DOI : 10.5958/0974-0112.2018.00111.1

Indian J. Hort. 75(4), December 2018: 662-666

Effect of staggered planting date on growth, floral, bulb and economic parameters in Phule Rajani tuberose under subhumid southern plains of Rajasthan

Ravi K. Meena, L. N. Mahawer* and H. L. Bairwa

Maharana Pratap University of Agriculture and Technology, Udaipur 313 001, Rajasthan

ABSTRACT

An investigation was carried out during 2013 and 2014 to find out an effect of staggered planting date on growth, floral, bulb and economic parameters in tuberose cv. Phule Rajani. The treatment comprised with various staggered planting dates *viz.* 15th April, 30th April, 15th May, 30th May, 15th June and 30th June at 15 days interval. Out of six staggered planting treatment P_1- 15th April were found significantly superior for leaves plant^{-1} (31.09), plant height (66.81 cm), spike length (59.94 cm), days to spike emergence (111.03), days to flower bud break (122.03), floret spike^{-1} (35.72), durability of spike (9.36 days), spike plant^{-1} (3.78), spike weight (72.12 g), bulb weight plant^{-1} (173.89 g), bulbs plant^{-1} (6.87, 16.43), gross return (₹ 680539 ha^{-1}), net return rupees (₹ 469506 ha^{-1}) and benefit / cost ratio (3.01) with highest trends in this planting which was found better over other staggered planting dates. Therefore, on the basis of two year study, it may be concluded that staggered planting from 15th April to 30th May can provide continuous supply of cut spike to market from tuberose planted field and resulted in ensure return to farmers.

Key words: *Polianthes tuberosa*, spike, planting time.

INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) is an important cut flower contains diploid chromosome 2n=60 for single type, belongs to family Amaryllidaceae, which is native from Maxico and commonly known as Gulcheri (Hindi), Rajnigandha (Bengali), Gul shabbo (Urdu), Nishigandha (Marathi), Nishigandhi (Malayalam) and Nelasampengi (Tamil). Commercially grown flowers for cut flower trade due to long vase life, loose flower and perfumery industry. The bulb of tuberose contains significant amount of '*hecogenin*' and '*tegogenine*' as alkaloid and also in small quantities medicinally active compounds. It is commercially cultivated in most of the tropical and subtropical parts of the world. Presently total estimated area under Indian floriculture is 317.2 '000' ha, total loose flower production 1804.52 '000' metric tons and 501000 lakh spikes during 2014-15 as reported by (Saxena *et al.,* 14) Tuberose is cultivated on large scale in France, South Africa, North Carolina, USA and India at world level. Major tuberose growing states in India are Karnataka, West Bengal, Maharashtra, Andhra Pradesh and Tamilnadu. It is grown mainly for cut flowers, table decoration, bouquet, garland, veni and gazra. The cultivation of tuberose on commercial basis is being taken up around big cities in India. For getting continuous supply of quality flowers, staggered planting time is one of the most important factors. The climatic factors like temperature, humidity and rainfall play a major role in successful tuberose production. The staggered planting dates ensure a continuous supply of cut flowers over an extended period of harvest and which can avoid glut in the market. Staggered planting time provide continuous flower, regular income to growers, employment and increased flower duration. Scanty research work is available on tuberose for particularly on the staggered planting dates. The present investigation was therefore undertaken to study the effect of staggered planting dates on vegetative growth, floral, bulb and economic parameters in tuberose under Sub-Humid Southern Plain and Aravali Hills of Rajasthan.

MATERIALS AND METHODS

The present study was initiated during 20013-14 and 2014-15 AICRP on Floriculture, Horticulture Farm, Department of Horticulture, Maharana Pratap University of Agriculture and Technology, Udaipur, which is situated at 24°35' N latitude and 73° 42' E longitudes at an elevation of 579.5 meters above mean sea level. The field had fairly leveled topography and clay loamy soil with pH 7.45 and EC 0.57 dS / m under irrigated condition. The experiment was laid out in randomized block design replicated four times with six staggered planting dates treatment. The healthy and disease free

*Corresponding author's E-mail: mahawer68@gmail.com

tuberose bulbs selected for planting had uniform diameter *i.e.* between 2.0-2.5 cm. Tuberose bulb cultivar Phule Rajani was planted on 15 April 2013, 30 April 2013, 15 May 2013, 30 May 2013, 15 June 2013 to 30 June 2013 at 15 days interval for staggered planting. The staggered planting was done at spacing 30 × 30 cm (Row × Plant) at a depth of 5-6 cm and covered with soil mixture properly. Subsequent irrigations were given at 7 days intervals during the summer season except rainy days. Irrigation was with held 30 days before bulb lifting for better bulb & bulblet development during dormancy. Before planting the tuberose bulbs were treated with bavistin @ 2g/per liter of water to avoid fungal contamination. The full dose of phosphorus in the form of single super phosphate (SSP), potash in the form of muriate of potash (MOP) and one-third dose of nitrogen in the form of urea were applied as basal dose at the time of last ploughing in field before bulbs planting of tuberose. Remaining two-third nitrogen was applied in two equal split doses in the form of top dressing at 30 and 60 days after bulb planting. The observations were recorded on various parameters, *viz.* leaf length, leaves plant^{-1}, plant height, spike length, rachis length, days to spike emergence, days to flower bud break, days to open 1st floret, days to open last floret on spike, floret opening at a time, floret remains open at a time, floret spike^{-1}, durability of spike in field, spikes plant^{-1}, spike weight, floral weight spike plant^{-1}, bulb diameter, bulb plant^{-1} and bulb weight plant^{-1}, respectively. Once planted tuberose crop observed subsequently during 2013 and 2014 for growth, floral and bulb parameters. There were 36 bulbs per plot. The data were recorded on ten plants per treatment per replication on vegetative growth, floral, bulb and economic parameters. The data were statistically analyzed at 5 % level of significance as per the method suggested by (Panse and Sukhatme, 13)

RESULTS AND DISCUSSION

The two year pooled data (Table 1) showed significant influence on highest leaf length (28.81 cm), leaves plant^{-1} (31.09), plant height (66.81cm), spike length (59.94 cm) and rachis length (27.62 cm) at staggered planting P_1- 15th April, followed by staggered planting P_2- 30th April and lowest trends at 30th June 2013, 2014 respectively, which might be favored by optimum temperature and longer days prevailing for more sunshine hours during the crop growth period. Climatic condition exist on the basis of two year average data for temperature during day 36.0°C, night 23.4°C, relative humidity during day 57.1 %, night 36.8 % and rainfall appears to be 16.83 mm at vegetative stage on staggered planting dates in tuberose on 15th April 2013, 2014 respectively. More leaves per plant is governed by gene and under earlier sown condition might be due to the fact that the crop received congenial temperature and longer sunny hour's days during early stages of growth which might be resulted in higher rate of photosynthesis, which ultimately has reflected for increased number of leaves. Present finding are in conformity with the findings obtained by (Asif *et al.,* 2) i.e. best planting time last week of March and first week of April in tuberose.

Whereas, highest plant height was observed on 15th April planted tuberose bulbs. This might be attributed to the fact, that during this period the day and night temperature was favorable for the synthesis of growth stimulating compounds, absorption of nutrients, cell division and cell elongation which might be resulted in vigorous growth and higher plant height. However, shortest plant height was recorded on 15th, 30th of June bulb planting due to higher temperature and hot dry condition prevailing at the time of experimentation. The increase in spike and rachis length might be because of cell division, cell elongation and longer days during spike/ rachis formation stage, which increases synthesis of amino

Table 1. Effect of staggered planting on growth and floral parameters in Phule Rajani Tuberose.

Treatment	Leaf length (cm)	Leaves plant^{-1}	Plant height (cm)	Days to spike emergence	Days to flower bud break	Spike length (cm)	Rachis length (cm)	Days to open 1st floret	Days to open last floret
P_1 15 April	28.81	31.09	66.81	111.03	122.03	59.94	27.62	124.43	133.79
P_2 30 April	27.33	27.61	65.96	112.69	123.69	58.86	27.08	127.35	135.31
P_3 15 May	26.09	26.80	61.47	115.97	126.97	54.28	24.79	129.39	137.85
P_4 30 May	25.32	26.27	60.48	116.86	127.86	53.19	24.25	130.26	138.54
P_5 15 June	25.24	25.98	60.95	118.12	129.12	54.07	24.68	131.52	139.58
P_6 30 June	25.09	25.63	58.17	119.37	130.37	50.93	23.12	132.77	140.60
CD (P= 0.05)	1.16	1.60	3.65	3.02	2.08	2.18	1.21	2.81	2.21

acids, chlorophyll formation and better carbohydrate transformation, which resulted into better rachis length and ultimately produced more florets per spike. This might also be due to the fact that long days caused better plant vegetative growth and stimulated the auxiliary buds resulting in more rachis length.

Further, staggered planting dates significantly showed earliest days to spike emergence (111.03), days to flower bud break (122.03), days to open 1st floret (124.43) and days to open last floret on spike (133.79) were recorded in staggered planting P_1- 15th April, followed by P_2- 30th April, whereas highest in 15, 30th June 2013, 2014 staggered planting. Late spike initiation may be due to late bulb sprouting, slow vegetative growth, lower synthesis of florigen in plant which entered late in to reproductive phase. The present finding are in conformity with the finding of Mishra (9), Singh and Kumar (17), Trivedi *et al.* (19), Gurav *et al.* (4), Nair *et al.* (11), Padaganur *et al.* (12), Sharma *et al.* (16), Kumar *et al.* (8) and Ikram *et al.* (5) in *Polianthes tuberosa.*

Although, two year pooled data (Table 2) reveals that significant influence with highest trends for floret opening at a time (5.14), floret remains open at a time (9.16), floret spike^{-1} (35.72), durability of spike in field (9.36 days), spikes plant^{-1} (3.78), spike weight (72.12 g) and floral weight spike plant^{-1} (137.18 g) were recorded at staggered planting P_1- 15th April, respectively followed by P_2- 30th April, whereas lowest trend were recorded at 15th, 30th June 2013, 2014 staggered planting. The increase in the number of spikes plant^{-1} might be due to the fact of availability of more food, water, air and light and optimum temperature during spike initiation period that promoted the number of spikes plant^{-1}. In respect to number of spikes plant^{-1} similar results were reported by (Padaganur *et al.,* 12) in tuberose. This might be due to the fact that occurrence of favorable climatic condition at the time of spike initiation *viz*., two year average data for temperature during day 29.7°C, night 23.5°C, relative humidity during day 86.6 %, night 73.5 % and rainfall appears to be 48.6 mm exist at the time of spike development stage on staggered planting treatment P_1- 15th April during 2013, 2014 respectively. It was possible due congenial temperature, more sunlight, nutrient uptakes in presence of water and CO_2 increases rate of photosynthesis which improve C: N ratio and florigen synthesis which ultimately resulted in early initiation of spike emergence. The acceleration of flower emergence in the present investigation was most probably due to induction of early and vigorous vegetative growth by planting the tuberose bulbs on 15th April 2013 and 2014. According to earlier findings, tuberose grew and flowered well under high humidity (Sharga, 15). The present findings are in conformity with the findings of Mukhopadhyay and Bankar (10), Yadav and Bose (20), Datta (3) and Ikram *et al.* (5) in tuberose.

Whereas, two year pooled data also represented that bulb diameter, bulb plant^{-1} and bulb weight plant^{-1} increased significantly with different staggered planting dates except those tuberose bulb planted on 15, 30th June. The highest bulb diameter (2.93 cm), bulb weight plant^{-1} (173.89 g) and bulb plant^{-1} (11.65) was recorded on 15th April planting followed by 30th April, 15th, 30th May, while lowest trends for bulb diameter, bulb plant^{-1} and bulb weight plant^{-1} were recorded on 15th, 30th June 2013, 2014 staggered planting dates, respectively. It might be due to availability of more nutrients uptake, presence of sun light with the help of chlorophyll that ultimately increases the rate of photosynthesis and translocation of assimilates through phloem transport system to sink which is in the form bulb. The bulbs planted on 15, 30th April 2013, 2014 resulted highest weight which was due to the effect of plant morphological characters like size, more numbers of leaves improved photosynthesis which help translocation of carbohydrate through phloem

Table 2. Effect of staggered planting on floral and bulb parameters in Phule Rajani Tuberose.

Treatment	Floret opening at a time	Floret remains open at a time	Floret spike^{-1}	Durability of spike in field	Spikes plant^{-1}	Spike weight (g)	Floral weight spike plant^{-1} (g)	Bulb diameter (cm)	Bulb weight plant^{-1} (g)	Bulb plant^{-1}
P_1 15 April	5.14	9.16	35.72	9.36	3.78	72.12	137.18	2.93	173.89	11.65
P_2 30 April	4.71	8.97	32.95	9.23	3.67	68.54	123.17	2.87	158.13	11.00
P_3 15 May	4.97	8.49	32.05	8.48	3.64	67.29	118.83	2.79	150.38	10.54
P_4 30 May	4.28	8.45	31.86	8.28	3.42	66.06	110.91	2.75	148.04	10.38
P_5 15 June	4.34	8.40	31.34	8.06	3.00	65.10	95.40	2.70	147.78	10.44
P_6 30 June	3.37	8.35	30.28	7.84	2.74	59.46	84.51	2.64	133.04	9.11
CD (P= 0.05)	0.66	0.44	1.24	0.33	0.43	3.27	16.26	0.11	10.45	0.96

Table 3. Effect of staggered planting on economic feasibility in Phule Rajani tuberose.

Treatment	Cost of Production 2013	Cost of Production 2014	Spike returns (₹/ ha)	Bulb returns (₹/ ha)	Gross returns (₹/ ha)	Net return (₹/ha)	B:C ratio
P_1 15 April	277700	144367	357000	323539	680539	469506	3.01
P_2 30 April	277700	144367	346395	305587	651982	440949	2.86
P_3 15 May	277700	144367	344014	292830	636844	425811	2.79
P_4 30 May	277700	144367	323354	288307	611662	400628	2.63
P_5 15 June	277700	144367	283176	289931	573107	362073	2.40
P_6 30 June	277700	144367	258443	252992	511435	300402	2.02

**₹ 1, 33,333 was the initial planting material not required in 2014.
**Estimated market selling price ₹ 1.00/- for each cut spike and ₹ 1.20/- planting marketable bulbs at Udaipur condition

in exist sink (spike/ bulb) when spike development stage complete its flowering as reproductive phase ceases during winter and finally bulblet initiation takes place and accumulation of more carbohydrate in bulblet improve its number, diameter, fresh weight resulted in to more bulb plant^{-1} in tuberose planted on 15th April 2013, 2014. Another probable reason for this variation in numbers of tubers per plant may be governed by gene and effect of environmental conditions prevailing during the period of investigation as reported by (Kumar *et al.*, 7) in dahlia.

The findings of Suh and Kwack (18) in gladiolus also showed that the formation of good quality corms was promoted with early planting dates. Contrary results were obtained by Zubair and Wazir (21) in gladiolus suggested that delay in planting resulted in decreased corm diameter. Asif *et al.* (2) found biggest bulbs of tuberose in the month of February. The present finding are in conformity with the finding of Yadav and Bose (20), Khobragade *et al.* (6), Gurav *et al.* (4) in tuberose and Ahmad *et al.* (1) in gladiolus.

Moreover, the two year study pooled data presented (Table 3) that the significantly highest returns from spike ha^{-1} (₹ 357000), bulb (₹ 323539) gross return (₹ 680539), net return (₹ 469506) ha^{-1} and benefit cost ratio (3.01) were recorded at 15th April, followed by 30th April, 15th May and 30th May, while lowest returns were recorded 30th June during 2013 and 2014 pooled data analysis, respectively.

On the basis of two year experimentation results during 2013, 2014 it may be concluded that staggered planting from 15th April to 30th May can provide continuous supply of tuberose cut spike to market by planting tuberose bulb at 15 days interval in staggered manner in field up to May month resulted in ensure return to farmers under Sub-Humid Southern Plains and Aravalli hills of Udaipur, Rajasthan.

ACKNOWLEDGEMENT

Authors gratefully acknowledge the University Grant Commission, New Delhi for awarding Rajiv Gandhi National Fellowship for Ph.D. research work. I gratefully acknowledge the Director, ICAR-Directorate of Floriculture Research Campus New Delhi for providing planting material and Dean RCA, Udaipur for providing facility during the period.

REFERENCES

1. Ahmad I., Khattak A. M., Ara N. and Amin N. U. 2011. Effect of planting dates on the growth of gladiolus corms in Peshawar. *Sarhad J. Agric.* **27**: 195-99

2. Asif M., Qasim M. and Mustafa G. 2001. Effect of planting dates on growth, flowering and corm characteristics of tuberose *(Polianthes tuberosa)* cv. Single. *Int. J. Agri. Bio.* **3**: 391-93.

3. Datta S.K. 2000. Progress Report 1999-2000. *AICRP on Floriculture, ICAR, New Delhi* pp: 234-35.

4. Gurav S. B, Singh B. R., Desai U. T., Katwate S. M., Kakade D. S., Dhane A. V. and Kanade V. D. 2005. Influence of planting time on the yield and quality of tuberose. *Indian J. Hort.* **62**: 216-17.

5. Ikram S., Khan, N. A., Mahsud A. S. S. and Mumtaz S. 2016. Flowering quality of *polianthes tuberosa* var. Fancy White as affected by planting dates in agro metrological conditions of Islamabad. *Sci. Tech. Devel.* **35**: 47-50.

6. Khobragade R. I., Damke M. M., Jadhao B. J. and Hedau C. V. 1997. Effect of planting time and spacing on growth, flowering and bulb production of tuberose cv. 'Single'. *PKV Res. J.* **21**: 44-47.

7. Kumar L., Mahawer L. N., Shukla A. K., Kaushik R. A. and Upadhyay B. 2009. Performance of dahlia (*Dahlia variabilis*) cultivars for vegetative, floral and relative economic parameters under sub humid southern plains and Aravalli hills of Udaipur. *Indian J. Agric. Sci.* **79**: 816-20.

8. Kumar S., Sharma J., Dahiya D. S. and Singh B. 2010. Effect of time of planting on growth and flowering of tuberose. *Haryana J. Hort. Sci.* **39**: 300-02.

9. Mishra H. P. 1999. Effect of planting time on plant growth, flower and spike production of tuberose (*Polianthes tuberosa* L.). *J. App. Hort.* (Lucknow), **1**: 145-48.

10. Mukhopadhyay A. and Bankar G. J. 1981. Effect of time of planting on growth, flowering and bulb production in tuberose (*Polianthes tuberosa* L.) cv. Single. *Indian Agrit.* **25**: 131-34.

11. Nair S. A., Shiva K. N. and Singh D. R. 2004. Effect of planting time on flowering of tuberose cv. Double in Andamans. *Indian J. Hort.* **61**: 372-75.

12. Padaganur V. G., Mokashi A. N. and Patil V. S. 2005. Effect of planting time on growth and yield of tuberose cv. Single. *Karnataka J. Agric. Sci.* **18**: 551-54.

13. Panse V. G. and Sukhatme P. V. 1985. *Statistical Methods for Agricultural Workers,* pp. 145-56. ICAR Publication, New Delhi.

14. Saxena M., Bhattacharya S. and Malhotra S. K. 2016. *Horticultural Statistics at a Glance* 2015, pp. 168-169. Oxford University Press, New Delhi.

15. Sharga A. N. 1977. Tuberose for elegance and fragrance. *Indian Hort.* **21**: 25-29.

16. Sharma R. K., Dashora L. K. and Mohammed S. 2007. Effect of time of planting and nitrogen on growth and flower yield of tuberose (*Polianthes tuberosa* L.) cv. 'Double'. *Orissa J. Hort.* **35**: 108-13.

17. Singh P. V. and Kumar M. 1999. Effect of spacing, depth and time of planting on growth, flowering and bulb production of tuberose cv. Double. *J. Orn. Hort. (New Series)*, **2**: 127-30.

18. Suh J. K. and Kwack B. H. 1990. The corm formation of gladiolus influenced by dormancy-breaking methods, cormel planting and corm harvesting times. *J. Korean Soc. Hort. Sci.* **31**: 294-99.

19. Trivedi J. D, Singh A. K. and Singh O. P. 2004. Effect of planting time on vegetative and flowering characters of tuberose (*Polianthes tuberosa* L.) cv. Double. *Adv. Plant Sci.* **17**: 263-66.

20. Yadav L. P. and Bose T. K. 1988. Improved flower agro-techniques of flower production in West Bengal. *Farmer Parlia.* **23**: 15-16.

21. Zubair M., Wazir F. K., Akhtar S. and Ayub G. 2006. Planting dates affect floral characteristics of gladiolus under the soil and climatic conditions of Peshawar. *Pakistan J. Bio. Sci.* **9**: 1669-76.

Received : January, 2017; Revised : July, 2018;
Accepted : September, 2018