32	4.76	**4.54**	1.55	1.72	**1.635**	14.365
T_7	5.35	5.73	**5.54**	6.90	7.57	**7.23**	1.35	1.08	**1.21**	2.10	1.51	**1.805**	15.795
T_8	5.30	5.74	**5.52**	1.92	2.13	**2.02**	4.62	4.82	**4.72**	2.93	2.99	**2.96**	15.225
T_9	4.92	5.29	**5.105**	6.85	7.21	**7.03**	6.40	6.68	**6.54**	16.00	17.50	**16.75**	35.425
SEm (±)	**0.06**	**0.69**	**---**	**0.06**	**1.74**	**---**	**0.087**	**3.71**	**---**	**0.34**	**9.57**	**---**	**---**
LSD (p=0.05)	**0.19**	**2.09**	**---**	**0.18**	**5.24**	**---**	**0.24**	**11.95**	**---**	**1.03**	**28.67**	**---**	**---**

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) * Singh (1991), T_8 =NPK 50%, T_9 = Control, DAH = Days after harvesting