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Studies On The Effect Of Bulb Size And Depth Of Planting On Vegetative Characteristics Of Tuberose (*Polianthes tuberosa* L.) cv. Suvasini Under Southern Telangana Conditions

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ABSTRACT
An experiment was laid out with four bulb sizes (B1- <1.5 cm, B2 - 3.0 cm, B3 - 4.5 cm, B4 - 6.0 cm) and four depths of planting (D1- 2 cm, D2 - 4 cm, D3 - 6 cm and D4- 8 cm) in a factorial randomized block design with three replications in tuberose cv. Suvasini. The research project aimed to develop low cost production technology for quality cut spikes for domestic markets of Southern Telengana region and to elicit the information on growth pattern at different stages of crop. The effect of bulb size and depth of planting showed statistically significant variation in vegetative characteristics of tuberose cv. Suvasini. The treatment combination of small bulbs at shallow depth of planting (<1.5 cm + 2.0 cm) implied early sprouting of bulbs (7.66 days). In converse, large bulbs at deeper depth of planting (6.0 cm + 8.0 cm) resulted in late sprouting of bulbs (20.33 days). The treatment combination of large bulbs at medium depth of planting (4.5 cm + 6.0 cm) recorded tallest plant, more number of leaves, maximum length of leaf at all stages of plant growth.
Key words : *tuberose, bulb size, depth of planting*

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INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) belongs to the family Amaryllidaceae. It was originated in Mexico. It is one of the important bulbous flowering crop cultivated for its long lasting spikes. From Mexico, it spreaded out to the different parts of the world during 16th century (Tiwari and Singh, 2002). In India tuberose is commonly called as Rajanigandha and Nelasampengi.

Tuberose bulbs contain an alkaloid lycorine, which causes vomiting. The bulbs are rubbed with turmeric, butter and applied as a paste over red pimples of infants. Dried tuberose bulbs in powdered form are used as a remedy for gonorrhoea. In Java, the flowers are eaten along with the juices of the vegetables. Suvasini is a cross between Mexican single × Pearl double and is a multi whorled cultivar with bold, big and pure white flowers borne on long spike. This variety produces more number of flowers per spike. The spikes are best suited for cut flowers. Suvasini is known to yield 25 per cent more flowers than double cultivars. Tuberose is one of the important cut flowers in the tropical and subtropical regions of the world. Tuberose is cultivated all over the world for their flowers. Morocco, France, Hawaii, South Africa, Egypt, India and China are the major producers of tuberose. As per area and production statistics of National Horticulture Board (NHB 2015), the total area under tuberose cultivation in the country is about 7.77 lakh hectare. The production of loose and cut flowers is estimated to be 40.22 „000 MT and 1390.00 lakh spikes respectively.

MATERIAL AND METHODS

The present investigation was conducted at College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University during the year 2016-2017. The experimental site, Mojerla is situated at an altitude of 543.3 above mean sea level on 78° 29° East longitude and 17° 19° North latitude. The climate of Mojerla is semi-arid. The soil of the experimental site was loamy texture with a soil pH of 7.5 and Electrical Conductivity of 0.21 dsm^{-1}.

The experiment consisted of two factors. Factor A: four levels of bulb size: B1- <1.5 cm, B2 - 3.0 cm, B3 - 4.5 cm, B4 - 6.0 cm and Factor B: four levels of depth of planting: D1- 2 cm, D2 - 4 cm, D3 - 6 cm and D4 - 8 cm. The experiment was laid out in factorial randomized block design with three replications. Observations were recorded for vegetative growth parameters for each treatment under each replication.

Observations recorded

The observations in respect of growth were recorded at 30 days interval from 30 days after planting to 90 days after planting.

Number of days required for sprouting

The number of days taken for sprouting of bulb in each treatment was taken as the number of days required for sprouting of bulbs and expressed in number of days.

Plant height (cm)

Tuberose is a bulbous crop and the aerial part of the plant mainly consists of leaves. Therefore, length of longest leaf from ground was taken as the height of the plant and expressed in cm.

Number of leaves per plant

Total number of leaves per plant was counted at 30, 60 and 90 days after planting.

Length of leaf (cm)

Fourth leaf from the base of the plant was selected and its length was measured from the base to the tip of the leaf at 30, 60 and 90 days after planting and expressed in centimeters.

RESULTS AND DISCUSSION

1. Days required for sprouting

The data recorded on number of days taken for sprouting of bulbs in tuberose cv. Suvasini as influenced by bulb size and depth of planting are presented in Table 1.

Bulb size significantly influenced the number of days taken for sprouting of tuberose bulbs. Bulb size B1 (< 1.5 cm) recorded early sprouting of bulbs (12.41 days) followed by B2 (3.0 cm) (13.25 days). The treatments B3 (4.5 cm) and B4 (6 cm) recorded maximum number of days (15.16 and 15.91 days) for sprouting of bulbs. Small size bulbs recorded early sprouting over large size bulbs. The depth of planting has significant influence on sprouting of tuberose bulbs. Shallow depth of planting D1 (2 cm) recorded early sprouting of bulbs (9.58 days). The minimum number of days (12.33 days) for sprouting of bulbs was recorded in D2 (4.0 cm). The treatments D3 (6.0 cm) and D4 (8.0 cm) recorded maximum number of days (16.08 and 18.75 days) for sprouting of bulbs. Shallow depth of planting recorded early sprouting of bulbs over deeper planting depth. Naeem *et al.* (2016) obtained similar results and reported that shallow depth of planting (5.0 cm) recorded early sprouting of bulbs than deeper depth of planting (10 cm) in African corn lily.

The interaction between bulb size and depth of planting on number of days taken for sprouting was significant. The treatment combination B1D1 (< 1.5 cm + 2 cm) recorded less number of days for sprouting of bulbs (7.66 days). The treatment combination B4D4 (6 cm + 8 cm) recorded maximum number of days (20.33 days).

Table 1: Effect of bulb size and depth of planting on days required for sprouting of bulbs in tuberose cv. Suvasini

Bulb size (B)(cm)	**Depth (D) (cm)**				
	(D_1) 2	(D_2) 4	(D_3) 6	(D_4) 8	Mean
(B_1) <1.5	7.66	10.00	14.33	17.66	12.41 a
(B_2) 3.0	9.33	12.33	14.35	17.00	13.25 b
(B_3) 4.5	10.66	12.00	18.00	20.00	15.16 c
(B_4) 6.0	10.67	15.00	17.66	20.33	15.91 d
Mean	9.58 a	12.33 b	16.08 c	18.75 d	
	B		D		B×D
S.Em±	0.31		0.32		0.63
CD@5%	0.65		0.37		1.30

2. Plant height at 30 days after planting (cm)

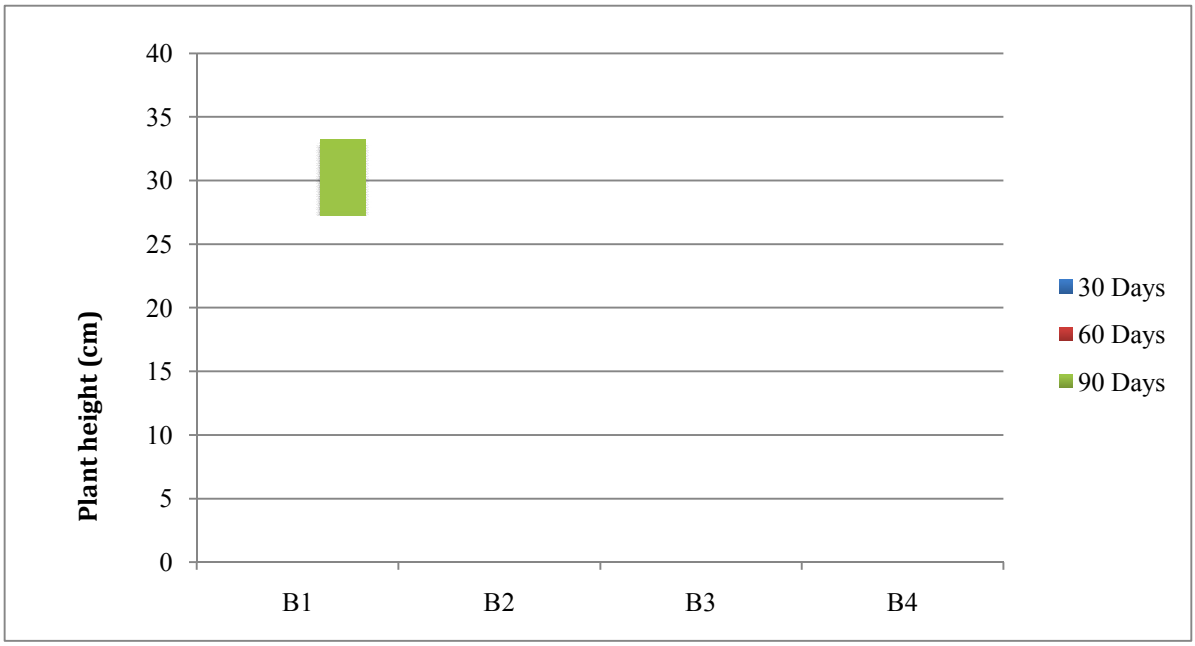
The data recorded on plant height at 30 days after planting as influenced by bulb size and depth of planting are presented in table 2.

Bulb size significantly influenced plant height at 30 days after planting (Fig.1). The tallest plant (13.81 cm) was recorded with B4 (6.0 cm large size bulb) followed by B3 (4.5 cm) (13.71 cm) and B2 (3.0 cm) (11.92 cm). The shortest plant height (11.01 cm) was observed with treatment B1 (< 1.5 cm small size bulb) respectively. Large sized bulbs recorded tallest plants over small size bulbs. The depth of planting of bulbs has significant influence on plant height at 30 days after planting (Fig.2). Planting depth of D3 (6 cm) recorded tallest plant (11.05 cm) was observed from D1 (2 cm), which is statistically similar (11.40 cm) to D4 (8 cm) respectively. The interaction between bulb size and depth of planting on plant height at 30 days after planting is significant. The tallest plant (17.66 cm) was observed from treatment combination B3D3 (4.5 cm + 6 cm) and it is followed by B4D3 (6 cm + 6 cm) (17.19 cm), whereas the shortest plant (9.58 cm) was observed with treatment combination B1D1 (< 1.5 cm + 2 cm) respectively.

Table 2: Effect of bulb size and depth of planting on plant height (cm) at 30 days after planting (DAP) of tuberose cv. Suvasini

Bulb size (B)(cm)	**Depth (D) (cm)**				
	(D_1) 2	(D_2) 4	(D_3) 6	(D_4) 8	Mean
(B_1) <1.5	9.58	10.52	13.66	10.26	11.01 d
(B_2) 3.0	10.16	11.67	15.04	10.83	11.92 c
(B_3) 4.5	11.78	12.98	17.66	12.42	13.71 b
(B_4) 6.0	12.67	13.27	17.19	12.10	13.81 a
Mean	11.05 d	12.11 b	15.89 a	11.40 c	
	B		D		B×D
S.Em±	0.16		0.19		0.39
CD@5%	0.32		0.40		0.80

Fig 1: Effect of bulb size on plant height at different days after planting (DAP) of tuberose



*Bulb sizes: B_1- < 1.5 cm, B_2- 3.0 cm, B_3- 4.5 cm, B_4- 6.0 cm.

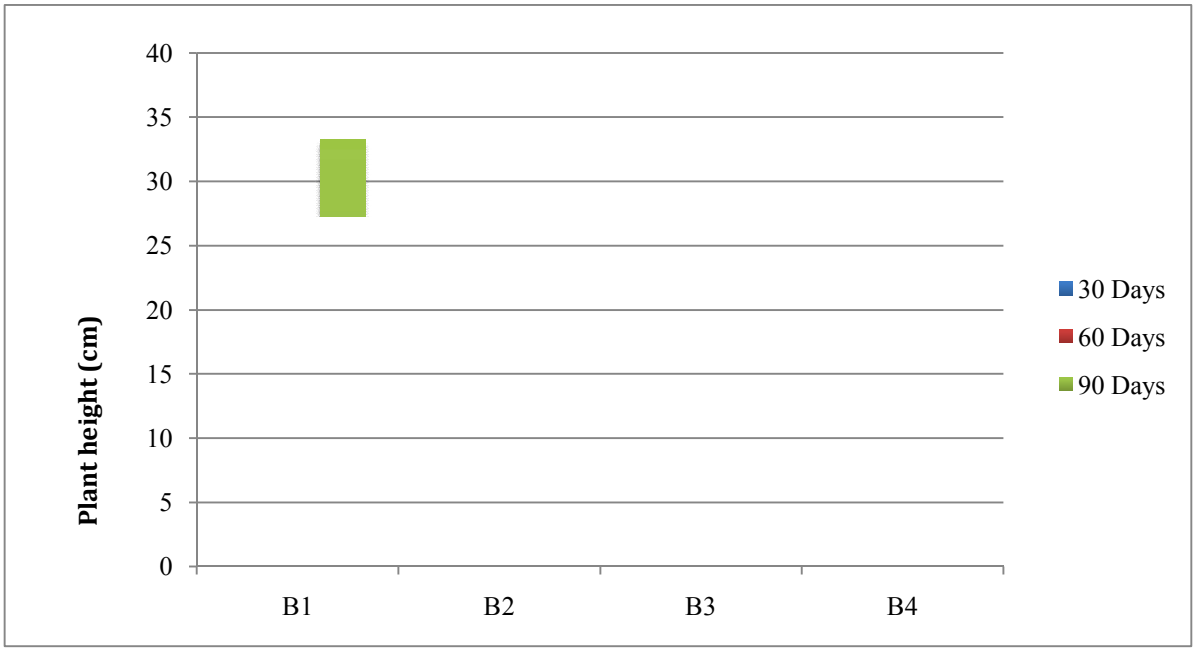
3. Plant height at 60 days after planting (cm)

The data recorded on plant height at 60 days after planting as influenced by bulb size and depth of planting are presented in table 3. Bulb size significantly influenced the plant height at 60 days after planting (Fig. 1). The tallest plant (28.41 cm) was recorded with B4 (6.0 cm) followed by B3 (4.5 cm) (27.61 cm) and B2 (3.0 cm) (25.08 cm). The shortest plant (24.36 cm) was observed with treatment B1 (< 1.5 cm). The depth of planting of bulbs has significant influence on plant height at 60 days after planting (Fig.2). Planting depth of 6 cm (D3) recorded tallest plants (34.82 cm) followed by D2 (4 cm depth of planting) (33.18cm) and D4 (8 cm depth of planting) (23.94 cm). The shortest plant (21.52 cm) was observed with treatment D1 (2 cm depth of planting) respectively. The interaction between bulb size and depth of planting on plant height at 60 days after planting is significant. The tallest plant (40.60 cm) was observed with treatment combination B3D3 (4.5 cm + 6 cm) and it is followed by B4D3 (6 cm + 6 cm) (38.11 cm), whereas the shortest plant (20.24 cm) was recorded with treatment combination B1D1 (< 1.5 cm + 2 cm) respectively.

Table 3: Effect of bulb size and depth of planting on plant height (cm) at 60 days after planting (DAP) of tuberose cv. Suvasini

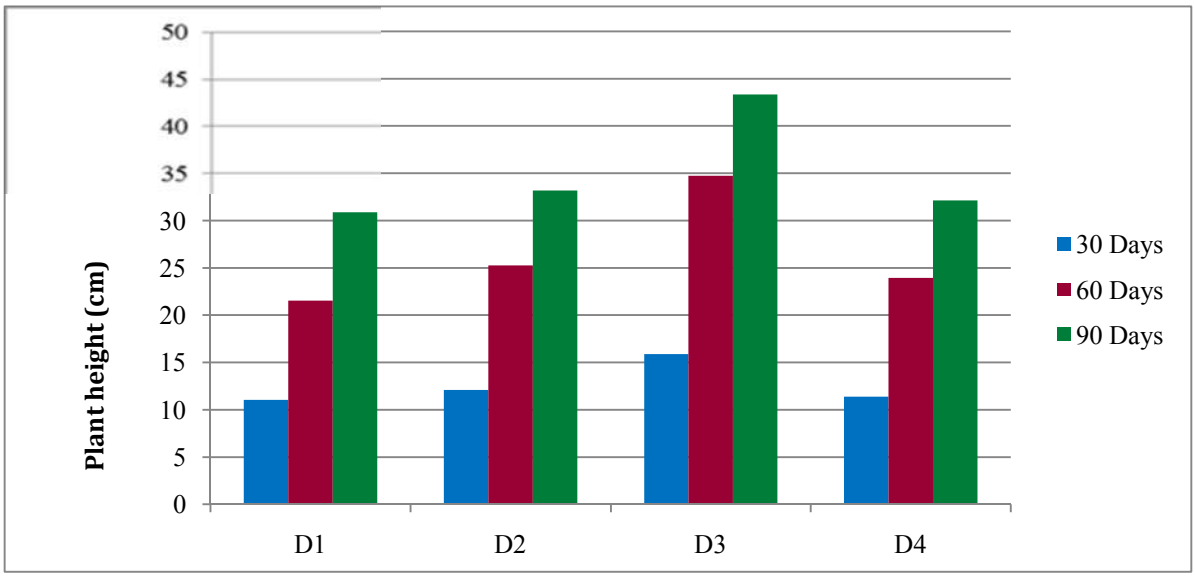
Bulb size (B)(cm)	**Depth (D) (cm)**				
	(D_1) 2	(D_2) 4	(D_3) 6	(D_4) 8	Mean
(B_1) <1.5	20.24	25.29	27.11	24.81	24.36 d
(B_2) 3.0	21.21	23.58	33.08	22.45	25.08 c
(B_3) 4.5	21.98	24.25	40.60	23.60	27.61 b
(B_4) 6.0	22.64	28.00	38.11	24.90	28.41 a
Mean	21.52 d	25.28 b	34.72 a	23.94 c	
	B		D		B×D
S.Em±	0.46		0.53		1.07
CD@5%	0.94		1.09		2.18

Fig 1: Effect of bulb size on plant height at different days after planting (DAP) of tuberose



*Bulb sizes: B_1- < 1.5 cm, B_2- 3.0 cm, B_3- 4.5 cm, B_4- 6.0 cm.

Fig 2: Effect of depth of planting on plant height at different days after planting (DAP) of tuberose



*Depth of plantings: D_1- 2.0 cm, D_2- 4.0 cm, D_3- 6.0 cm, D_4- 8.0 cm.

4. Plant height at 90 days after planting (cm)

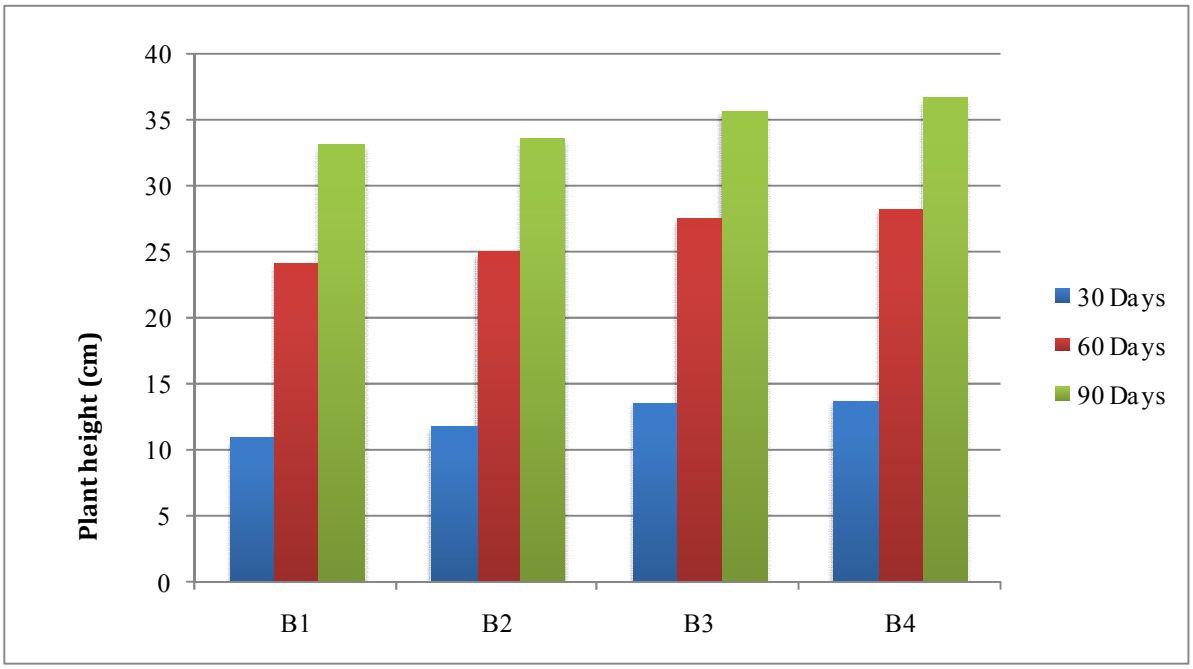
The data recorded on plant height at 90 days after planting as influenced by bulb size and depth of planting are presented in table 4. Bulb size significantly influenced plant height at 90 days after planting (Fig.1). The tallest plant (36.68 cm) was recorded with B4 (6.0 cm large size bulb) followed by B3 (4.5 cm) (35.90 cm) and B2 (3.0 cm) (33.65 cm). The shortest plant height (33.27 cm) was found from treatment B1 (< 1.5 cm small size bulb). The depth of planting of bulbs has significant influence on plant height at 90 days after planting (Fig.2). Planting depth at D3 (6 cm) recorded tallest plant (43.32 cm) followed by D2 (4 cm depth of planting) (33.18 cm) and D4 (8 cm depth of planting) (32.12 cm). The shortest plant height (30.87 cm) was recorded from treatment 2 cm depth of planting (D1). The interaction between bulb size and depth of planting on plant height at 60 days after planting is significant. The tallest plant (49.26 cm) was observed with the treatment combination B3D3 (4.5 cm + 6 cm) and it is followed by B4D3 (6 cm + 6 cm) (46.90 cm), whereas the shortest plant height (30.06 cm) was recorded from treatment combination of < 1.5 cm + 2 cm (B1D1).

From the above results, it is evident that plant height was maximum in larger bulb size because of larger bulb had huge stored food material that supported the plant to increase vegetative growth. Ahmad *et al.* (2009) in tuberose observed that large bulb size resulted in vigorous growth as compared to small and medium sized bulbs and Mane *et al.* (2007) also reported that taller plants were observed in bigger bulb size may be due to more carbohydrate and metabolites content in big size bulbs in tuberose. The plant height has increased as the depth of planting of bulb increased up to 6 cm depth (D3) from the ground. Further increase in depth of planting of bulbs, decreased plant height. There had been poor growth of plant with respect to their plant height when the bulbs were planted at shallow (D1) (2 cm) and deeper (D4) (8 cm) depths.

Table 4: Effect of bulb size and depth of planting on plant height (cm) at 90 days after planting (DAP) of tuberose cv. Suvasini

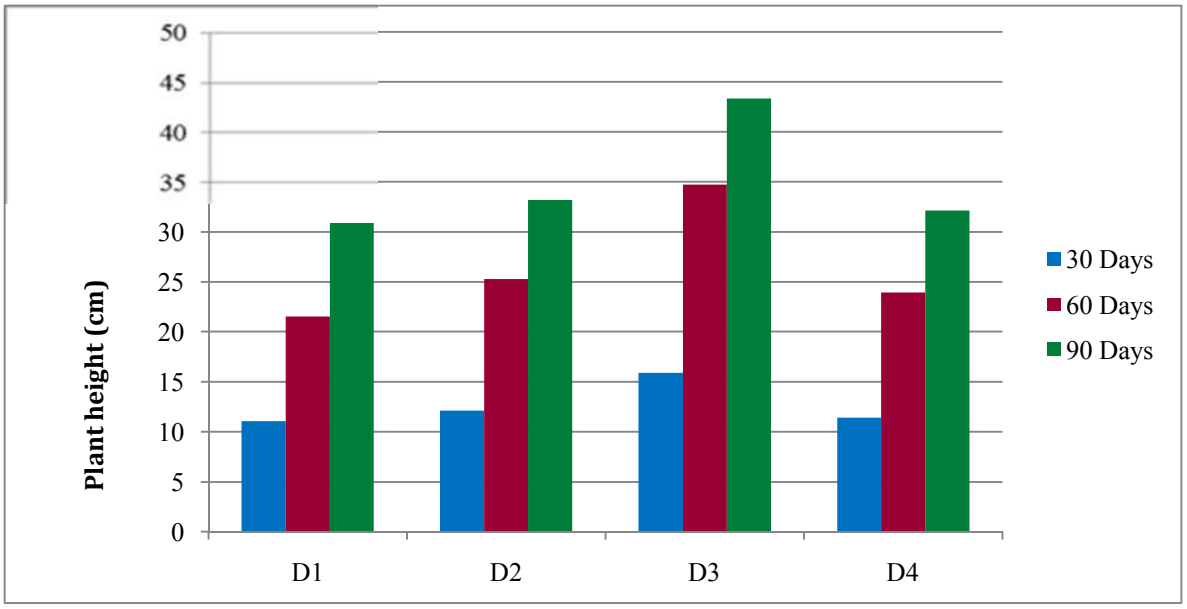
Bulb size (B)(cm)	Depth (D) (cm)				
	(D_1) 2	(D_2) 4	(D_3) 6	(D_4) 8	Mean
(B_1) <1.5	30.06	34.86	35.88	32.26	33.27 d
(B_2) 3.0	30.61	31.56	41.25	31.18	33.65 c
(B_3) 4.5	30.95	31.68	49.26	31.71	35.90 b
(B_4) 6.0	31.85	34.64	46.90	33.34	36.68 a
Mean	30.87 d	33.18 b	43.32 a	32.12 c	
	B		D		B×D
S.Em±	0.39		0.45		0.90
CD@5%	0.79		0.92		1.84

Fig 1: Effect of bulb size on plant height at different days after planting (DAP) of tuberose



*Bulb sizes: B_1- < 1.5 cm, B_2- 3.0 cm, B_3- 4.5 cm, B_4- 6.0 cm.

Fig 2: Effect of depth of planting on plant height at different days after planting (DAP) of tuberose



*Depth of plantings: D_1- 2.0 cm, D_2- 4.0 cm, D_3- 6.0 cm, D_4- 8.0 cm.

5 Number of leaves per plant at 30 days after planting

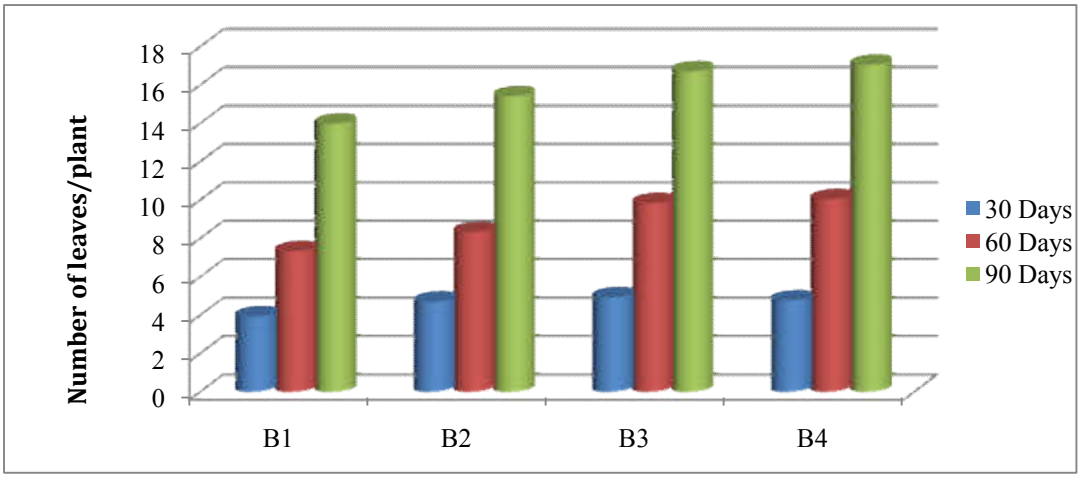
The data recorded on number of leaves per plant at 30 days after planting as influenced by bulb size and depth of planting are presented in table 5. Bulb size significantly influenced the number of leaves per plant at 30 days after planting (Fig. 3). Bulb size B4 (6.0 cm large size bulb) recorded maximum number of leaves per plant (4.97) followed by 4.5 cm size bulbs (B3) (4.80) and 3.0 cm size bulbs (B2). The treatment B1 (<1.5 cm) recorded less number of leaves per plant (3.97). Large size bulbs recorded more number of leaves over small size bulbs. The depth of planting has significant influence on number of leaves per plant at 30 DAP (Fig. 4). Planting depth of D3 (6 cm) recorded higher number of leaves per plant (6.54) followed by D2 (4 cm depth of planting) (4.27) and D4 (8 cm depth of planting) (3.94). The treatment D1 (2 cm depth of planting) recorded less number of leaves per plant (3.71). The interaction between bulb size and depth of planting on number of leaves per plant at 30 DAP is significant. The treatment combination

B3D3 (4.5 cm + 6.0 cm) recorded more number of leaves per plant (7.52) and it is followed by B4D3 (6.0 cm + 6.0 cm) (6.66). The treatment combination B1D1 (<1.5 cm + 2 cm) recorded less number of leaves (3.25) per plant.

Table 5: Effect of bulb size and depth of planting on number of leaves per plant at 30 days after planting (DAP) of tuberose cv. Suvasini

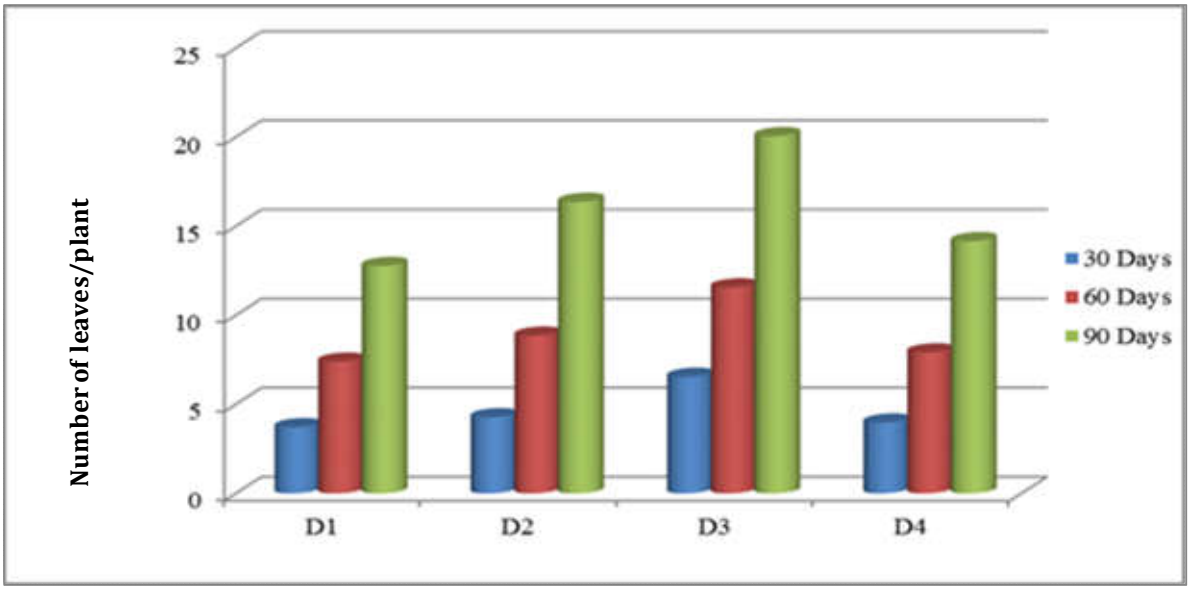
Bulb size (B)(cm)	Depth (D) (cm)				
	(D_1) 2	(D_2) 4	(D_3) 6	(D_4) 8	Mean
(B_1) <1.5	3.25	3.91	5.25	3.50	3.97 d
(B_2) 3.0	3.65	4.91	6.73	3.67	4.74 c
(B_3) 4.5	4.13	4.33	7.52	3.91	4.97 a
(B_4) 6.0	3.83	3.91	6.66	4.81	4.80 b
Mean	3.71 d	4.27 b	6.54 a	3.97 c	
	B	D		B×D	
S.Em±	0.20	0.24		0.49	
CD@5%	0.40	0.50		1.01	

Fig 3: Effect of bulb size on number of leaves per plant at different days after planting (DAP) of tuberose cv. Suvasini



*Bulb sizes: B_1- < 1.5 cm, B_2- 3.0 cm, B_3- 4.5 cm, B_4- 6.0 cm.

Fig 4: Effect of depth of planting on number of leaves per plant at different days after planting (DAP) of tuberose cv. Suvasini



*Depth of plantings: D_1- 2.0 cm, D_2- 4.0 cm, D_3- 6.0 cm, D_4- 8.0 cm

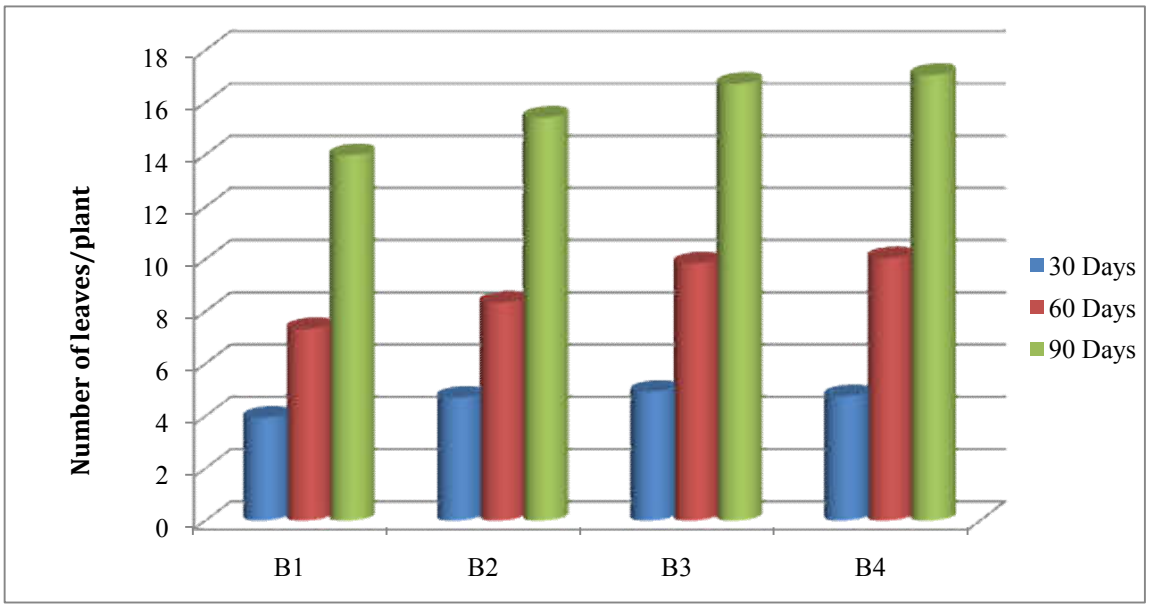
6. Number of leaves per plant at 60 days after planting

The data recorded on number of leaves per plant at 60 days after planting as influenced by bulb size and depth of planting are presented in table 6. Bulb size significantly influenced the number of leaves per plant at 30 days after planting (Fig. 3). Bulb size B4 (6.0 cm large size bulb) recorded maximum number of leaves per plant (10.08) followed by 4.5 cm size bulbs (B3) (9.88) and 3.0 cm size bulbs (B2) (8.38). The treatment B1 (<1.5 cm) recorded less number of leaves per plant (7.37). Large size bulbs recorded more number of leaves over small size bulbs. The depth of planting has significant influence on number of leaves per plant at 60 DAP (Fig. 4). Planting depth of 6 cm (D3) recorded higher number of leaves per plant (11.56) followed by D2 (4 cm depth of planting) (8.85) and D4 (8 cm depth of planting) (7.91). The treatment D1 (2 cm depth of planting) recorded less number of leaves per plant (7.39). The interaction between bulb size and depth of planting on number of leaves per plant at 30 DAP is significant. The treatment combination B3D3 (4.5 cm + 6.0 cm) recorded more number of leaves per plant (13.61) and it is followed by B4D3 (6.0 cm + 6.0 cm) (12.30). The treatment combination B1D1 (<1.5 cm + 2 cm) recorded less number of leaves (6.25) per plant.

Table 6: Effect of bulb size and depth of planting on number of leaves per plant at 60 days after planting (DAP) of tuberose cv. Suvasini

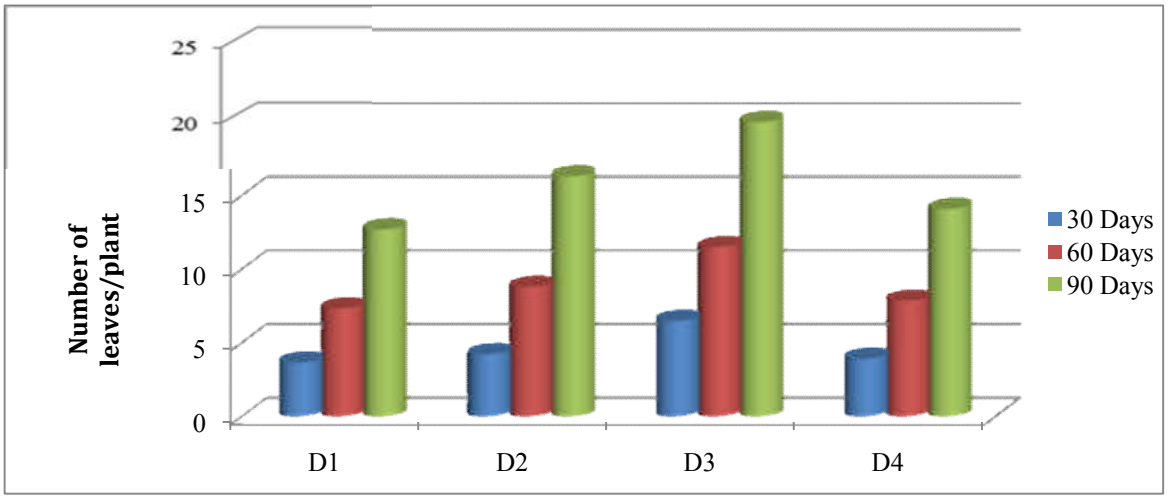
Bulb size (B)(cm)	Depth (D) (cm)				
	(D_1) 2	(D_2) 4	(D_3) 6	(D_4) 8	Mean
(B_1) <1.5	6.25	7.40	9.16	6.69	7.37 d
(B_2) 3.0	6.69	8.58	11.16	7.08	8.38 c
(B_3) 4.5	7.52	9.50	13.61	8.90	9.88 b
(B_4) 6.0	9.11	9.33	12.30	9.00	10.08 a
Mean	7.39 d	8.85 b	11.56 a	7.91 c	
	B		D		B×D
S.Em±	0.23		0.29		0.53
CD@5%	0.46		0.54		1.10

Fig 3: Effect of bulb size on number of leaves per plant at different days after planting (DAP) of tuberose cv. Suvasini



*Bulb sizes: B_1- < 1.5 cm, B_2- 3.0 cm, B_3- 4.5 cm, B_4- 6.0 cm.

Fig 4: Effect of depth of planting on number of leaves per plant at different days after planting (DAP) of tuberose cv. Suvasini



*Depth of plantings: D_1- 2.0 cm, D_2- 4.0 cm, D_3- 6.0 cm, D_4- 8.0 cm

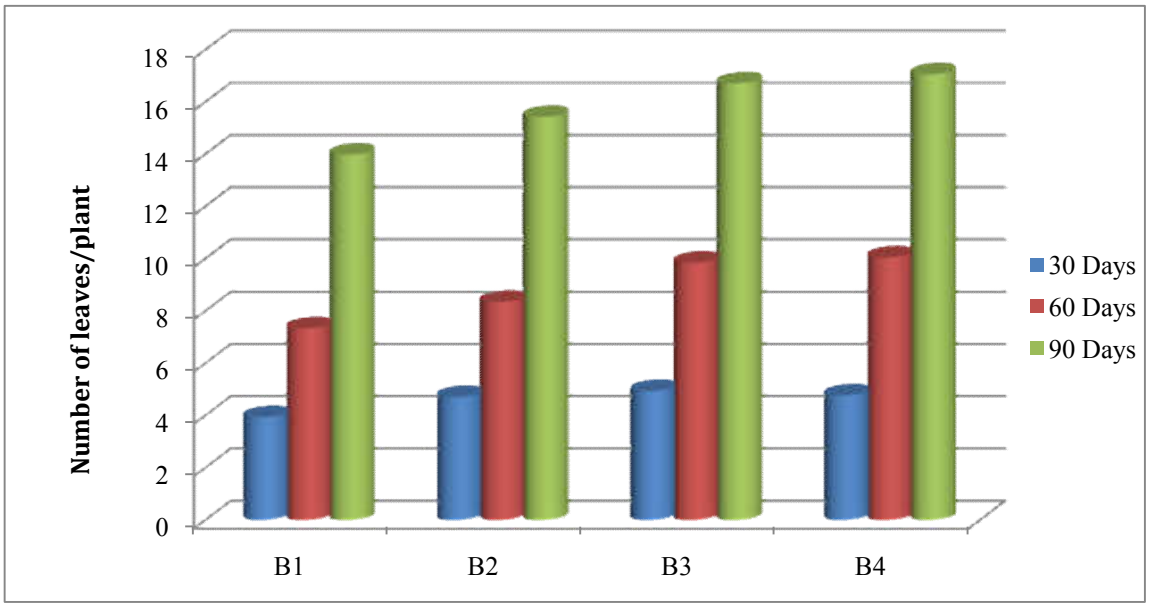
7. Number of leaves per plant at 90 days after planting

The data recorded on number of leaves per plant at 90 days after planting as influenced by bulb size and depth of planting are presented in table 7. Bulb size significantly influenced the number of leaves per plant at 90 days after planting (Fig. 3). Bulb size B4 (6.0 cm large size bulb) recorded maximum number of leaves per plant (17.09) followed by 4.5 cm size bulbs (B3) (16.75) and 3.0 cm size bulbs (B2) (15.40). The treatment B1 (<1.5 cm) recorded less number of leaves per plant (14.02). Large size bulbs recorded more number of leaves over small size bulbs. The depth of planting has significant influence on number of leaves per plant at 90 DAP (Fig. 4). Planting depth of 6 cm (D3) recorded higher number of leaves per plant (20.05) followed by D2 (4 cm depth of planting) (16.36) and D4 (8 cm depth of planting) (14.15). The treatment D1 (2 cm depth of planting) recorded less number of leaves per plant (12.76). Ali and Akbari (2012) and Suseela (2015) reported that maximum number of leaves per plant was observed where the bulbs were planted at the depth of 6.0 cm in tuberose. The interaction between bulb size and depth of planting on number of leaves per plant at 90 DAP is significant. The treatment combination B3D3 (4.5 cm + 6.0 cm) recorded more number of leaves per plant (21.97) and it is followed by B4D3 (6.0 cm + 6.0 cm) (21.03). The treatment combination B1D1 (<1.5 cm + 2 cm) recorded less number of leaves per plant (11.40). From the above results, it is revealed that production of more number of leaves were observed in all the growth stages with bigger sized bulbs. This might be due to higher stored food reserves in large sized bulbs as a result of which there were an increase in number of leaves compared to small bulbs. Similar results of more number of leaves per plant were reported by Hatamzadeh *et al.* (2012) in tuberose, indicated that increased bulb size positively related with increasing vegetative growth and reason for more growth of large bulbs may be due to presence of more water and nutrients than smaller bulbs. The depth of planting of bulbs at 6 cm resulted in more number of leaves which may be attributed to better anchorage and sturdy growth. Correct planting depth influenced the available space for development of bulb and it also influenced time to emergence and good soil conditions for subsequent flowering. Suseela (2015) reported that planting of bulbs at 6 cm recorded maximum number of leaves per plant in tuberose cv. Suvasini.

Table 7: Effect of bulb size and depth of planting on number of leaves per plant at 90 days after planting (DAP) of tuberose cv. Suvasini

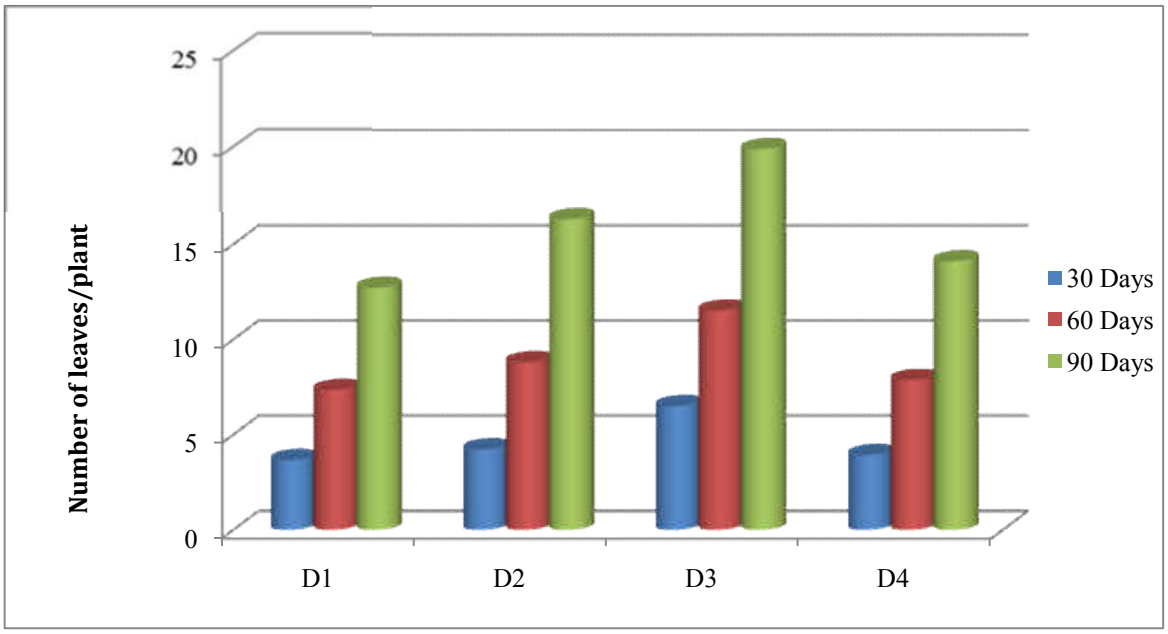
Bulb size (B)(cm)	Depth (D) (cm)				
	(D_1) 2	(D_2) 4	(D_3) 6	(D_4) 8	Mean
(B_1) <1.5	11.40	14.12	17.28	13.28	14.02 d
(B_2) 3.0	12.25	16.35	19.92	13.33	15.46 c
(B_3) 4.5	13.06	17.64	21.97	14.32	16.75 b
(B_4) 6.0	14.35	17.32	21.03	15.66	17.09 a
Mean	12.76 d	16.36 b	20.05 a	14.15 c	
	B		D		B×D
S.Em±	0.28		0.32		0.65
CD@5%	0.57		0.67		1.34

Fig 3: Effect of bulb size on number of leaves per plant at different days after planting (DAP) of tuberose cv. Suvasini



*Bulb sizes: B_1- < 1.5 cm, B_2- 3.0 cm, B_3- 4.5 cm, B_4- 6.0 cm.

Fig 4: Effect of depth of planting on number of leaves per plant at different days after planting (DAP) of tuberose cv. Suvasini



*Depth of plantings: D_1- 2.0 cm, D_2- 4.0 cm, D_3- 6.0 cm, D_4- 8.0 cm

8. Length of leaf at 30 days after planting (cm)

The data recorded on length of leaf at 30 days after planting as influenced by bulb size and depth of planting are presented in table 8. Bulb size significantly influenced the length of leaf per plant at 30 days after planting. Bulb size B4 (6.0 cm large size bulb) recorded maximum length of leaf (11.21 cm) followed by 4.5 cm size bulbs (B3) (10.82 cm) and 3.0 cm size bulbs (B2) (10.02 cm). The treatment B1 (<1.5 cm) recorded reduced length of leaf (9.29 cm). Large sized bulbs produced highest leaf length over small size bulbs. The depth of planting has significant influence on length of leaf at 30 DAP. Planting at depth of D3 (6 cm) recorded maximum length of leaf (12.94 cm) followed by D2 (4 cm depth of planting) (10.40 cm) and D4 (8 cm depth of planting) (9.88 cm). The treatment D1 (2 cm depth of planting) recorded less length of leaf (8.12 cm). The interaction between bulb size and depth of planting on length of leaf at 30 DAP is significant. The treatment combination B3D3 (4.5 cm + 6.0 cm) recorded maximum leaf length (14.06) and

it is followed by B4D3 (6.0 cm + 6.0 cm) (13.33 cm). The treatment combination B1D1 (<1.5 cm + 2 cm) recorded reduced length of leaf (7.66 cm).

Table 8: Effect of bulb size and depth of planting on length of leaf (cm) at 30 days after planting (DAP) of tuberose cv. Suvasini

Bulb size (B)(cm)	Depth (D) (cm)				
	(D_1) 2	(D_2) 4	(D_3) 6	(D_4) 8	Mean
(B_1) <1.5	7.66	9.41	11.42	8.66	9.29 d
(B_2) 3.0	7.99	9.56	12.95	9.58	10.02 c
(B_3) 4.5	8.26	10.13	14.06	10.85	10.82 b
(B_4) 6.0	8.57	12.50	13.33	10.44	11.21 a
Mean	8.12 d	10.40 b	12.94 a	9.88 c	
	B	D		B×D	
S.Em±	0.20	0.23		0.46	
CD@5%	0.40	0.47		0.94	

9. **Length of leaf at** 60 **days after planting (cm)**

The data recorded on length of leaf at 60 days after planting as influenced by bulb size and depth of planting are presented in table 9. Bulb size significantly influenced the length of leaf at 60 days after planting. The maximum length of leaf (18.79 cm) was observed from B4 (6 cm large size bulb), which is followed (18.62 cm) by B3 (4.5 cm) while the minimum length (17.93 cm) was recorded with B2 (3.0 cm). The treatment B1 (< 1.5 cm small size bulb) recorded reduced length of leaf (17.05 cm). The depth of planting has significant influence on length of leaf at 60 DAP. The highest leaf length (20.73 cm) was found from D3 (6 cm depth of planting) followed by D2 (18.38 cm) (4 cm depth of planting) whereas, the minimum length of leaf (17.55 cm) was observed from D4 (8 cm depth of planting). The treatment D1 (2 cm depth of planting) recorded reduced length of leaf (15.72 cm). The interaction between bulb size and depth of planting on length of leaf at 60 DAP is significant. The treatment combination B3D3 (4.5 cm + 6.0 cm) recorded highest leaf length (21.73 cm) and it is followed by B4D3 (6.0 cm + 6.0 cm) (20.95 cm). The treatment combination B1D1 (<1.5cm + 2 cm) recorded reduced length of leaf (15.29 cm).

Table 9: Effect of bulb size and depth of planting on length of leaf (cm) at 60 days after planting (DAP) of tuberose cv. Suvasini

Bulb size (B)(cm)	Depth (D) (cm)				
	(D_1) 2	(D_2) 4	(D_3) 6	(D_4) 8	Mean
(B_1) <1.5	15.29	17.75	19.03	16.13	17.05 d
(B_2) 3.0	15.66	17.13	21.23	17.70	17.93 c
(B_3) 4.5	15.75	18.84	21.73	18.16	18.62 b
(B_4) 6.0	16.20	19.81	20.95	18.23	18.79 a
Mean	15.72 d	18.38 b	20.73 a	17.55 c	
	B	D		B×D	
S.Em±	0.21	0.24		0.48	
CD@5%	0.42	0.49		0.98	

10. Length of leaf at 90 days after planting (cm)

The data recorded on length of leaf at 90 days after planting as influenced by bulb size and depth of planting are presented in table 10. Bulb size significantly influenced the length of leaves at 90 days after planting. The highest leaf length (27.41 cm) was observed from B4 (6.0 cm large size bulb), which is followed (26.71 cm) by B3 (4.5 cm) while the minimum length (26.10 cm) was recorded with B2 (3.0 cm). The treatment B1 (<1.5 cm small size bulb) recorded reduced leaf length (25.56 cm). Large bulbs are produced highest leaf length over small size bulbs. Harish (2014) obtained similar results and reported that larger bulbs produced maximum leaf length compared to smaller bulbs in tuberose. The depth of planting has significant influence on length of leaf at 90 days after planting. The highest leaf length (30.53 cm) was found from D3 (6 cm depth of planting) and followed by D2 (26.70 cm) (4 cm depth of planting)

whereas, the minimum length of leaf (25.70 cm) was observed from D4 (8 cm depth of planting). The treatment D1 (2 cm depth of planting) recorded reduced length of leaf (22.84 cm). The interaction between bulb size and depth of planting on length of leaf was significant. The highest leaf length (31.75 cm) was observed from B3D3 (4 cm + 6 cm) followed by B4D3 (6 cm + 6 cm) (30.76 cm), whereas the treatment combination B1D1 (< 1.5 cm + 2 cm) recorded lowest leaf length (15.29 cm). Large sized bulbs at medium depth of planting recorded maximum length of leaf.

From the above results, it is revealed that maximum length of leaf were observed in larger bulbs as larger bulbs have huge stored food material that supported to increase vegetative growth of the plants. Ahmad et al. (2009) observed that large bulb size resulted in vigorous growth as compared to small and medium sized bulbs in tuberose.

Table 10: Effect of bulb size and depth of planting on length of leaf (cm) at 90 days after planting (DAP) of tuberose cv. Suvasini

Bulb size (B)(cm)	Depth (D) (cm)				
	(D_1) 2	(D_2) 4	(D_3) 6	(D_4) 8	Mean
(B_1) <1.5	22.61	26.27	29.00	24.39	25.56 d
(B_2) 3.0	22.62	25.20	30.63	25.95	26.10 c
(B_3) 4.5	22.85	26.74	31.75	25.50	26.71 b
(B_4) 6.0	23.30	28.61	30.76	26.96	27.41 a
Mean	22.84 c	26.70 b	30.53 a	25.70 d	

	B	D	B×D
S.Em±	0.25	0.29	0.59
CD@5%	0.52	0.60	1.21

CONCLUSION

The treatment combination of small bulbs at shallow depth of planting (<1.5 cm + 2.0 cm) implied early sprouting of bulbs. In converse, large bulbs at deeper depth of planting (6.0 cm + 8.0 cm) resulted in late sprouting of bulbs. Plant height was increased with age of the plant *i.e* from 30 DAP to 90 DAP. Among different treatment combinations, large bulbs at medium depth of planting (6.0 cm + 6.0 cm) recorded tallest plants which were on par with 6.0 cm + 4.0 cm at all stages of plant growth. Number of leaves and length of leaf increased with age of the plant. Among different treatment combinations, large bulbs at medium depth of planting (6.0 cm + 6.0 cm) recorded more number of leaves and maximum length of leaf which was on par with 6.0 cm + 4.0 cm at all stages of plant growth.

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