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Performance of tulip cultivars at different altitudes of Northern Himalayas of India

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ABSTRACT

Study on evaluation of different tulip cultivars was carried out during year 2018-19 at different altitudes of Northern Indian Himalayas (1550 m amsl, 1585 m amsl, 1600 m amsl , 1615 m amsl) with an objective to delaminate the genetic diversity on the basis of qualitative and quantitative traits of growth, flowering and propagation ratio. Results depict the variability among different tulip cultivars in terms of vegetative, floral and propagation ratio. The variability response for minimum to maximum ranged 81.00(White flag) to 114 .00(Candela) for days to bulb sprouting after planting , 107.00 to(Alectric) 135 .00 (Atilla graffiti) for days to flowering, 4.70(Candela) to 8.50 cm(Apeldoorn) for flower diameter,9.00(candela) to 23.00 days(Angelique) for duration of flowering, 37.00(white flag) to 54.51 cm(Apeldoorn) for plant height (cm) , 4.00(white flag) to 6.00(Apeldoorn) for number of leaves per plant, 1.00(candela) to 1.92(Apeldoorn) for number of bulbs plant^{-1} and 9.30(candela) to 19.14 g(Apeldoorn) for bulb weight plant^{-1} . Evaluation of tulip genotypes reveals improvement in performance at higher altitudes. Genetic variability on the basis of morphological parameters categorized cultivars early and mid from flowering pattern point of view. Significant correlations were observed for different parameters among the cultivars.

Keywords: *Tulip cultivars, Altitudes, Morphology, Flowering, Variability, Correlation*

INTRODUCTION

Tulip (*Tulipa* sp.), belongs to family Liliaceae. In international market, Tulip ranks first amongst the bulbous crops and demanded temperate ornamental bulbous crop in international floriculture trade (Masoodi *et al* 2018). Globally 50000 ha are under bulb production and around 50% of the area is under Dutch cultivation. Tulip bulb production occupies around 14000 ha in Netherland with a production of around 4.5 billion tulip bulbs annually. Around 3,000 tulip varieties belonging to 14 groups are available in trade including early, mid and late flowering. The reason for taking up this study has a justification of delaminating cultivars, evaluation in terms of distinctiveness, stability and uniformity on the basis of morphological , floral and propagation ratio. Second very important justification to carry out this study is due to the fact that tulip species which were used for developing hybrid tulips(*tulipa culsiana* and *tulipa lanata)* grow wild in Indian Himalayas. When assessing the situation of import, temperate bulbs particularly Tulip are imported annually worth crores of rupees in India though there is a potential of production and developing new cultivars. In India, Kashmir is endowed with highly suitable agro-climate and offers immense scope for hybrid development and bulb production . So in absence of any interstate competition, Kashmir can supply bulbs of tulip, not only in the state but to national markets.

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But which variety can perform best from vegetative to reproductive point of view is always questionable. Thus current study of evaluation envisages a scope for delaminating varieties of tulip which can be explored from varietal improvement and commercial point of view.

MATERIALS AND METHODS

Geographical features of study area

Different altitudes of Indian Northern Himalayan regions of Kashmir ,Jammu & Kashmir viz. Shalimar: 1585 m amsl, Budgam: 1550 m amsl, Suhama Ganderbal : 1600 m amsl, Kupwara: 1615 m amsl were tested for evaluation of tulip cultivars.

Experimental details

Number of varieties : 9
Locations : 4

2.3 Design : RCBD (Randomized Complete Block Design)
No of Replications in each location **:** 03

Preparation of beds for experimental trial

The field selected for the experiment was prepared by ploughing with tractor thoroughly and leveled properly. The stubbles of previous crop, weeds and grasses were removed and then field was finally leveled to make the soil pulverized.

Application of manures and fertilizers and Cultural practices

Recommended dose of well decomposed farmyard manure (FYM) and inorganic fertilizers were applied and mixed thoroughly with the soil before the planting of bulbs.

Uniform cultural practices were followed through the growth period. Irrigation, weeding-cum-hoeing and plant protection measures were carried out as and when required.

Observations recorded

Observations were observed on days to bulb sprouting after planting , days to flowering, flower diameter(cm), duration of flowering(days), plant height (cm) , number of leaves per plant, number of bulbs plant^{-1} and bulb weight plant^{-1}

Statistical analysis

Statistical analysis of the data collected for different parameters at different altitudes during the present investigation was subjected to analysis of variance for randomized block design with three replications (Gomez and Gomez, 1983).

Descriptive Analysis and Correlation Analysis

In this study, violin box plots were employed to visually analyze and compare various parameters of tulip cultivars across different study areas, namely Budgam, Ganderbal, Kupwara, and Shalimar. The box plots provided a five-number summary of the data, enabling a comprehensive understanding of the variations and distributions of each parameter. This discussion will highlight the key findings and implications of the study, focusing on days to flowering and sprouting, flower diameter, maximum plant height, average number of leaves, number of bulbs, and bulb weight across the different tulip cultivars and study areas.

Correlation plots were generated using the R software to investigate the relationships between various parameters of tulip cultivars. The parameters under consideration included days to flowering, days to sprouting, flower diameter, maximum plant height, average number of leaves, number of bulbs, and bulb weight. The correlation analysis aimed to identify any significant associations between these parameters and shed light on their interdependencies. The results of the correlation analysis are presented below.

RESULTS AND DISCUSSION

Results depicts the variability response of different tulip cultivars in terms of vegetative ,floral and propagation ratio at different altitudes. As evident from Table 3.1& Table 3.2 , the variability response for minimum to maximum values ranged 81.00(white flag) to 114 .00(candela) for days to bulb sprouting after planting , 107.00 to(Alectric) to 135 .00 (Atilla graffiti)for days to flowering, 4.70(Candela) to 8.50 cm(Apleldoorn) for flower diameter,9.00(Candela) to 23.00 days(Angelique) for duration of flowering, 37.00(White flag) to 54.51 cm(Apleldoorn) for plant height (cm) , 4.00(White flag) to 6.00(Apeldoorn) for number of leaves per plant, 1.00(Candela) to 1.92(Apeldoorn) for number of bulbs plant^{-1} and 9.30(Candela) to 19.14 g(Apleldoorn) for bulb weight plant^{-1} at 1500 and 1650 m amsl, simultaneously and respectively. Qualitative traits were observed at higher altitudes and the differences were statistically significant. Genetic variability on the basis of morphological categorized cultivars early, mid and late from flowering pattern point of view. Alectric, Angelique, Atilla graffiti Apeldoorn, Apricot impression falls under mid season flowering cultivars where as Avant grade, Candela, Orange brilliant, White flag in early flowering cultivars .Fig 3.1 shows significant correlation for different parameters among the cultivars at different altitudes for qualitative as well as quantitative traits.

Days to Flowering and Sprouting: The violin box plots revealed that the days to flowering and sprouting were highest in the Kupwara district, followed by Ganderbal. This finding indicates that the climatic conditions or other environmental factors in Kupwara and Ganderbal may lead to delayed flowering and sprouting compared to other study areas. Understanding these differences can be crucial for tulip growers and breeders, as it may influence their cultivation practices and management strategies in these regions.

Flower Diameter: The violin box plots showed that the flower diameter was highest in the Apeldoorn variety, followed by the Angelique variety. This finding suggests that Apeldoorn and Angelique cultivars have larger flowers compared to the other tulip varieties studied. The difference in flower size could be a crucial factor for ornamental purposes, as larger flowers might be more attractive to consumers and florists. Moreover, this information can assist in selecting cultivars based on specific preferences for flower size.

Maximum Plant Height: The study revealed that the maximum plant height was observed in the Kupwara district for the Apeldoorn and Apricot Impression varieties. This observation may be attributed to the favorable growing conditions in Kupwara, such as soil type, temperature, and moisture, which may have contributed to the plants' height development. Understanding the factors influencing plant height is essential for optimizing cultivation practices and enhancing the overall quality of the tulip crop.

Average Number of Leaves: Interestingly, the average number of leaves was found to be approximately the same for all nine tulip varieties across all study areas. This result implies that the genetic makeup of the cultivars or the environmental conditions might have less impact on the leaf count. However, further investigation is warranted to determine if there are any subtle differences or factors influencing leaf development.

Number of Bulbs and Bulb Weight: The study demonstrated that the number of bulbs and bulb weight were highest in the Kupwara district. This suggests that Kupwara's environmental conditions are favorable for bulb formation and growth, leading to larger and more numerous bulbs compared to other study areas. Understanding the factors contributing to the higher bulb production in Kupwara can be valuable for tulip farmers and may lead to increased productivity in other regions as well.

Mohammad, *et .al* (2020) while working on popularization genetics of narcissus species reveals high diversity among the species . Masoodi (2022) found significant co relation in different Lilium cultivars in floral trait. Masoodi (2022) reported correlated findings in common hyacinth cultivars for qualitative and quantitative traits which are in close conformity to this study. High heritability with high genetic advance indicates that the trait is governed by the additive gene action. Selection on the basis of these characters would be more effective for improvement the Lilium. Number of leaves, inflorescence diameter and number of days to bud appearance exhibited high heritability with moderate genetic advance indicating presence of dominant and epistatic genes and these traits can be improved through hybridization (Kumar *et al*., 2012). Cultivars and Phenotypic co-efficient of variation was fond to be higher than the genotypic co-efficient of variation for all the traits indicating that the genotypic expression is superimposed by the environmental influence.

These findings are in agreement with the work of Monika *et al*. (2008) and Masoodi & Sofi (2018), Masoodi (2022). Similar results were observed for number of flowers per stem in China Aster by Ravikumar and Patil (2003) and Nimbalkar *et al* 2016 in French marigold and number of florets per spike in gladiolus (Kispotta *et al.,* 2017). Grassotti *et al*. (1990) and Balode (2010) also reported higher phenotypic variability for plant height in Lilium. Higher genotypic co-efficient of variation for different plant characters can be effectively utilized in future breeding programme. Singh and Sen (2000) suggested that if the phenotypic coefficient of variation is greater than the genotypic co-efficient of variation, the apparent variation is not only due to genotypes, but also due to influence of environment and hence selection may be misleading. The estimates of phenotypic and genotypic co-efficients of variance showed a low disparity for plant height (cm), number of leaves per plant and inflorescence diameter (cm) indicating the least effect of environment on different traits and phenotypic variability could be a reliable measure of genotypic variability. The progress in the selection is directly proportional to the amount of genetic gain, therefore the effect of selection is realized more quickly in the characters with high heritability and genetic advance estimating the relative amount of heritable portion of variation. Bhatia *et al*. (2013) also observed similar results for spike length and plant height in tulip, Mishra *et al.* (2006) in spray chrysanthemum for the time taken for bud initiation. The results are also in line with the findings of Singh and Kumar (2008) in marigold for number of flowers per plant and plant height, Dhiman *et al*. (2015) in Asiatic hybrid lily, Masoodi *et. al.* (2018) in Asiatic, Oriental and La hybrids, Bichoo *et al.* (2002) in gladiolus, and in gladiolus for number of floret per spike (Ramzan *et al.*, 2016) and number of flowers per plant in chrysanthemum (Baskaran *et al.,* 2009).

CONCLUSION

Tulip cultivars tested in the experiment performed well at different altitudes. However it was observed that as the altitude goes at higher qualitative as well as quantitative traits showed significant differences. Highest altitude of 1615m amsl tested in the research programme showed statistically significant results over all other altitudes. On the basis of performance from flowering point of view, Alectric, Angelique, Atilla graffiti Apeldoorn, Apricot impression falls under mid season flowering cultivars where as Avant grade, Candela, Orange brilliant, White flag in early flowering cultivars. There was a positive correlation among the cultivars for all quality traits.

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Table 1: Flowering Response of Tulip Cultivars at Different Altitudes of North Indian Himalayas

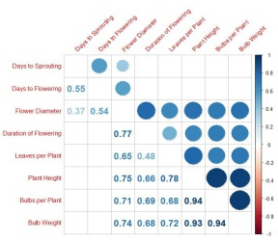
Variety/ Altitude	Days to sprouting (DAP)				Days to flowering (DAP)				Flower diameter(cm)				Duration of flowering(days)			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Alectric	90.00	88.00	95.00	97.00	110.00	107.00	117.00	119.00	6.00	5.00	6.00	6.50	17.50	15.00	19.50	22.50
Angelique	100.00	96.00	107.00	109.00	115.00	112.00	119.00	122.00	7.15	7.00	8.10	8.30	19.00	17.00	21.00	23.00
Apeldoorn	103.00	100.00	106.00	109.00	122.00	118.00	125.00	127.00	8.18	7.98	8.50	8.50	18.50	17.50	20.50	22.50
Apricot impression	96.00	94.00	100.00	102.00	118.00	114.00	121.00	123.00	7.33	7.13	8.00	8.00	17.00	17.00	19.00	21.00
Atilla graffity,	104.00	100.00	104.00	106.00	130.00	125.00	133.00	135.00	7.15	7.00	7.90	8.10	16.00	14.00	18.50	20.50
Avant grade	100.00	93.00	105.00	108.00	125.00	122.00	128.00	130.00	7.50	7.00	8.00	8.00	17.00	14.00	19.00	21.00
Candela	107.00	103.00	110.00	114.00	117.00	114.00	121.00	124.00	4.70	4.50	5.00	5.00	9.00	9.00	9.00	9.00
Orange brilliant	99.00	96.00	104.00	106.00	122.00	116.00	125.00	127.00	6.70	6.20	7.00	7.00	17.00	15.00	19.00	21.00
White flag	84.00	81.00	88.00	91.00	118.00	114.00	122.00	125.00	5.50	5.00	6.10	6.50	12.00	11.00	14.50	16.50
C.D (p=0.05)	**2.05**	**2.09**	**2.01**	**2.11**	**1.60**	**1.58**	**1.63**	**1.63**	**1.03**	**1.07**	**1.06**	**1.09**	**1.17**	**1.19**	**1.22**	**1.22**

Table 2: Varietal Response to Vegetative and Propagation Traits at Different Altitudes of North Indian Himalayas

Variety/ Altitude	Plant height(cm)				No. Of leaves per plant				No. Of bulbs per plant				Bulb weight per plant(g)			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Alectric	39.16	37.00	41.51	43.30	4.50	4.50	4.50	4.50	1.27	1.18	1.40	1.55	13.45	12.15	14.20	16.17
Angelique	42.15	41.00	44.12	44.13	5.00	5.00	5.00	5.00	1.38	1.32	1.51	1.55	15.40	14.40	17.00	16.25
Apeldoorn	52.11	50.50	52.51	54.51	6.00	6.00	6.00	6.00	1.62	1.57	1.77	1.92	17.24	17.04	18.64	19.14
Apricot impression	48.17	46.53	50.00	51.90	5.00	5.00	5.00	5.00	1.46	1.42	1.67	1.84	16.30	16.00	17.55	18.32
Atilla graffity,	36.12	34.12	37.80	38.93	4.50	4.50	4.50	4.50	1.10	1.05	1.25	1.32	12.30	11.30	13.10	13.61
Avant grade	42.19	39.50	44.53	46.13	4.50	4.50	4.50	4.50	1.40	1.37	1.48	1.56	15.75	13.75	17.25	17.68
Candela	33.13	32.22	34.71	36.00	4.00	4.00	4.00	4.00	1.13	1.00	1.22	1.29	12.30	9.30	12.70	12.94
Orange brilliant	43.12	41.52	44.51	45.73	5.50	5.50	5.50	5.50	1.40	1.37	1.50	1.59	16.00	15.00	17.70	18.10
White flag	39.13	37.00	40.51	42.5	4.00	4.00	4.00	4.00	1.17	1.17	1.36	1.52	13.30	12.10	14.00	16.00
C.D (p=0.05)	**4.16**	**4.24**	**4.44**	**4.34**	**0.12**	**0.10**	**0.12**	**0.14**	**0.38**	**0.40**	**0.42**	**0.44**	**0.40**	**0.41**	**0.44**	**0.47**

- **Study area altitudes in m above mean sea level**

1: Shalimar: 1585 m amsl,
2 Budgam: 1550 m amsl,
3 Ganderbal : 1600 m amsl,
4 Kupwara: 1615m amsl






Experimental views at different locations.

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