

Investigation and determination effects of bulb size and sowing date on quantity characteristics of *Polianthes tuberosa* in greenhouse condition of Jiroft

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ABSTRACT: Planting date and bulb size are the most effective of parameters affecting growth and flowering in bulbous plants. So, for study of planting date and bulb size on yield and flowering quality in tuberose, effect of three bulb sizes, including 1/5, 1/5-2/5 and 3-4 cm in diameter and planting date: 1 May, 1 June, 1 July on quantity characteristics of *Polianthes tuberosa* in greenhouse condition of Jiroft. The experiment was carried out as a split plot in a complete randomized block design with three replications. All the data was subjected to analysis of variance (ANOVA) using of SAS software and the means separated using the Duncan's Multiple Rang Test. percentage of germination, leaf number and vegetative growth of plantlets, days to emergence, length, diameter and number of inflorescence spike, days from emergence to first floret evaluated . Results revealed that, period of growth and flowering decreased by July Time and large bulb size resulted in vigorous growth, maximum yield and more number of bulbils as compared to small and medium sized bulbs. It was concluded that large sized bulbs with 3 – 4 cm diameter are best for planting of tuberose. planting date between of 1 May and 1 of June is recommended for good growth, best cutflower and more corms production of tuberose under greenhouse conditions of Jiroft.

Keywords: bulb size, planting date, quantity characteristics, *Polianthes tuberosa*, greenhouse, Jiroft.

INTRODUCTION

Jiroft with an area of about 2000 hectares of greenhouse is the largest center for greenhouse products in the country after Tehran. As a founder and developer of the greenhouse industry, it plays an important role in production, employment, economy, and supply of greenhouse products. With respect to suitable climate and the ability to produce all kinds of greenhouse products, cut flowers and apartment flowers, the city has promised the producers of the region, that it will have exported directly or indirectly a major part of greenhouse products in near future. Tuberose with the scientific name of *Polianthes tubrosa*, is a rhizomatous plant from the family of Agavaceae native in Mexico and is one of the most important cut flowers in Iran (Hekmati, 1382). This flower is one of a variety of cut flowers in tropical and subtropical regions that are planted both in open air and under greenhouse conditions, but if it is planted for commercial and economic purposes, it will have the best results in greenhouse conditions. (3).

A great deal of research has been done on different aspects of tuberose. A study in Egypt was done on the effects of stratification pre-treatment before planting in 5 ° C for 15 days and then placing in 100 ° water for 10 seconds, in 35° water for 24 hours on the yield and quality of tuberose 120 days after planting. It concluded that

rhizomes which cover 4 cm of the surrounding and immerse in warm water, produced the highest number of bulbs with the best quality in the plant (Ghosh. et al 2004).

In a study, the largest flowers were produced using CCC (chlormequat) (Muhammad and Nir 2004 and 2001)

In another study, November and December were introduced as the best times due to the effect of temperature and humidity on the flowering of Dile cultivar of tuberose (Eftekhar, 2011).

In a study, flowering in tuberose bulbs was adjusted by temperature and gibberellin. In this experiment, 40 and 80 ml /liter gibberellins were applied at 4 and 30 ° C for 20 days before planting. The best results in this study were obtained at 4 ° C and 40 ml/ liter gibberellin (Yang et al., 2002).

In another study in Italy, titled "Effect of bulb size and planting date on flower yield and bulb growth quality in cold greenhouses for winter and spring products," the best result was obtained from treatment with 9-10 and 10-12 cm media and the planting date of December to May which could be extended to open-air plantation (Zizou 1999).

In another study titled "Effects of bulb size on growth and flowering and production of new bulbs in single-cross cultivar of tuberose in Pakistan, the best size of bulb was 3-4 cm (Ahmad, 2009).

In the study by Ramysh Kumar in India, titled as the growth, flowering and bulb production in different perimeter sizes, planting depths and planting spacing, the best results were achieved from baby onion with a 2.5 cm perimeter, a 6-cm planting depth, and a planting spacing of 25 × 25 (Ramysh Kumar 2003). Also, in a study conducted in India regarding the effects of the planting date on the flowering of the Dile cultivar of tuberose, the November and December were listed as the best planting dates in the area (Naris et al. 2001).

In the study conducted on the effect of planting date and bulb size on the growth and production of bulb in gladiole, the highest production of bulbs and stems of flowers was achieved on March 19th using the largest rhizomes (Lasker and Jana 1994).

In a study, it was found that the planting depth and rhizome size were the most effective factors on growth and flowering in bulb plants. In this study, the effects of three sizes of rhizomes including 1.5, 2.5 and 3.5 cm and planting depths of 4, 6 and 10 cm were evaluated on the yield and quality of tuberos, vegetative and flowering characteristics under greenhouse conditions. The results showed that smaller rhizomes, due to the physiological failure of puberty, each flower, the larger the better quality rhizome, but to increase the yield and production of flowers with more economic value, the best rhizome size is 3.5 cm in diameter and the sowing depth of 6 cm. Hatamzadeh et al. (2012) studied various planting dates on the qualitative properties of cut flowers in Juntay university of India and showed that July 25th was the best planting date to maintain the quality of tuberose cut flowers (Daei and Shukla, 2002). In the study of seven planting dates, (began on February 1st, and six plantations were completed 2 ± 15 days later), on the growth, flowering and characteristics of Polianthes tuberosa, sowing was recommended between the last week of March and the first week of April (Mohammad Asif et al. 2001).

Methods and materials

In order to find the most suitable sowing date and the cultivar as well as to determine the mutual effect of these two factors in greenhouse conditions of Jiroft and Kahnuj areas for 2 crop years (2009-2011), an experiment was conducted using split plots in a randomized complete block design with three replications in greenhouses of Jiroft Agricultural Research Center. The sowing date, the main factor, was considered on April 10th, May 10th and July 10th and the bulb size, the minor factor, was considered in three levels with large (3-4), medium (1.5-2.5) and small diameters (less than 1.5 cm). Each sub plot or treatment consists of 4 planting lines in 6 m long and 25 cm wide and they were considered similarly for all treatments. The distance between the sub plots is 25 cm and the distance between the main plots is one meter and the distance between the replications is 2 m. Approximately one month before planting, two specimens were prepared from depths 0-30 and 30-60 cm of soil profiles so as to get information about the physical and chemical properties of the soil, including EC, pH, the percentage of main nutritional elements (N, P, K) and soil texture. Then, they were sent to the soil & water laboratory for fertilizer recommendations. The land preparation operations were carried out and the plan was completed. Rhizomes with different perimeters were prepared from Dezful and planted on March 10th, April 10th and May 10th. The agronomic activities during crop management were done such as irrigation, thinning, fighting against weeds and pests and plant diseases, etc. the greenhouses were covered by plastics after plantation. Germination percentage, flowering stem length, flowering stem diameter, number of florets, number of leaves and duration until the flower emergence were recorded from two lines in the middle of the plot by removing half a meter from up and down lines. nitrogen fertilizer was used at the 3-5 leaf stages. Data were analyzed by SAS. Then, the means were compared by Duncan method to reach the best treatments, and at the end of two years, the biannual variance analysis was also performed.

Results

Table 1: summary of results of variance analysis related to characters studied in the first year

Character	Freedom degree	Germination	Stem length (cm)	Stem diameter (cm)	Floret No.	Leaf No.	Planting time until flowering (day)
Replication	2	1.92 ^{ns}	4.48 ^{ns}	0.027 ^{ns}	2.39 ^{ns}	0.48 ^{ns}	73.37 ^{ns}
Planting date (a)	2	50.03 [*]	367.37 ^{**}	0.063 [*]	22.34 [*]	50.70 [*]	99.37 [*]
Error (a)	4	2.6	1.48	0.0025	1.09	0.37	22.09
Perimeter of bulb	2	13.81 [*]	124.70 [*]	0.329 [*]	12.87 [*]	38.48 [*]	34.47 [*]
Planting date × bulb perimeter	4	25.37 ^{ns}	154.20 ^{ns}	0.088 ^{ns}	17.56 ^{ns}	41.87 ^{ns}	306.03 ^{ns}
Error	12	3.12	4.92	0.0057	0.50	1.68	33.46
CV%		1.81	2.41	9.7	3.98	8.42	7.17

similar letters in each column in 5% and % probability levels show significant difference and ns means no significant difference in means

Table 2: Comparison of means of characters in the first year

Characters Treatments	Germination	Flowering stem length (cm)	Flowering stem diameter (cm)	Floret No.	Leaf No.	Planting time until flowering
Planting date	April 10 th	97/55 ^a	0/81 ^a	18/77 ^a	16/77 ^a	77 ^b
	May 10 th	93/33 ^b	0/83 ^a	18/55 ^a	16/77 ^a	81 ^{ab}
	June 10 th	85 ^c	0/67 ^b	15/9 ^b	12/66 ^b	83 ^a
Bulb perimeter	1.5	87 ^b	0/55 ^b	16/38 ^b	13/22 ^c	82 ^a
	1.5-2.5	94 ^a	0/85 ^a	18/33 ^a	15/66 ^b	80 ^a
	3-4 cm	94 ^a	0/91 ^a	18/55 ^a	17/33 ^a	79 ^a

Table 3: summary of results of variance analysis related to characters studied in the second year

Character	Freedom degree	Germination	Flowering stem length (cm)	Flowering stem diameter (cm)	Floret No.	Leaf No.	Planting time until flowering (day)
Replication	2	261/77 ^{ns}	1/81 ^{ns}	0/03 ^{ns}	14/92 ^{ns}	0/03 ^{ns}	47.44 ns
Planting date (a)	2	226/17 ^{ns}	315/25 [*]	0/09 [*]	6/37 [*]	39/70 [*]	173.44 [*]
Error (a)	4	313/72	30/70 ^{ns}	0/001 ^{ns}	1/64 ^{ns}	5/70 ^{ns}	33.22 ns
Perimeter of bulb	2	160/33 [*]	170/48 ^{**}	0/27 [*]	12/48 ^{**}	49/48 ^{**}	168.77 ^{**}
Planting date × bulb perimeter	4	422/44 ^{ns}	175/87 [*]	0/05 [*]	9/87 [*]	48/98 [*]	182.22 [*]
Error	12	314/46	28/460	0/023	2/18	8/09	46/62
CV%		18/93	5/80	19/63	8/65	18/5	8/51

similar letters in each column in 5% and % probability levels show significant difference and ns means no significant difference in means

Table 4: Comparison of means of characters in the second year

Characters Treatments	Germination	Flowering stem length (cm)	Flowering stem diameter (cm)	Floret No.	Leaf No.	Planting time until flowering (day)
Planting date	April 10 th	93/44 ^a	0/86 ^a	17/66 ^a	17 ^a	84/66 ^a
	May 10 th	97 ^a	0/80 ^{ab}	17/44 ^a	16 ^a	80/11 ^{ab}
	June 10 th	85/44 ^b	0/66 ^b	16/11 ^b	13 ^b	75/88 ^b
Bulb perimeter	1.5	87/22 ^b	0/57 ^b	16 ^b	12/55 ^b	82/77 ^a
	1.5-2.5	92/88 ^a	0/85 ^a	16/88 ^{ab}	15/44 ^{ab}	82/66 ^a
	3-4 cm	95/77 ^a	0/90 ^a	18/33 ^a	18/11 ^a	75/22 ^b

In this experiment, which was conducted for two years, statistical analysis was performed for each year separately and the analysis of variance of two years was carried out at the end of the second year. Since the treatment of the year was not significant on the traits, the results of combined analysis were ignored. Based on the results of table 1, in the first year, the planting date has been significant on percentage of germination, length of flowering stem, flowering stem diameter, number of leaves, number of florets and the onset of flowering stems at 1% level. Also, the size of rhizome was significant on all of the studied traits, namely germination percentage, length and diameter of flowering stem, number of florets, number of leaves and emergence of flowering stem at 5% level. According to the results of this table, it seems that the effect of bulb size on the characters was more effective than the planting date. The mutual effect of sowing date and bulb size was not significant on the emergence of flowering stems, length and diameter of flowering stem, number of florets, number of leaves and the percentage of germination.

The effect of planting date on germination percentage

According to the results of table 2, the planting dates of April 10th, May 10th and June 10th did not have a significant difference, but the planting date of July 10th was significant, which means that the best planting dates for percentage of germination are on April 10th and June 10th.

The effect of planting date on flowering stem length

The results of table 2 show that the effect of different planting dates on the length of the flowering stem is significant. The highest length of the flowering stem was obtained on April 10th, with a size of 97/55 cm, and the shortest flowering stem length of 85 cm was obtained on July 10th.

The effect of planting date on stem diameter

April 10th and May 10th were not significant, but July 10th was significant. The diameter of the stem in this date was the lowest (0.67 cm).

The effect of planting date on the number of florets and leaves

On April 10th and May 10th, the highest number of leaves and florets was obtained that they did not differ significantly and the lowest number of leaves and florets was obtained on July 10th.

The effect of planting date on the planting time until flowering (day)

There was no significant difference between April 10th and May 10th and between May 10th and July 10th but April 10th was significantly different with July 10th. On April 10th, flowering time was after 77 days, on May 10th, the flowering time was after 81 days and on July 10th, flowering time was after 83 days. April 10th and May 10th were the best dates.

The effect of bulb perimeter (the first year)

The bulb environment was significant on all traits at 1% level. The highest numbers recorded during flowering stem length, flower stem diameter, number of florets and number of leaves were obtained in a 3-4 cm perimeter and the number of flowers in 1.5, 1.5-2.5 and 3-4 cm perimeters were obtained by 82, 80 and 79 respectively, indicating that the larger the environment around the bulbs is, the faster the onset of flowering will occur.

However, the results of the research in the second year in table (3) show that the planting date was significant on the length and diameter of the flowering stem, the number of florets, the number of leaves and the onset of

flowering stems at a 5% probability level and was not significant on the germination percentage. The effect of bulb size was significant on all traits. The mutual effect of sowing date and size of bulb was not significant on the onset of flowering stems, length and diameter of flowering stem, number of florets, number of leaves and the percentage of germination. According to the mean comparison test, the studied characters in the second year of the project in table 4 show that the effect of bulb size on all studied characters is greater than the planting date. Whereas, the large size of bulb (3-4 cm) was better than small- (below 1.5 cm) and medium-sized bulbs (1.5 to 2.5 cm). In greenhouse conditions, the effect of bulb size on all characters was significant at 1% probability level. The mutual effect of date of sowing and size of bulb was significant on the length and diameter of flowering stem, number of florets, number of leaves and the onset of flowering stem emergence, but it was not significant on germination percentage.

The effect of planting date on germination percentage

There was no significant difference among April 10th, May 10th and July 10th.

The effect of planting date on flowering stem length

The results of table 4 show that the effect of different planting dates is significant on the length of the flowering stem. The highest length of the flowering stem was recorded on May 10th (97 cm) which does not have a significant difference with July 10th. The shortest length of the flowering stem (44.85 cm) was obtained on July 10th.

The effect of planting date on flowering stem diameter

The effect of planting dates of April 10th and May 10th was not significant on stem diameter but July 10th was significant. The diameter of stem on July 10th was the lowest (0.66 cm).

The effect of planting date on the number of florets and leaves

The highest number of leaves and florets was obtained on April 10th and May 10th which did not differ significantly, and the lowest number of leaves and florets was obtained on July 10th, which was consistent with the results of the first year.

The effect of planting date on planting date until flowering (day)

There was no significant difference between April 10th and May 10th and between May 10th and July 10th but April 10th was significantly different with July 10th. On April 10th, flowering time was 66.84, on May 10th, the flowering time was 11.80 and on July 10th, flowering time was 88.75. The warm weather in May and July reduced the flowering time since planting.

The effect of bulb perimeter (the second year)

The bulb environment was significant on all characters at 1% level. The highest numbers recorded during flowering stem length, flower stem diameter, number of florets and number of leaves were obtained in a 3-4 cm perimeter and the time duration to flower emergence in 1.5, 1.5-2.5 and 3-4 cm perimeters were obtained by 77.82, 66.82 and 22.75 respectively, indicating that the larger the environment around the bulbs is, the faster the onset of flowering will occur.

Discussion and conclusion

Finally, the results of analysis of variance in both years indicate that the planting date and size of bulb, as well as the mutual effect of these two, are significant on germination percentage, length and diameter of flowering stem, number of florets, number of leaves and the onset of emergence of flowering.

Considering the fact that the results were not significant on April 10th and May 10th and the results of mean comparisons were similar, they are recommended as the best planting dates for planting and producing tuberose cut flowers in Jiroft greenhouses. Because the best quality tuberose cut flowers were produced in the 3-4 cm perimeter in greenhouse conditions, it can be used as the best bulb perimeter for planting tuberose in greenhouse conditions.

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