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Effect of bulb density, nitrogen application time and deheading on growth, yield and relative economics of daffodil cv. Tunis (*Narcissus* sp.)

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A two years field experiment was carried out to study the effect of bulb density, nitrogen application time and deheading on the growth and bulb yield of daffodil cv. Tunis was conducted during winter seasons of 2009 to 2010 and 2010 to 2011 on silty clay loam soil, low in available Nitrogen, medium in available phosphorus and potassium with neutral pH. The study revealed that the bulb density at 15.0 t ha^{-1} proved significantly superior recording higher values of growth characters and resulted in 30.30 and 57.47% higher bulb yield than 12.50 and 10.00 t ha^{-1}, respectively. Application of nitrogen in two splits at 1st week of March and April significantly improved the growth characters and registered 9.88 and 21.56% higher bulb yield than single split of nitrogen at 1st week of March, respectively. Deheading at tight bud stage did not affect the top growth characters *viz.*, number and dry weight of leaves and leaf area however, significantly improved bulb dry weight and increased the bulb yield by 5 to 15 % over no deheading. Bulbs planted at 15.0 t ha^{-1} and supplied with Nitrogen in 2 splits at 1st week of March and April followed by deheading at tight bud stage recorded the highest benefit cost of Rs 0.51(per rupee) and net returns of Rs 6, 30,508.0 ha^{-1}.

Key words: B.C ratio, bulb weight, nitrogen splits, deheading, tight bud stage.

INTRODUCTION

Daffodil (*Narcissus* sp.), the most important early season on blooming flower, is known for its unmatched beauty and fragrance. Like other bulbous crops, the flower and bulb production in daffodil is influenced greatly by agronomic and environmental factors. Unfortunately the work done on these aspects is lacking in the country. As such, it is essential to standardize the cultivation of daffodils so that they can be grown in the farmers field by adopting proper management practices because cultural and management practices play a vital role in the qualitative traits of flowering plants. One of the important management practices is the maintenance of proper bulb density for obtaining maximum quality bulbs per unit area. Planting of quality bulbs would improve the quality of flowers. No doubt, nitrogen is the limiting nutrient element for growth and development of bulbs but there is need to identity the time for its application so that it is need utilized by the crop to maximum level. Besides, it is a known fact that the flowers and bulbs are two major sinks in bulb crops and the removal of one sink may influence the other sink (John and Khan, 2003). Deheading at tight bud stage would lead to maximum accumulation of photosynthates in bulbs thereby would improve the bulb yield (Xia et al., 2005).

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In view of this, the present study was initiated during winter seasons of 2009 to 2010 and 2010 to 2011.

MATERIALS AND METHODS

A field experiment to study the effect of bulb density, nitrogen application time and deheading on growth, bulb production in daffodil cv. Tunis was conducted during winter seasons of 2009 to 2010 and 2010 to 2011 at the Research Farm, Division of Floriculture, Medicinal and Aromatic plants, Sher-e- Kashmir University of Agriculture Sciences and Technology of Kashmir, Shalimar on a silty clay loam soil low in available nitrogen (269.0 kg ha^{-1}), medium in available phosphorus (14.6 kg ha^{1}) and potassium (160.0 kg ha^{-1}) with neutral pH (7.5). The treatments consisting of 3 factors *viz.*, 3 bulb densities (10.00, 12.50 and 15.00 kg ha^{-1}), 3 nitrogen application time (2 splits in 2nd week of Nov and 1st week of March, 2 splits in 1st week of March and April and single split in 1st week of March), 2 deheadings (no deheading and deheading at tight bud stage) were laid out in a randomized block design replicated thrice. The fertilizers *viz.*, phosphorus at the rate of 150 kg ha^{-1} and potassium at the rate of 75 kg ha^{-1} through single super phosphate and murate of potash, respectively were applied as basal before planting of bulbs. Nitrogen at the rate of 150 kg ha^{-1} through urea was applied as per treatments. Other cultural and management operations were carried as per recommended package of practices. Uniform sized bulbs at the rate as per treatment were planted in 2nd week of November, 2009. Deheading operation as per treatment was carried at tight bud stage as per treatment. Observations on various parameters *viz.*, number and dry weight of leaves $palnt^{-1}$, leaf area per plant at 30, 60 and 90 DAM during 2009 to 2010 and 2010 to 2011, bulb dry weight at 30, 60, and 90 DAM during 2010 to 2011 and bulb yield were recorded from 5 randomly selected plants from each plot. Bulbs were excavated on 25.07.2011. Data was analysed by the method given by Panse and Sukhatme (1985). Benefit cost ratio and net returns were determined on the basis of cost of cultivation.

RESULTS AND DISCUSSION

The growth characters viz., number and dry weight of leaves and leaf area recorded significant improvement with bulb density of 15.00t ha^{-1} over 10.00 t ha^{-1} during 2010 to 2011 at 30, 60 and 90 days after March 1st (DAM), however, all these parameters remained non significant during 2009 to 10 (Table 1). Number of bulbs and bulb yield was significantly highest at bulb density of 15.0 t ha^{-1} (Table 2).Whereas bulb dry weight at 30, 60 and 90 DAM was significantly highest bulb density of 10.0 t ha^{-1}. Bulb yield at 15.0 t ha^{-1} 30.30 and 57.47% more than 12.5 and 10.0 t ha^{-1}, respectively, Leopold and Kriedmann (1980) indicated that within limits, plants inherent capacity for growth is direct consequence of how successfully it exploits the local environment. Such factors as light, temperature, moisture and mineral nutrition assumes major importance. The higher density affords more leaves, greater leaf area and more bulb dry weight per unit area and therefore greater potential for overall yield. When higher density does not produce competition for above factors, the photosynthetic rate of individual leaves would tend to increase Kumar et al. (2003) and Nazki et al. (2005) also support the results. Singh and Singh (2005) found that medium bulb spacing of 20 × 25 cm produced maximum growth and number of bulbs in tuberose as compared to bulb spacings of 20 × 20 cm and 30 × 30 cm. Similarly, Patel et al. (2006) reported that for higher yield of bulbs, tuberose could be planted at closer spacing instead of wider spacing.

Application of nitrogen in splits at 1st week of March and April resulted in significant improvement in growth characters that is, number and dry weight at 30, 60 and 90 DAM and number of bulbs ha^{-1} during 2010 to 2011 in comparison to single split of nitrogen at 1st week of March and 2 splits of nitrogen at 2nd week of November and 1st week of March and the treatments recorded 9.88 and 21.56% higher bulb yield than single nitrogen split in 1st week of March and 2 splits of nitrogen in 2nd week of November and 1st week of March, respectively. The treatment ensured regular supply of nitrogen is small quantities at critical growth stages. Thus, proper utilization of applied nitrogen might be responsible for better growth. Goss (1973) also reported similar findings. Besides, Nitrogen is an essential constituent of proteins, chlorophyll and amino acids. Regular and timely supply of nitrogen to bulbs might have increased the weight of bulbs and hence increase in total bulb yield. Singh et al. (2005) and Hermandez et al. (2008) found that application of nitrogen in 2 splits *viz.,* half at planting and half at spike initiation increased the number of leaves $plant^{-1}$, leaf length, plant height, reduced the days to sprouting and lesser number of stems of inferior quality of tuberose bulbs. These results also support the present findings.

Deheading did not affect the growth characters *viz.*, number of leaves, leaf dry weight and leaf area. However, deheading at tight bud stage significantly improved bulb dry weight at 30, 60 and 90 DAM and number of bulbs than no deheading. The treatment recorded 5.15% increase in total bulb yield over no deheading. Increase in bulb dry with and total bulb yield under deheading at tight bud stage is obviously a result of more resource allocation to the under ground sinks which could other wise have been used by the developing flowers (Wang and Breen, 1984). Any relocation of photosynthates as a consequence of elimination of floral sink mostly takes place to the main bulb. The results agree with those of John and Khan (2003).

The study revealed that the bulbs planted at the rate of 15.0 t ha^{-1} and supplied with 150 kg ha^{-1} nitrogen in 2 splits at 1st week of March and April followed by deheading at tight bud stage recorded the highest benefit cost ratio of Rs 0.51 and net returns of 6,30,508.16 ha^{-1} (Table 3). Thus the study leads to the conclusion that for producing economic highest bulb yield in daffodil cv. Tunis bulb at the rate of 15.00 t ha^{-1} be planted and supplied with 150 kg N ha^{-1} in 2 splits at 1st week of March and April followed by deheading at tight bud stage.

Table 1. Growth characters in daffodil cv. Tunis as affected by bulb density, nitrogen application time and deheading.

Treatment	Days after March 1st (DAM)											
	Number of leaves plant^{-1} (g)						Leaf area palnt^{-1} (m^2)					
	30		60		90		30		60		90	
	2009-2010	2010-2011	2009-2010	2010-2011	2009-2010	2010-2011	2009-2010	2010-2011	2009-2010	2010-2011	2009-2010	2010-2011
Planted bulb weight (t ha^{-1})												
W_1 10.00	3.20	3.77	4.18	4.47	3.88	4.17	24.08	28.30	34.90	38.00	28.36	31.26
W_2 12.50	3.28	3.92	4.26	4.64	3.96	4.34	26.78	31.60	35.05	34.26	28.55	33.05
W_3 15.00	3.34	4.13	4.31	4.87	4.01	4.59	27.98	32.54	27.98	32.54	29.16	33.66
CD (P= 0.05)	NS	0.25	NS	0.39	NS	0.37	NS	0.85	NS	1.58	NS	1.74
Nitrogen application time (150 kg ha^{-1})												
N_1 Two splits (2nd week of Nov. and 1st week of March)	3.24	3.88	4.24	4.52	3.98	4.22	25.81	30.89	35.00	39.78	28.50	31.80
N_2 Two splits (1st week of March and 1st week of April)	3.30	4.10	4.31	4.98	4.02	4.68	26.98	31.70	35.40	42.74	29.21	34.61
N_3 Single split (1st week of March)	3.29	3.84	4.20	4.50	3.85	4.20	35.85	29.85	35.20	37.17	28.36	31.66
CD (P= 0.05)	NS	0.25	NS	0.39	NS	0.37	NS	1.85	NS	1.58	NS	1.74
D_0 No deheading	3.26	3.91	4.24	4.71	3.98	4.39	26.36	31.22	25.30	40.12	29.05	32.94
D_1 Deheading at tight bud stage	3.28	3.97	4.26	4.62	3.92	4.34	26.20	80.40	35.10	39.74	28.33	32.44
CD (P= 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Treatment	Leaf dry weight plant^{-1} (g)					
	30		60		90	
	2009-2010	2010-2011	2009-2010	2010-2011	2009-2010	2010-2011
Planted bulb weight (t ha^{-1})						
W_1 10.00	0.79	0.93	0.90	1.04	0.99	1.14
W_2 12.50	0.82	1.00	0.92	1.11	1.00	1.18
W_3 15.00	0.82	1.04	0.94	1.15	1.04	1.25
CD (P= 0.05)	**NS**	**0.05**	**NS**	**0.06**	**NS**	**0.08**
Nitrogen application time (150 kg ha^{-1})						
N_1 Two splits (2nd week of Nov. and 1st week of March)	0.81	0.97	0.91	1.08	1.00	1.16
N_2 Two splits (1st week of March and 1st week of April)	0.82	1.02	0.95	1.17	1.05	0.28
N_3 Single split (1st week of March)	0.80	0.98	0.90	1.05	0.98	1.30
CD (P= 0.05)	NS	0.05	NS	0.06	NS	0.08
Deheading						
D_0 No deheading	0.81	1.00	0.93	1.11	1.03	1.21

Table 1. Contd.

D_1	Deheading at tight bud stage	0.81	0.98	0.91	1.09	0.99	1.17
CD (P= 0.05)		NS	NS	NS	NS	NS	NS

Table 2. Bulb dry weight (after March 1st) and total bulb yield daffodil cv. Tunis as affected by bulb density, nitrogen application time and deheading.

Treatment	Bulb dry weight plant^{-1} (g)			Bulb weight plant^{-1} (g)	Number of bulbs ha^{-1} (lakhs)	Total bulb yield (q/ha^{-1})
	30	60	90			
Planted bulb weight (t ha^{-1})						
W_1 10.00	10.85	13.261	15.94	39.02	6.101	14.86
W_2 12.50	10.03	12.74	15.06	38.85	7.141	17.16
W_3 15.00	9.70	11.50	13.37	37.29	9.864	22.36
CD (P= 0.05)	0.29	0.38	0.36	0.97	0.72	0.39
Nitrogen application time (150 kg ha^{-1})						
N_1 Two splits (2nd week of Nov. and 1st week of March)	10.19	12.07	14.15	37.02	7.262	16.37
N_2 Two splits (1st week of March and 1st week of April)	10.65	13.06	15.70	39.77	8.130	19.90
N_3 Single split (1st week of March)	10.34	12.33	14.52	38.37	7.711	18.11
CD (P= 0.05)	**0.29**	**0.38**	**0.36**	**0.97**	**0.72**	**0.39**
Deheading						
D_0 No deheading	10.18	12.20	14.20	37.74	7.655	17.67
D_1 Deheading at tight bud stage	10.60	12.78	15.38	39.02	7.747	18.58
CD (P= 0.05)	0.23	8.31	0.29	0.79	NS	0.32

Table 3. Relative economics (hectare Basis) of daffodil cv. Tunis as affected by bulb density, nitrogen application time and deheading.

Treatment combination	Gross returns (ha^{-1})	Cost of cultivation (ha^{-1})	Net returns (ha^{-1})	Benefit cost ratio (returns per rupee invested)
$W_1 N_1 D_0$	10,02,240.00	8,29,061.84	1,73,178.16	0.21
$W_1 N_1 D_1$	10,27,800.00	8,29,061.84	1,98,738.16	0.24
$W_1 N_2 D_0$	11,22,660.00	8,29,061.84	2,93,598.16	0.35
$W_1 N_2 D_1$	11,39,220.00	8,29,061.84	3,10,158.16	0.37
$W_1 N_3 D_0$	10,92,060.00	8,29,061.84	2,62,998.16	0.32
$W_1 N_3 D_1$	11,08,620.00	8,29,061.84	2,79,558.16	0.34
$W_2 N_1 D_0$	11,96,460.00	10,29,611 .84	1,66,848.16	0.16
$W_2 N_1 D_1$	12,13,020.00	10,29, 611.84	1,83,40.08	0.18

Table 3. Contd.

$W_2 N_2 D_0$	13,52,700.00	10,29, 611.84	3,23,088.16	0.31
$W_2 N_2 D_1$	13,69,280.00	10,29, 611.84	3,39,668.16	0.33
$W_2 N_3 D_0$	12,77,280.00	10,29, 611.84	2,47,668.16	0.24
$W_2 N_3 D_1$	12,93,840.00	10,29, 611.84	2,64,228.16	0.25
$W_3 N_1 D_0$	16,88,220.00	12,30,151.84	4,58,068.16	0.37
$W_3 N_1 D_1$	17,04,780.00	12,30 ,151.84	4,74,628.16	0.38
$W_3 N_2 D_0$	18,44,460.00	12,30 ,15 1.84	6,14,308.16	0.50
$W_3 N_2 D_1$	18,60,660.00	12,30 ,151.84	6,30,508.16	0.51
$W_3 N_3 D_0$	17,69,040.00	12,30 ,15 1.84	5,38,888.16	0.44
$W_3 N_3 D_1$	17,85,600.00	12,30 ,15 1.84	5,55,448.16	0.45

Where: $W_{1 = 10.00}$ t ha^{-1}, $W_{2 =12.50}$ t ha^{-1}, $W_{3 =15.00}$ t ha^{-1}, $N_{1 =}$2 splits in 2nd week of November and 1st week of March, $N_{2 =}$ 2 splits in 1st week of March and April, N_3 = single split in 1st week of March, $D_{0 =}$ No deheading, $D_{1 =}$ Deheading at tight bud stage.

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