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EFFECT OF SPACING, BULB SIZE AND DEPTH OF PLANTING ON GROWTH, FLOWERING AND VASE LIFE OF TUBEROSE (*POLIANTHES TUBEROSA* L.) CV. SUVASINI

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ABSTRACT
An experiment was laid out with four spacings (30x20cm, 30x30cm, 45x20 cm, 45x30 cm), three bulb sizes (< 2.0 cm, 2.0-3.0 cm and > 3.0 cm) and two depths of planting (2.5 cm and 6.0 cm) in a randomized block design with three replications in tuberose cv. Suvasini. The main objective is to study their individual and interaction effects of spacing, bulb size and depth of planting on vegetative growth , flower yield and vase life in tuberose cv. Suvasini . Vegetative growth parameters like number of leaves per plant , leaf area index at maturity and all spike quality parameters were found significantly influenced with wider spacing (45x30 cm). The large bulb size (> 3.0cm) recorded significant increase in all growth , spike parameters and spike yield per hectare. The length of spike, number of spikes per plot and hectare and longevity of spike in field increased significantly at deeper depth (6.0 cm). Among the different treatment combinations bulbs with more than 3.0 cm diameter planted at optimum spacing (30x30 cm) and at 6.0 cm depth of planting were found best to get maximum commercial advantage for achieving higher spike yield per plot (107.83) and per hectare (2.72 lakh ha^{-1}) with long vase life (17.87 days) of tuberose cv. Suvasini.

INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) is a commercial bulbous flower crop grown for its cut flower, decoration and garlands. It is hardy, bulbous, perennial perpetuating by the bulbs and bulblets. It has a great economic potential for cut flower trade and essential oil industry. The spikes are excellent for vase and other floral decorations. The spikes lasts long in vase for 10-15 days (Sadhu and Bose, 1978). The natural flower oil of tuberose is one of the most expensive raw material for perfume industry. Traditionally four cultivars of tuberose are popular *viz*., single, semi double, double and variegated. Among double types, cultivar Suvasini has been gaining importance for the purpose of cut flower cultivation because of long flower spikes and florets are big and bold white with tips tinged with pinkish red. To meet the ever increasing domestic market demand and to tap the export potential of fresh flowers and the value added products from tuberose, there is a need to increase the productivity of this crop. Optimum plant spacing is an important practice for providing better light interception, moisture, nutrients which are vital for successful crop production and quality. Plant spacing affects yield, quality of spikes and bulb production. Large bulbs normally have more stored food than smaller ones and capable of producing more side shoots (Mukhopadhyay, 1963). Deeper planting produced significantly higher plant height, more spikes and bulb yield in Freesia (Choi *et al*., 1997). Therefore keeping in view the economic importance of the crop, the present study was undertaken with the objective *i.e* to study the effect of spacing, bulb size and depth of planting on vegetative, floral parameters and vase life of tuberose cv.Suvasini.

MATERIALS AND METHODS

The present investigation was conducted at Horticultural college and Research Institute, Dr.YSR Horticultural University, Venkataramannagudem during 2012-2014. Which is located at 16º 63′ 120" N latitude and 81º 27′ 568" E longitude and 34m above MSL. It experiences hot humid summer and mild winters. The experimental soil was red sandy loam with good drainage and moderate water holding capacity with sand 70% of sand , silt 20% and clay 15% . The soil pH is 6.87 and E.C. is 0.3 dSm^{-1}. The experiment was conducted in a factorial randomized block design involving four levels of spacing *i.e.* S_1 (30x20 cm), S_2 (30x30 cm) , S_3 (45x20 cm,) and S4 (45x30 cm) and three levels of bulbs *viz*. B_1 (less than 2.0 cm) , B_2 (2.0-3.0 cm),B_3 (more than 3.0 cm) and two levels of depth of planting *i.e* D_1 (2.5 cm) and D_2 (6.0 cm) replicated thrice totally 24 treatment combinations. Bulbs of different sizes were selected and treated with Bavistin 0.1 percent solution for 20 minutes, a day before planting and allowed to dry overnight under shade. The field was brought to the fine tilth by ploughing and harrowing. Beds were prepared of 3x2 m^2 gross plot size. Bulbs of tuberose cv. Suvasini were selected treatment

wise and planted in the beds on 7th July, 2012 and again in 2014. The basal dose of half of N and full of P and K 120:100:150 kg/ha (Kishore and Singh, 2006) were applied and the remaining half dose of nitrogen was top dressed in 2 split doses *i.e.*, 30 and 60 days after planting. The various observations on growth , floral and vase life parameters were recorded on five plants randomly selected from net plot area and tagged. The pooled data collected from 2 years for all the characters studied were subjected to statistical analysis by adopting 'Analysis of Variance' (ANOVA) technique for factorial randomized block design as suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The data regarding the effect of different levels of spacing , bulb size and depth of planting on growth characters of tuberose cv. Suvasini. Table 1 indicated that treatment S_4 (45x30 cm) took significantly less number of days for sprouting (8.36 days) and 50% sprouting (14.53 days) followed by S_2 (30x03 cm). The early sprouting under wider spacing can be ascribed to availability of sufficient space and better nutrient availability to the bulbs. The above results are in conformity with the results of Singh and Kumar (1999) in tuberose. Amjad and Ahmad (2012) in lilium reported that maximum sprouting was recorded with wider spacing. It might be due to proper planting procedures, moisture and abundant light availability that might have helped in maximum sprouting of bulbs.

Shallow planting of bulbs (2.5 cm) recorded early sprouting (7.86 days) which might be attributed to better aeration and promoted physiological activity of bulb including uptake of nutrients and water. Similar results were also reported by Singh and Kumar (1999) in tuberose. Further, it was observed that the small sized bulbs (<2.5 cm) recorded early sprouting (8.19 days) which may be attributed to less quantity of growth inhibitors in bulbs compared to large sized bulbs. The above results are in conformity with Raja and Palanisami (1999) who observed that smaller sized bulbs took less number of days for sprouting as compared to large size bulbs in tuberose.

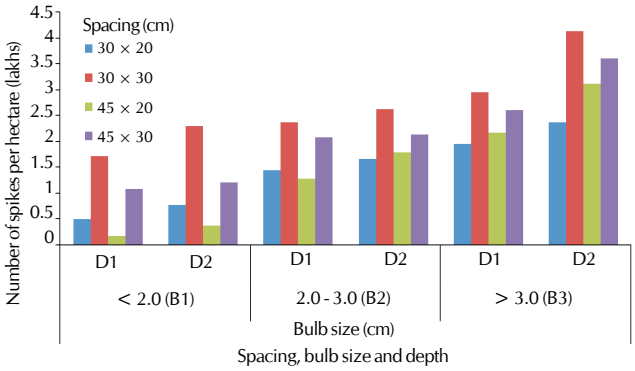

Figure 1:Effect of spacing, bulb size and depth of planting on number of spikes per hectare (lakhs) of tuberose cv. Suvasini

Regarding number of leaves, leaf area index and total chlorophyll content per plant data (Table 2) revealed that in all the stages of plant growth the number of leaves and total chlorophyll content per plant were highest under wider spacing S_4 (45×30 cm). This might be due to availability of more space to every plant for availing sufficient nutrients, soil moisture and solar radiation. This is in accordance with the findings of Malik *et al*. (2009) and Malam *et al*. (2010) in tuberose. Production of more number of leaves were observed in all growth stages with bigger sized bulbs (B_3 - >3 cm). This might be due to higher stored food reserves in large bulbs as a result of which there was an increase in number of leaves in

Table 1: Effect of spacing, bulb size and depth of planting on number of days for sprouting of bulbs and days to 50% sprouting of bulbs in tuberose cv. Suvasini

Bulb size		Days for sprouting of bulbs					Days to 50% sprouting of bulbs				
		Spacing									
		S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
B_1	D_1	7.25	6.35	6.75	5.25	6.40	15.10	10.85	11.90	8.30	11.59
	D_2	12.85	9.00	9.20	8.90	9.99	26.45	21.05	22.55	14.80	21.21
	Mean	10.05	7.68	7.98	7.08	8.19	20.78	15.95	17.23	11.65	16.40
B_2	D_1	9.90	7.50	7.65	7.15	8.05	17.05	12.70	15.10	10.35	13.80
	D_2	14.60	10.90	11.3	10.15	11.74	29.30	23.95	25.60	17.35	24.05
	Mean	12.25	9.20	9.48	8.65	9.89	23.18	18.33	20.35	13.85	18.92
B_3	D_1	11.95	8.30	8.10	8.25	9.15	21.05	15.45	17.05	13.80	16.84
	D_2	16.95	13.25	14.75	10.50	13.86	33.35	26.05	29.20	22.35	27.74
	Mean	14.45	10.78	11.43	9.38	11.51	27.20	20.75	23.13	18.07	22.29
		For comparing means of spacing and depth of planting									
	D_1	9.70	7.38	7.50	6.88	7.87	17.73	13.00	14.68	10.88	14.07
	D_2	14.80	11.05	11.75	9.85	11.86	29.70	23.68	25.78	18.17	24.33
	Mean	12.25	9.22	9.63	8.37	9.86	23.72	18.34	20.23	14.53	
		S Ed		CD at 5%			S Ed		CD at 5%		
Spacing		0.27		0.57			0.48		0.98		
Bulb size		0.24		0.49			0.41		0.85		
Depth of planting		0.19		0.40			0.34		0.70		
Sp x Bs		0.47		0.98			0.82		1.70		
Bs x Dop		0.30		0.62			0.67		1.39		
Sp x Dop		0.34		0.69			0.58		1.20		
Sp x Bs x Dop		0.58		1.20			0.95		1.97		

Table 2: Effect of spacing, bulb size and depth of planting on number of leaves, leaf area index and total chlorophyll content at maturity in tuberose cv. Suvasini.

Bulb size		Number of leaves					Leaf area index					Total chlorophyll content				
		Spacing														
		S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
B_1	D_1	73.79	95.65	76.49	95.16	85.27	2.63	2.26	1.76	1.92	2.14	32.75	44.98	37.48	45.93	40.28
	D_2	81.35	99.37	83.64	99.15	90.88	3.17	2.85	2.07	2.32	2.60	34.95	47.58	39.92	48.88	42.83
	Mean	77.57	97.51	80.06	97.16	88.07	2.35	2.38	2.47	2.29	2.37	36.79	46.27	38.69	47.40	41.55
B_2	D_1	83.44	104.49	89.97	103.59	95.37	2.92	2.59	2.34	2.38	2.55	40.84	49.16	40.92	51.95	45.71
	D_2	86.46	107.36	94.82	111.00	99.91	3.36	3.30	2.41	2.68	2.93	39.32	52.8	42.79	54.88	47.44
	Mean	84.95	105.93	92.39	107.29	97.64	2.81	2.84	2.87	2.50	2.74	37.13	50.98	41.85	53.41	46.57
B_3	D_1	79.81	110.00	97.37	113.57	100.73	3.03	2.75	2.54	2.71	2.75	43.38	55.27	45.18	57.25	50.27
	D_2	90.23	115.75	101.12	117.96	106.26	3.72	3.60	2.39	2.89	3.15	45.48	61.72	48.05	62.75	54.50
	Mean	85.02	111.75	99.24	116.85	103.22	3.37	3.06	2.57	2.80	2.95	44.42	57.21	46.62	60.00	52.38
		For comparing means of spacing and depth of planting														
	D_1	82.49	104.55	89.19	105.57	95.45	2.86	2.29	2.28	2.52	2.48	39.18	51.09	42.15	53.54	46.49
	D_2	82.54	105.58	91.94	108.63	97.17	2.97	3.25	2.83	2.54	2.89	39.72	51.88	42.63	53.67	46.97
	Mean	82.52	105.06	90.56	107.10	96.31	2.85	2.76	2.64	2.53	2.68	39.45	51.49	42.39	53.60	47.23
		S Ed		CD at 5%			S Ed		CD at 5%			S Ed		CD at 5%		
Spacing		0.96		1.99			0.022		0.045			27.00		0.56		
Bulb size		0.83		1.73			0.018		0.039			0.23		0.48		
Depth of planting		0.68		1.41			0.015		0.032			0.19		0.40		
Sp x Bs		1.67		3.45			0.037		0.077			0.47		0.97		
Bs x Dop		1.18		2.44			0.026		0.055			0.33		0.68		
Sp x Dop		1.36		2.82			0.03		0.063			0.38		0.79		
Sp x Bs x Dop		3.34		6.91			0.020		0.041			0.54		1.11		

Table 3: Effect of spacing, bulb size and depth of planting on number of days to spike emergence and number of days to 50% flower opening in tuberose cv. Suvasini

Bulb size		Days to Spike emergence					Days to 50% flower opening				
		Spacing									
		S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
B_1	D_1	190.83	151.24	181.38	151.77	168.80	211.58	150.45	175.03	152.86	172.48
	D_2	216.80	153.38	206.38	155.50	183.02	236.16	180.36	211.48	157.91	196.47
	Mean	203.81	152.31	193.88	153.64	175.90	223.87	164.56	193.25	157.30	184.47
B_2	D_1	155.58	119.58	152.98	116.76	136.22	207.26	145.77	172.12	148.65	168.45
	D_2	179.38	135.36	177.36	129.56	155.41	230.58	171.62	200.48	154.24	189.23
	Mean	167.47	127.46	165.17	123.16	145.81	218.92	158.69	186.30	147.04	178.84
B_3	D_1	148.97	109.96	139.68	103.86	125.61	203.72	137.08	169.59	128.06	159.61
	D_2	158.10	130.51	154.84	125.11	142.14	225.69	169.52	196.61	153.07	186.22
	Mean	153.54	120.24	147.26	114.48	133.87	214.70	141.80	183.10	139.56	172.91
		For comparing means of spacing and depth of planting									
	D_1	165.12	126.93	158.01	124.13	143.54	207.52	149.98	172.25	130.53	166.84
	D_2	184.75	139.75	179.53	136.72	160.18	230.81	173.83	202.85	155.07	190.64
	Mean	174.94	133.34	168.77	130.43	151.86	219.16	161.91	187.55	142.80	178.62
		S Ed		CD at 5%			S Ed		CD at 5%		
Spacing		0.80		1.66			0.35		0.73		
Bulb size		0.69		1.44			0.30		0.63		
Depth of planting		0.57		1.17			0.24		0.51		
Sp x Bs		1.39		2.88			0.61		1.26		
Bs x Dop		0.98		2.35			0.43		0.89		
Sp x Dop		1.14		2.03			0.49		1.03		
Sp x Bs x Dop		1.61		3.32			0.71		1.46		

comparison to small bulbs. Similar results of more number of leaves and better vegetative growth were also reported by Abdollah Hatamzadeh *et al*. (2012) in tuberose who concluded that increased bulb size was positively related with increasing vegetative growth and the reason for more growth of large bulbs might be due to the presence of more water and nutrients than smaller bulbs. Rao *et al*. (1992) and Mahanta *et al*. (1998) in tuberose illustrated that increased bulb size resulted more number of leaves in tuberose. These are in alliance with the results of Bhat *et al*. (2008) in gladiolus and Ahmad *et al*. (2009) in tuberose.

Further, it was recorded that the deeper planting of bulbs D_2 (6 cm) resulted in more number of leaves which can be attributed to better anchorage and sturdier growth. Correct planting depth influenced the available space for development of bulbs and it also influenced the time to emergence and created good soil conditions for subsequent flowering. These results are in line with those reported by Nagaraju *et al*. (2004) in tuberose. The data regarding Leaf area index (Table 2) was found to increase at all growth stages of plant. Closer spacing (30x20 cm) significantly increased the leaf area index, which might be due to high plant density or more number of plants per unit area. Similar results are obtained by Singh (2000), Sharma and Guptha (2003), Pranavrana *et al*. (2005) in gladiolus and

Table 4: Effect of spacing, bulb size and depth of planting on spike length, spike weight and number of florets per spike in tuberose cv. Suvasini

Bulb size		Spike length					Spike weight					Number of florets per spike				
		Spacing														
		S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
B_1	D_1	47.78	73.1	54.7	84.76	65.09	96	106.6	95.82	110.47	102.22	19.37	38.75	28.17	37.74	31
	D_2	61.65	91.16	76.11	93.31	80.51	123.63	131.62	126.1	129.42	127.69	29.19	41.39	33.63	41.88	36.52
	Mean	54.57	82.13	65.4	89.03	72.8	109.81	119.11	110.96	119.95	114.95	24.28	40.07	30.9	38.81	33.76
B_2	D_1	49.27	79.59	58.49	86.37	68.43	99.07	109.22	99.48	115.92	105.92	28.12	44.55	39.27	46.78	39.68
	D_2	63.23	97.79	78.38	99.03	84.6	120.86	128.17	124.92	126.82	125.19	34.64	46.32	40.57	47.04	42.14
	Mean	56.25	88.69	68.43	92.7	76.51	109.96	118.7	112.2	121.37	115.55	31.38	45.44	39.92	46.91	40.91
B_3	D_1	53.62	83.21	70.82	88.76	74.1	103.12	106.6	101.92	118.95	107.64	36	46.5	41	49.26	43.19
	D_2	66.69	106.15	81.44	108.13	90.6	125.8	135.8	129.47	136.8	131.96	39.5	56.36	47	57.32	50.04
	Mean	60.15	94.48	76.13	98.44	82.35	114.46	120.11	115.7	127.87	119.8	37.75	50.13	44	53.29	93.23
		For comparing means of spacing and depth of planting														
	D_1	50.13	78.63	61.33	86.63	69.18	99.4	107.47	99.07	115.11	105.26	29	43.26	37.96	45.97	39.04
	D_2	63.85	98.23	78.64	100.16	85.22	123.43	131.14	126.83	131.01	128.1	33.27	47.15	38.58	47.36	41.59
	Mean	56.97	88.43	69.99	93.39	77.2	111.41	1119.3	112.95	123.06	116.68	31.13	45.21	38.27	46.67	40.31
		S Ed		CD at 5%			S Ed		CD at 5%			S Ed		CD at 5%		
Spacing		0.49		1.03			0.24		0.51			0.24		0.49		
Bulb size		0.43		0.89			0.21		0.44			0.20		0.43		
Depth of planting		0.35		0.73			0.17		0.36			0.16		0.35		
Sp x Bs		0.87		1.79			0.42		0.88			0.41		0.86		
Bs x Dop		0.61		1.27			0.3		0.62			0.29		0.6		
Sp x Dop		0.71		1.46			0.35		0.72			0.33		0.7		
Sp x Bs x Dop		1.00		2.06			0.50		1.03			0.48		0.99		

Table 5: Effect of spacing, bulb size and depth of planting on on number of spikes per plot, number of spikes per hectare and field vase life in tuberose cv. Suvasini

Bulb size		Number of spikes per plot					Number of spikes per hectare					Field vase life				
		Spacing														
		S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
B_1	D_1	17.92	65.35	13.38	40.55	34.3	0.5	1.72	0.17	1.07	0.86	9.47	13.75	11.79	15.02	12.5
	D_2	57.3	108.03	17.54	104.35	71.8	1.44	2.67	1.78	2.61	2.12	10.2	14.32	13.62	15.75	13.47
	Mean	37.61	86.69	41.96	72.45	53.05	0.97	2.19	1.07	1.84	1.49	10.93	12.8	12.4	15.1	12.8
B_2	D_1	27.8	91.02	50.8	82.67	63.07	0.77	2.3	0.37	2.08	1.38	11.57	14.02	11.75	15.32	13.17
	D_2	79.77	126.07	93.22	122.9	105.49	1.95	2.37	1.27	2.13	1.93	11.67	14.85	12.09	15.35	13.49
	Mean	53.78	106.96	72.01	101.01	84.28	1.36	2.65	1.82	2.6	1.65	11.92	14.03	12.7	15.38	13.5
B_3	D_1	34.87	140.55	85.27	115.65	94.08	1.65	2.96	2.17	1.07	1.96	12.92	14.75	13.62	15.82	14.28
	D_2	96.62	161.47	124.31	144.05	131.61	2.37	4.13	3.11	3.6	2.65	15.75	17.87	16.57	18.62	17.2
	Mean	65.75	129.85	96.53	104.37	112.84	2.01	3.28	2.64	2.69	2.3	14.68	15.77	15.64	16.85	15.74
		For comparing means of spacing and depth of planting														
	D_1	26.86	85.03	49.81	60.01	55.42	0.97	2.14	1.27	1.6	1.49	12.76	13.35	13	15.23	13.32
	D_2	77.9	130.63	96.02	124.99	107.38	1.92	3.3	2.42	3.12	2.69	13.3	14.97	13.21	16.32	14.72
	Mean	52.38	107.83	72.92	92.61	81.4	1.44	2.72	1.84	2.36	2.09	13.03	14.16	13.1	15.77	
		S Ed		CD at 5%			S Ed		CD at 5%			S Ed		CD at 5%		
Spacing		0.41		0.85			0.016		0.030			0.09		0.19		
Bulb size		0.35		0.73			0.014		0.029			0.08		0.17		
Depth of planting		0.29		0.60			0.011		0.024			0.06		0.14		
Sp x Bs		0.71		1.47			0.02		0.06			0.16		0.34		
Bs x Dop		0.5		1.04			0.02		0.041			0.11		0.24		
Sp x Dop		0.58		1.2			0.023		0.048			0.13		0.28		
Sp x Bs x Dop		0.82		1.71			0.033		0.069			0.2		0.41		

Rashmita Toppo (2014) in tuberose. Ramachandrudu and Thangam (2007) reported that more leaf length at closer spacing may be attributed to more leaf density or leaf area index in gladiolus. Maximum chlorophyll content under wider spacing with bigger bulbs at deeper depth of planting might be due to proper anchorage, less competition and availability of nutrients especially nitrogen is essential for chlorophyll content. These results are in conformity with results of Singh (2000) and Sharma and Gupta (2003) and Pranavrana (2005) in gladiolus and Rashmita Toppo (2014) in tuberose.

The data pertaining to the effect of different levels of spacing, bulb size and depth of planting on floral characters of tuberose cv. Suvasini as presented in (Table 3 and Table 4) indicated that the treatment S_4 (45x30 cm) took significantly least number of days for first spike emergence (130.43 days) and 50% floret opening (142.80 days) compared to remaining spacings. The wider spacing recorded highest number of spikes per clump (3.65) with longest spike (93.40 cm), more spike weight (123.06 g) and having highest number of florets per spike (46.67) as compared to S_1 but it was followed by S_2. The production of more number of spikes having more florets may probably be due to less competition between the plants for water, minerals, nutrition and light, which is in conformity with the results of Singh and Kumar (1999), Nagaraju *et al*. (2004) and Malam *et al*. (2010) in tuberose and Bhat *et al*. (2008), Sudhakar and Ramesh (2012) and Regar *et al*. (2016) in gladiolus.

As regards to bulb size, the data presented in (Table 3 and Table 4) revealed that bigger sized bulbs (> 3.0 cm) took less number of days (133.88 days) for spike emergence, (169.79 days), 50% floret opening and produced more number of

spikes (2.71) with longest spikes (82.30) having maximum number of florets (46.29) with maximum spike weight (119.53 g) as compared to smaller bulbs B_1 and B_2. The bigger sized bulbs showed better results in case of flower production and quality, which might be due to the more reserve metabolites being present in larger bulbs, that helps in production of more number of quality flowers. Ogale *et al*. (1995) found similar results in gladiolus there by confirming the present findings.

In case of depth of planting the data presented in (Table 3 and Table 4) indicated that the deeper planting (6 cm) recorded more number of days (160.19 days) for spike emergence, (217.79 days) 50% floret opening as compared to shallow depth of planting (143.55 days), (204.58 days). This might be due to late emergence of plants in the field. The deep planting was responsible for significant increase in number of spikes per plant (2.82). Though the length of the spike recorded maximum (85.22 cm) in deeper planting (6 cm), the girth of the spike and floret were found more in shallow depth of planting. The longevity of the spike under field condition was recorded maximum(14.72 days) in 6 cm depth of planting. The deeper planting of bulbs at 6 cm might had resulted in healthy spikes with quality flowers. These results were in line to the findings of Mane *et al*. (2007) in tuberose Cv. Single.

Effects of interaction

The two way interactions between the spacing x bulb size, Bulb size x depth of planting and spacing x depth of planting on vegetative parameters was found significant. The three way interaction between spacing, bulb size and depth of planting was also found to be significant in respect of all growth and spike parameters. The data in (Table 5) revealed that spike yield per plot and hectare (Fig.1) was maximum under 30x30 cm spacing with > 3.0 cm bulbs at deeper depth of planting (6.0cm). It may be due to increased vegetative parameters such as number of leaves, leaf area index, chlorophyll content and yield attributing parameters *viz.,* number of spikes, spike length, number of florets per spike, spike weight. Similar results were reported by Kadam *et al*. (2005), Mane *et al*. (2007), Malam *et al*. (2010) ,Abdollah Hatamzadeh *et al*.(2012) and Rashmita Toppo (2014) in tuberose. The higher field vase life was recorded in treatmental combination 45x30 cm spacing with >3 cm bulb size and 6 cm depth of planting may be due to less competition for nutrients, water and light under wider spacing. The bigger sized bulbs might have contributed for better vase life due to sturdy growth of the plant with continuous food supply. Nagaraju *et al*. (2004) reported that initial vigour and subsequent availability of water and nutrients known to keep the plant healthy and green for longer periods of time, thus it improves the longevity of the spikes. Similar results were also reported by Mane *et al*. (2007), Abdollah *et al*. (2012) and Rashmita Toppo (2014) and in tuberose.

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