

Influence of different spacing and plant growth regulators on flower yield and vase life of spider lily under Middle Gujarat Agro Climatic conditions

M. M. MASU¹, D. D. PAREKH², B. N. SATODIYA³, H. C. PATEL⁴ AND N. I. SHAH⁵

College of Horticulture,
Anand Agricultural University, Anand-388 810 (Gujarat)

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ABSTRACT

An experiment was conducted during 2013-14 to 2015-16 to study the influence of different spacing and plant growth regulators on growth and flower yield of spider lily under middle Gujarat Agro Climatic conditions at College Nursery, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand. Local cultivar of spider lily was used in experiment and transplanting of spider lily crop is carried out in *Kharif* season of the year 2013 i.e. second fortnight of July, 2013. Three different planting distance viz. 90 x 45 cm, 60 x 60 cm and 60 x 45 cm and foliar spray of two different plant growth regulators viz. gibberellic acid and naphthalic acetic acid were used as treatment. Spider lily crop grown at distance of 60 x 60 cm and two spray of Gibberellic acid @ 200 mg per litre was most effective treatment which improved the flower quality and increased the flower yield of spider lily.

Key words: Spider lily, growth regulators

Spider Lily (*Hymenocallis speciosa* L.) belongs to the genus *Hymenocallis* of Amaryllidaceae family. It comprising of about 40 species of bulbous plants and of native of Peru, South America. It is cultivated for the beneficial white fragrant flowers. *Hymenocallis speciosa* L. is commonly called 'spider Lily' whose flower have spider like appearance. Its white mild sweet fragrant flowers are utilized as different ornamentals preparation like *venies*, *gajras*, garlands etc. Lily flowers are mostly used in the preparation of garlands especially for colour contrast because of their white colour. Spider Lily is commercially grown and the area under cultivation is increasing day by day. In recent years, scientists have given due attention for improving the growth, flowering, yield and quality of flower crops with the application of plant growth regulators in various ways. Response of flowering plants to growth regulators treatments are being studied with a view of having compact plants with

greater number of flowers and also to hasten or delay flowering according to the need of growers (Yawale *et al.*, 1998).

MATERIALS AND METHODS

The research experiment was conducted on 'influence of different spacing and plant growth regulators on growth and flower yield of spider lily under middle Gujarat agro climatic conditions' at College Nursery, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand during the year 2013-14 to 2015-16. Local cultivar of spider lily was used in experiment and transplanting of spider lily crop is carried out in *Kharif* season of the year 2013 i.e. second fortnight of July, 2013. The experiment was carried out in Middle Gujarat Agro Climatic Zone-III. The recommended dose of fertilizer of 20 ton per hectare Farm Yard Manure (FYM) and 300:200:200 (NPK) kg/ha were given in the experiment. In which, nitrogen was applied in 4 equal splits in June, September, December and March months while, Farm Yard Manure (FYM), phosphorus and potash were applied as basal dose.

¹ Assistant Research Scientist, Directorate of Research

² Assistant Professor, ³ Associate Professor, ⁴ Principal,

⁵ Professor and Head, Department of Horticulture, B. A. College of Agriculture.

Three different planting distance and foliar spray of two different plant growth regulators viz, gibberellic acid and naphthalic acetic acid were used as treatment and it was comprised four replications. The experiment was laid in Split Plot Design (SPD) and consist of three spacing treatments viz., S₁- 90 x 45 cm, S₂- 60 x 60 cm S₃- 60 x 45 cm in main plot and 8 Foliar spray treatments viz., T₁- gibberellic acid @ 100 mg/l, T₂-Foliar spray of gibberellic acid @ 150 mg/l, T₃-Foliar spray of gibberellic acid @ 200 mg/l, T₄-Foliar spray of Naphthalic acetic acid (NAA) @ 50 mg/l, T₅-Foliar spray of Naphthalic acetic acid (NAA) @ 100 mg/l, T₆-Foliar spray of Naphthalic acetic acid (NAA) @ 150 mg/l, T₇-Water Spray (control) and T₈-No spray (control) in sub plot. Spraying of plant growth regulators twice at 45 and 60 days after planting of bulb in first year. From second year onwards spraying will be done at 45 and 60 days after cutting of leaves. Cutting of leaves will be done in the month of March.

RESULTS AND DISCUSSION

Number of flower buds per stalk

The individual effect of spacing on number of flower buds per stalk was found significant during the years (Table 1). The significantly maximum number of flower bud per stalk was recorded with treatment of spacing of 60 x 60 cm in the year 2013-14 and 60 x 45 cm in the year 2014-15 and 2015-16 while, effect of spacing on number of flower buds per stalk was found non-significant in pooled analysis. Whereas, the individual effect of plant growth regulators on number of flower buds per stalk was found significant during the all the years and in pooled analysis. The significantly maximum number of flower buds per stalk was recorded with gibberellic acid @ 200 mg/l treatment as compared to other treatments of plant growth regulators during all the years and in pooled analysis. The increase in number of flowers buds per stalk could

Table 1 Effect of spacing and plant growth regulators on number of flower buds per stalk of spider lily

Treatments	Year			Pooled
	2013-14	2014-15	2015-16	
A. Effect of spacing				
S ₁ – 90 x 45 cm	16.52	16.41	15.47	16.13
S ₂ – 60 x 60 cm	17.15	16.50	15.50	16.38
S ₃ – 60 x 45 cm	16.59	17.07	16.12	16.59
S.Em±	0.103	0.11	0.12	0.19
CD at 5%	0.36	0.38	0.40	NS
B. Effect of PGR's				
T ₁ -Gibberellic acid – 100 mg/l	15.95	16.00	15.01	15.65
T ₂ - Gibberellic acid – 150 mg/l	16.88	16.86	15.85	16.53
T ₃ - Gibberellic acid – 200 mg/l	19.58	18.67	17.67	18.63
T ₄ - NAA – 50 mg/l	16.68	16.69	15.68	16.35
T ₅ - NAA – 100 mg/l	15.78	15.76	14.83	15.45
T ₆ - NAA – 150 mg/l	16.87	16.84	15.92	16.54
T ₇ - Water Spray (control)	16.97	16.94	16.02	16.64
T ₈ - No spray (control)	15.30	15.50	14.59	15.13
S.Em±	0.206	0.21	0.22	0.12
CD at 5%	0.58	0.61	0.62	0.34
Interaction				
S x T S.Em±	0.357	0.37	0.38	0.48
CD at 5%	1.01	1.06	1.08	NS
C.V.%	4.27	4.50	4.86	4.53
Y x S				Sig.
Y x T				NS
Y x S x T				Sig.

Table 2 Interaction effect of spacing and plant growth regulators on number of flower buds per stalk for the year 2013-14, 2014-15 and 2015-16

Plant growth regulators/ Spacing	2013-14			2014-15			2015-16		
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
T ₁ - Gibberellic acid – 100 mg/l	15.55	16.80	15.50	15.57	15.47	16.97	14.58	14.48	15.97
T ₂ - Gibberellic acid – 150 mg/l	15.45	19.05	16.15	15.42	16.12	19.02	14.42	15.13	18.00
T ₃ - Gibberellic acid – 200 mg/l	18.85	21.05	18.85	17.82	18.07	20.10	16.83	17.07	19.10
T ₄ - NAA – 50 mg/l	16.90	16.10	17.05	16.92	17.02	16.12	15.93	16.03	15.10
T ₅ - NAA – 100 mg/l	15.95	15.35	16.05	15.92	16.02	15.32	14.92	15.03	14.55
T ₆ - NAA – 150 mg/l	16.75	16.70	17.15	16.72	17.12	16.67	15.97	16.10	15.67
T ₇ - Water Spray (control)	17.40	16.50	17.00	17.37	16.97	16.47	16.60	15.98	15.48
T ₈ - No spray (control)	15.30	15.65	14.95	15.47	15.17	15.87	14.48	14.17	15.12
S x PGR	S. Em±	0.357			0.37			0.38	
	C. D. at 5 %	1.01			1.06			1.08	
	C. V. %	4.27			4.50			4.86	
Y x S x T	S. Em±	0.37							
	C. D. at 5 %	1.03							

Interaction effect (Y x S) on flower buds per stalk of spider lily (Pooled)

Year/Spacing	S ₁	S ₂	S ₃
Y ₁	16.51	17.15	16.58
Y ₂	16.40	16.50	17.07
Y ₃	15.46	15.49	16.12
S. Em±	0.11		
C. D. at 5 %	0.33		

Table 3 Effect of spacing and plant growth regulators on number of stalk per clump of spider lily.

Treatments	Year			Pooled
	2013-14	2014-15	2015-16	
A. Effect of spacing				
S ₁ – 90 x 45 cm	6.29	6.05	5.04	5.79
S ₂ – 60 x 60 cm	6.06	6.31	5.30	5.89
S ₃ – 60 x 45 cm	6.29	6.31	5.31	5.97
S.Em±	0.045	0.04	0.05	0.08
CD at 5%	0.16	0.15	0.17	NS
B. Effect of PGR's				
T ₁ -Gibberellic acid – 100 mg/l	6.75	6.75	5.74	6.41
T ₂ - Gibberellic acid – 150 mg/l	6.72	6.75	5.72	6.39
T ₃ - Gibberellic acid – 200 mg/l	6.92	6.92	5.92	6.58
T ₄ - NAA – 50 mg/l	6.32	6.35	5.35	6.00
T ₅ - NAA – 100 mg/l	6.05	6.04	5.04	5.71
T ₆ - NAA – 150 mg/l	6.20	6.22	5.21	5.87
T ₇ - Water Spray (control)	5.45	5.46	4.47	5.12
T ₈ - No spray (control)	5.32	5.30	4.30	4.97
S.Em±	0.097	0.10	0.10	0.06
CD at 5%	0.275	0.28	0.28	0.16
Interaction				
S x T S.Em±	0.168	0.17	0.17	0.09
CD at 5%	NS	NS	NS	NS
C.V.%	5.41	5.60	6.64	5.84
Y x S				Sig.
Y x T				NS
Y x S x T				NS

Interaction effect (Y x S) on No. of stalk per clump of spider lily (Pooled)

Year/Spacing	S ₁	S ₂	S ₃
Y ₁	6.29	6.06	6.28
Y ₂	6.05	6.31	6.31
Y ₃	5.04	5.30	5.31
S. Em±	0.05		
C. D. at 5 %	0.14		

Table 4: Effect of spacing and plant growth regulators on Bud length (cm) of spider lily

Treatments	Year			Pooled of year
	2013-14	2014-15	2015-16	
A. Effect of spacing				
S ₁ – 90 x 45 cm	18.02	17.70	16.69	17.48
S ₂ – 60 x 60 cm	17.71	18.00	17.07	17.59
S ₃ – 60 x 45 cm	17.72	17.69	16.69	17.37
S.Em±	0.393	0.39	0.40	0.23
CD at 5%	NS	NS	NS	NS
B. Effect of PGR's				
T ₁ -Gibberellic acid – 100 mg/l	18.50	18.47	17.45	18.14
T ₂ - Gibberellic acid – 150 mg/l	18.24	18.23	17.23	17.90
T ₃ - Gibberellic acid – 200 mg/l	18.17	18.17	17.17	17.84
T ₄ - NAA – 50 mg/l	17.63	17.60	16.61	17.28
T ₅ - NAA – 100 mg/l	17.63	17.60	16.61	17.28
T ₆ - NAA – 150 mg/l	17.80	17.78	16.78	17.46
T ₇ - Water Spray (control)	17.67	17.64	16.80	17.37
T ₈ - No spray (control)	16.90	16.88	15.88	16.55
S.Em±	0.69	0.69	0.70	0.40
CD at 5%	NS	NS	NS	NS
Interaction				
S x T S.Em±	1.209	1.21	1.21	0.70
CD at 5%	NS	NS	NS	NS
C.V.%	13.56	13.60	14.39	13.84
Y x S				NS
Y x T				NS
Y x S x T				NS

be attributed to the increase in photosynthesis and respiration with enhanced carbohydrate fixation in GA₃ treated plants. This result is in conformity with the result obtained by Misra *et al* (2000) in lily and Nagaraja *et al* (1999), Singh (1999), Tak and Nagda (1999) in tuberose. The interaction effect of spacing and plant growth regulators on number of flower buds per stalk was found significant during all the years but, it was found non-significant in pooled analysis (Table 2). The treatment combination of T₃S₂ gave significantly the highest number of flower buds per stalk in the year 2013-14 and 2014-15. The interaction effect of Y x S and Y x S x T were also significant.

Number of stalk per clump

The data presented in Table 3 indicated that the individual effect of spacing on number of stalk per clump was found significant during the year 2013-14, 2014-15 and 2015-16. The significantly maximum number of stalk per clump was recorded with treatment of 90 x 45 cm spacing and 90 x 45 cm spacing as compared to 60 x 60 cm spacing in 2013-14. The significantly maximum number of stalk per clumps

was recorded at a spacing of 60 x 60 cm and 60 x 45 cm in 2014-15 and 60 x 45 cm spacing in 2015-16. The effect of spacing on number of stalk per clump was found non-significant in pooled analysis. The individual effect of plant growth regulators on number of stalk per clump was found significant during all the years and in pooled analysis. The maximum number of stalk per clump was recorded with gibberellic acid @ 200 mg/l as treatment as compared to other treatments of plant growth regulators during all the years and in pooled analysis. The interaction effect of spacing and plant growth regulators on number of stalk per clump was found non-significant during all the years as well as in pooled analysis. The interaction effect of Y x S was significant.

Bud length (cm)

The individual effect of spacing on bud length was found non-significant during all the years and in pooled analysis (Table 4). The individual effect of plant growth regulators on bud length was found non-significant during all the year and in pooled analysis. The higher bud length of spider lily was recorded in all the

Table 5 Effect of spacing and plant growth regulators on Fresh flower weight (g) of spider lily.

Treatments		Year			Pooled
		2013-14	2014-15	2015-16	
A. Effect of spacing					
S ₁ – 90 x 45 cm		2.30	2.31	2.18	2.26
S ₂ – 60 x 60 cm		2.34	2.22	2.12	2.22
S ₃ – 60 x 45 cm		2.32	2.37	2.27	2.32
S.Em±		0.052	0.06	0.07	0.04
CD at 5%		NS	NS	NS	NS
B. Effect of PGR's					
T ₁ -Gibberellic acid – 100 mg/l		2.31	2.27	2.08	2.22
T ₂ - Gibberellic acid – 150 mg/l		2.29	2.30	2.20	2.26
T ₃ - Gibberellic acid – 200 mg/l		2.47	2.47	2.37	2.46
T ₄ - NAA – 50 mg/l		2.24	2.21	2.12	2.19
T ₅ - NAA – 100 mg/l		2.31	2.28	2.18	2.26
T ₆ - NAA – 150 mg/l		2.15	2.15	2.05	2.12
T ₇ - Water Spray (control)		2.28	2.22	2.12	2.21
T ₈ - No spray (control)		2.50	2.50	2.20	2.40
S.Em±		0.121	0.11	0.12	0.07
CD at 5%		NS	NS	NS	0.19
Interaction					
S x T	S.Em±	0.210	0.200	0.210	0.120
	CD at 5%	NS	NS	NS	NS
	C.V.%	18.08	17.92	19.43	18.46
Y x S					NS
Y x T					NS
Y x S x T					NS

treatments of gibberellic acid as compared to other treatments of foliar spray. The increase in the bud length may be due to the cell elongation and cell division or both. This result is in accordance with the findings of Nagaraja *et al* (1999), Singh (1999) and Tak and Nagda (1999) in tuberose.

Fresh flower weight (g)

The data presented in Table 5 indicated that the individual effect of spacing on fresh flower weight was found non-significant during all the years and in pooled analysis. The individual effect of plant growth regulators on fresh flower weight was found non-significant during the year 2013-14, 2014-15 and 2015-16 but, it was significant in pooled analysis. The significantly maximum fresh flower weight (2.46 gm) was recorded with gibberellic acid @ 200 mg/l in pooled analysis. The increase in fresh

flower weight might be due to attributable to the increased spike length and accumulation of more food material.

Number of flower bundles per hectare

The individual effect of spacing on number of flower bundles per hectare was found significant during all the years and in pooled analysis (Table 6). The significantly maximum number of flower bundles per hectare was recorded with treatment of spacing (60 x 45 cm) as compared to other spacing treatments. The individual effect of plant growth regulators on number of flower bundles per hectare was found significant during the all the years and in pooled analysis. The significantly maximum number of flower bundles per hectare (80562 in 2013-14, 76821 in 2014-15 and 62167 in 2015-16) were recorded with gibberellic acid @ 200 mg/l treatment as compared

Table 6 Effect of spacing and plant growth regulators on Number of flower bundles per hectare of spider lily

Treatments	Year			Pooled
	2013-14	2014-15	2015-16	
A. Effect of spacing				
S ₁ – 90 x 45 cm	51533	57020	44794	51116
S ₂ – 60 x 60 cm	58224	63802	48976	57000
S ₃ – 60 x 45 cm	77747	68383	54379	66836
S.Em±	708.47	1127.97	513.74	2945.07
CD at 5%	2451.71	3903.43	1777.86	11561.93
B. Effect of PGR's				
T ₁ -Gibberellic acid – 100 mg/l	64191	65432	52256	60627
T ₂ - Gibberellic acid – 150 mg/l	67775	69224	55303	64101
T ₃ - Gibberellic acid – 200 mg/l	80562	76821	62167	73183
T ₄ - NAA – 50 mg/l	63414	68725	50529	60889
T ₅ - NAA – 100 mg/l	57600	56516	44329	52815
T ₆ - NAA – 150 mg/l	63038	62616	49558	58404
T ₇ - Water Spray (control)	55336	55521	42879	51245
T ₈ - No spray (control)	48095	49693	38045	45277
S.Em±	1133.72	2400.57	1228.41	975.07
CD at 5%	3205.041	6786.44	3472.73	2702.75
Interaction				
S x T S.Em±	1963.66	4157.91	2127.67	5939.18
CD at 5%	5551.291	11754.47	6014.95	17159.72
C.V.%	6.29	13.19	8.61	10.03
Y x S				Sig.
Y x T				NS
Y x S x T				Sig.

to rest of the treatments of plant growth regulators. This increase in yield might be due to the availability of desirable food materials and more carbohydrate supply which ultimately effects on flowers production. These results are in accordance with the findings of Khan and Tewari (2003) in dahlia; Maurya and Nagda (2002) in gladiolus and Tak and Nagda (1999) in tuberose. The interaction effect of spacing and plant growth regulators on number of flower bundles per hectare was found significant during all the years and in pooled analysis (Table 7). The interaction effects of Y x S and Y x S x T were also significant.

Vase life (hours)

The data presented in Table 8 revealed that the individual effect of spacing on vase life was found non-significant during the year 2014-15, 2015-16 and in pooled analysis but, it was significant in the year 2013-14. The significantly maximum vase life was recorded with treatment of spacing of 60 x 45 cm (17.01 hour) as compared to another

spacing and which was at par with spacing of 60 x 60 cm (16.94 hour). The individual effect of plant growth regulators on shelf life was found significant during all the years and in pooled mean. The significantly maximum vase life (18.55 hrs in 2013-14, 18.61 hrs in 2014-15, 17.30 hrs in 2015-16 and 18.16 hrs in pooled) was recorded in treatment of gibberellic acid @ 200 mg/l as compared to rest of the treatments during all the years and in pooled analysis. The interaction effect of spacing and plant growth regulators on vase life was found non-significant during all the years and in pooled analysis.

CONCLUSION

The result obtain from the present investigation concluded that, spider lily crop grown at distance of 60 x 60 cm and two spray of Gibberellic acid @ 200 mg per litre was most effective treatment which improved the flower quality and increased the

Table 7 Interaction effect of spacing and plant growth regulators on number of flower bundles per hectare

Plant growth regulators/ Spacing	2013-14			2014-15			2015-16		
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
T ₁ - Gibberellic acid – 100 mg/l	52736	61345	78493	51059	58773	86465	40288	46940	69539
T ₂ - Gibberellic acid – 150 mg/l	51462	71692	80171	52466	60032	95174	41504	47690	76715
T ₃ - Gibberellic acid – 200 mg/l	65304	80044	96337	67475	92415	70573	54336	74655	57510
T ₄ - NAA – 50 mg/l	55015	52528	82700	55539	97389	53248	43414	65882	42320
T ₅ - NAA – 100 mg/l	46891	48642	77267	66896	52075	50577	51637	41313	40038
T ₆ - NAA – 150 mg/l	50336	58456	80322	77487	54141	56219	62080	42458	44136
T ₇ - Water Spray (control)	48748	48097	69163	45365	51786	69411	35038	39856	53744
T ₈ - No spray (control)	41775	44986	57522	39873	43806	65402	30060	33042	51031
S x T		1963.66			4157.91			2127.67	
					11754.47			6014.96	
					13.19			8.61	
Y x S x T		2925.21							
		8108.28							

Interaction effect (Y x S) on number of flower bundles per hectare of spider lily (Pooled)

Year/Spacing	S ₁	S ₂	S ₃
Y ₁	51533	58224	77747
Y ₂	57020	63802	68383
Y ₃	44794	48976	54379
S. Em±		824.25	
C. D. at 5 %		2449.07	

Table 8 Effect of spacing and plant growth regulators on Vase life (hours) of spider lily

Treatments	Year			Pooled	
	2013-14	2014-15	2015-16		
A. Effect of spacing					
S ₁ – 90 x 45 cm	16.14	16.62	15.41	16.11	
S ₂ – 60 x 60 cm	16.94	16.13	15.07	16.05	
S ₃ – 60 x 45 cm	17.01	16.83	16.00	16.65	
S.Em±	0.167	0.10	0.21	0.23	
CD at 5%	0.58	NS	NS	NS	
B. Effect of PGR's					
T ₁ -Gibberellic acid – 100 mg/l	16.38	16.60	15.31	16.10	
T ₂ - Gibberellic acid – 150 mg/l	17.15	17.16	15.67	16.66	
T ₃ - Gibberellic acid – 200 mg/l	18.55	18.61	17.30	18.16	
T ₄ - NAA – 50 mg/l	16.63	16.60	15.47	16.23	
T ₅ - NAA – 100 mg/l	15.71	16.27	15.14	15.71	
T ₆ - NAA – 150 mg/l	15.55	16.05	15.24	15.62	
T ₇ - Water Spray (control)	17.50	15.95	15.04	16.17	
T ₈ - No spray (control)	16.12	15.72	14.76	15.53	
S.Em±	0.539	0.46	0.43	0.28	
CD at 5%	1.52	1.32	1.23	0.77	
Interaction					
S x T	S.Em±	0.934	0.81	0.43	0.48
	CD at 5%	NS	NS	NS	NS
	C.V.%	11.19	9.75	9.71	10.27
Y x S					Sig.
Y x T					NS
Y x S x T					NS

Interaction effect (Y x S) on Vase life (hours) of spider lily (Pooled)

Year/Spacing	S ₁	S ₂	S ₃
Y ₁	16.14	16.94	17.01
Y ₂	16.78	16.13	16.96
Y ₃	15.40	15.07	16.00
S. Em±	0.17		
C. D. at 5 %	0.50		

flower yield of spider lily. Spraying of Gibberellic acids twice at 45 and 60 days after planting of bulb in first year and from second year onwards, spraying will be done at 45 and 60 days after cutting of leaves. Cutting of leaves will be done in the month of March.

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