

phosphobacterium at 2 kg ha⁻¹ with closest spacing of 45x5 cm recorded the higher plant height (48.5 cm) at 100th and 135th of sowing.

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Effect of planting density and nutrients on bulb development and flowering in seed propagated aggregatum onion (*Allium cepa* L. Var. *aggregatum* Don.) type Gnanamedu local

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Abstract : An experiment was conducted at Horticultural College & Research Institute to find out the response of aggregatum onion to different spacing and levels of organic, inorganic and biofertilizers in respect of bulb diameter, bulb length, shape index and flowering. The experiment was laid out in split plot design with 30 treatments replicated thrice. Three spacing viz., S₁ 45x5, S₂ 45x10, and S₃ 45x15 cm formed the main plot treatments. The subplot treatments consist of 10 combinations involving three levels of N (20, 40 and 60 kg ha⁻¹), three levels of P (20, 40 and 60 kg ha⁻¹) and constant level of K (30 kg ha⁻¹) along with FYM 25 t ha⁻¹, *Azospirillum* at 2 kg ha⁻¹ and phosphobacterium at 2 kg ha⁻¹. An organics alone and absolute control without nutrients were also adopted. The increase in length of bulb and shape index were higher at closest spacing of 45x5 cm, while the widest spacing of 45x15 cm registered the greater bulb diameter. Manurial treatments had significant influence on the bulb characters, which showed an increasing trend with increasing level of nutrients. Spacing and nutrients had no influence on the days taken for flower initiation, days to 50 per cent flowering and days for maturity. Interaction effect revealed that application of 60:60:30 kg NPK ha⁻¹, FYM at 25 t ha⁻¹, *Azospirillum* at 2 kg ha⁻¹ and phosphobacterium 2 kg ha⁻¹ along with closest spacing of 45x5 cm recorded the higher bulb length (5.70 cm) and shape index (1.09 %). (Key words : Onion, Planting density, Bulb development, Flowering).

Multiplier onion (*Allium cepa* var. *aggregatum*) is one of the most important spice crops valued for its unique pungency. It requires large quantities of readily available nutrients. An optimum plant density is important for the higher utilization of applied nutrients. Information on the response of *aggregatum* onion to population and different levels of nutrients would provide a basis for assessing the optimum plant density and levels of nutrients. The present study was therefore, conducted to find out the response of *aggregatum* onion to different spacing and levels of organic, inorganic nutrient sources and biofertilizers in respect of bulb diameter, bulb length, shape index and flowering.

Materials and Methods

The experiment was laid out at Horticultural College and Research Institute, Coimbatore during 1995-96 in split plot design with 30 treatments replicated thrice. Three spacing viz. S_1 - 45x5, S_2 - 45x10, and S_3 - 45x15 cm formed the main plot treatments. The subplot treatments consist of 10 combinations viz.

- M_1 - Control - No organic manure, no biofertilizer and no inorganic fertilizers.
- M_2 - Recommended dose of inorganic fertilizers 30: 60: 30 kg NPK ha⁻¹ as basal and 30 kg N ha⁻¹ as top dressing after 30 days
- M_3 - 60: 60: 30 kg NPK + 25 t FYM + 2 kg *Azospirillum* + 2kg phosphobacterium / ha
- M_4 - 40: 60: 30 kg NPK + 25 t FYM + 2 kg *Azospirillum* + 2kg phosphobacterium / ha
- M_5 - 20: 60: 30 kg NPK + 25 t FYM + 2 kg *Azospirillum* + 2 kg phosphobacterium / ha
- M_6 - 60: 60: 30 kg NPK + 2 kg *Azospirillum* + 2 kg phosphobacterium / ha
- M_7 - 60: 20: 30 kg NPK + 2 kg *Azospirillum* + 2 kg phosphobacterium / ha
- M_8 - 40: 40: 30 kg NPK + 2 kg *Azospirillum* + 2 kg phosphobacterium / ha
- M_9 - 20: 20: 30 kg NPK + 2 kg *Azospirillum* + 2 kg phosphobacterium / ha
- M_{10} - Organic alone (25 t FYM + 2 kg *Azospirillum* + 2 kg phosphobacterium / ha)

Farm Yard Manure was applied at 25 t ha⁻¹ and *Azospirillum* and phosphobacterium each at 1 kg ha⁻¹ as seed treatment and 2 kg ha⁻¹ as soil application applied at the time of planting. Observations on bulb diameter, bulb length, shape index and flowering were recorded and statistically analysed.

Results and Discussion

The results presented in the table (Table 1-3) revealed that the wider spacing of 45x15 cm recorded the greater bulb diameter. Diameter of bulb was significantly increased with addition of each level of applied nutrients, viz. 60:60:30 kg NPK ha⁻¹ FYM at 25 t ha⁻¹, *Azospirillum* at 2 kg ha⁻¹ and phosphobacterium at 2 kg ha⁻¹ (M_3). The presence of better sink source relationship would have diverted and stored the photosynthesis in the bulbs leading to higher yield. This might be due to lower plant population, less competition for nutrients and free aeration promoting better growth. Similar findings were reported by Patil *et al.* (1984) in onion.

An increase in bulb length and shape index of bulb was obtained in the treatment planted with closer spacing of 45x5 cm. The bulb length and shape index was registered higher in the plots applied with increased nutrient (M_3). This could be due to better nourishment and efficient utilisation of nutrients. The enhanced photosynthesis in turn produces more metabolites and photo assimilates and their further diversion to the developing bulbs resulting in increased bulb length and shape index. Janardan *et al.* (1993) reported similar findings in onion.

The plant density and nutrient combination did not influence the commencement of flowering, days taken to 50 per cent flowering and days for maturity of onion bulbs. The influence of nutrients on delaying the initiation of flowering was due to prolonged vegetative phase. The findings of this study are in conformity to that of earlier workers Pall and Padda (1972) and Bhardwaj (1991) in onion.

The increase in length of bulb and shape index were higher at closest spacing of 45x5 cm, while the widest spacing of 45x15 cm registered the greater bulb diameter. Manurial treatments expressed significant influence on the bulb characters, which showed an increasing trend with enhancing the level of nutrients. Spacing and nutrients exhibited negative influence on the days taken for flower initiation, days to 50 per cent

Table 1. Effect of spacing and nutrients on bulb diameter (cm) and length (cm)

Treatments	Diameter (cm)				Length (cm)			
	S ₁	S ₂	S ₃	Mean	S ₁	S ₂	S ₃	Mean
M ₁	2.73	2.51	2.63	2.62	2.41	2.42	2.23	2.35
M ₂	3.98	6.50	8.75	6.41	3.68	3.35	2.82	3.28
M ₃	5.77	8.41	10.85	8.34	5.70	4.47	4.18	4.78
M ₄	5.02	7.55	10.52	7.69	4.85	4.56	3.92	4.44
M ₅	4.82	7.24	9.68	7.24	4.62	4.24	3.54	4.13
M ₆	4.85	7.33	9.66	7.28	4.63	4.32	3.53	4.16
M ₇	3.85	6.87	9.21	6.64	3.61	3.33	3.62	3.52
M ₈	3.99	6.74	8.97	6.56	3.72	3.33	3.10	3.38
M ₉	3.76	6.21	8.60	6.19	3.44	3.04	2.61	3.03
M ₁₀	3.88	5.38	8.63	5.96	3.50	2.91	2.55	2.98
Mean	4.26	6.47	8.75	6.49	4.01	3.59	3.21	3.60
	SE _d	CD			SE _d	CD		
S	0.02	0.05			0.02	0.05		
M	0.14	0.29			0.14	0.29		
S x M	0.25	NS			0.25	NS		
M x S	0.24	NS			0.24	NS		

Main plot - Spacing (S) Sub plot - Nutrients (M)

Table 2. Effect of spacing and nutrients on shape index of bulb

Treatments	Shape index (%)			
	S ₁	S ₂	S ₃	Mean
M ₁	0.87	0.89	0.76	0.59
M ₂	0.85	0.85	0.65	0.79
M ₃	1.09	1.12	0.97	1.06
M ₄	0.87	0.88	0.76	0.83
M ₅	0.85	0.85	0.66	0.78
M ₆	0.82	0.81	0.62	0.75
M ₇	0.80	0.78	0.57	0.71
M ₈	0.77	0.73	0.52	0.67
M ₉	0.76	0.70	0.48	0.64
M ₁₀	0.70	0.64	0.44	0.84
Mean	0.84	0.82	0.64	0.77
	SE _d	CD		
S	0.003	0.007		
M	0.005	0.010		
S x M	0.012	0.010		
M x S	0.009	0.019		

Main plot - Spacing (S) Sub plot - Nutrients (M)

Table 3. Effect of spacing and nutrients on days for flower initiation and 50 per cent flowering

Treatments	Days for flower initiation				Days for 50% flowering			
	S ₁	S ₂	S ₃	Mean	S ₁	S ₂	S ₃	Mean
M ₁	98.15	101.91	104.54	101.53	105.56	101.83	105.92	114.44
M ₂	104.13	106.35	107.12	105.87	110.81	105.07	115.75	110.54
M ₃	114.47	118.50	127.25	120.07	130.75	129.50	127.50	129.25
M ₄	108.02	109.22	109.58	108.94	117.15	109.75	109.51	112.14
M ₅	105.84	105.13	105.38	105.45	108.08	108.00	106.12	107.40
M ₆	108.05	107.35	109.50	108.30	107.57	108.00	106.72	107.43
M ₇	103.63	105.89	106.08	105.20	106.50	103.50	104.29	104.76
M _x	107.10	107.32	107.52	107.65	107.91	101.15	101.84	103.63
M ₁₀	103.59	104.28	106.27	104.71	105.32	101.92	101.43	102.89
M ₁₀	105.43	106.95	106.38	106.25	101.75	101.52	101.83	101.70
Mean	105.84	107.29	109.06	107.40	111.14	108.02	109.09	109.42
	SE _d	CD			SE _d	CD		
S	0.32	NS			0.25	NS		
M	2.32	NS			0.68	NS		
S x M	5.58	NS			1.85	NS		
M x S	3.84	NS			1.15	NS		

Main plot - Spacing (S) Sub plot - Nutrients (M)

flowering and days for maturity. Interaction effect revealed that application of 60:60:30 kg NPK ha⁻¹, FYM at 25 t ha⁻¹, *Azospirillum* at 2 kg ha⁻¹ and phosphobacterium 2 kg ha⁻¹ along with closest spacing of 45x5 cm recorded the greater bulb length (5.70 cm) and shape index (1.09%).

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