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K Bhavana

P.G., Department of Floriculture and Landscape Architecture, Dr. Y.S.R Horticultural University, College of Horticulture, Anantharajupeta, Annamayya, Andhra Pradesh, India

Dr. K Swarajya Lakshmi

Professor, Department of Horticulture Head, Dr. Y.S.R.H.U- College of Horticulture, Anantharajupeta, Annamayya, Andhra Pradesh, India

Dr. V Vijaya Bhaskar

Professor, Department of Horticulture, College of Horticulture, Chinalataripi, Gudluru Mandal, Prakasam, Andhra Pradesh, India

Dr. VV Padmaja

Associate Professor, Department of Plant Physiology, Dr. Y.S.R.H.U- College of Horticulture, Anantharajupeta, Annamayya, Andhra Pradesh, India

Dr. M Jayaprada

Associate Professor, Department of Genetics and Plant Breeding, Dr. Y.S.R.H.U- College of Horticulture, Anantharajupeta, Annamayya, Andhra Pradesh, India

Corresponding Author:

K Bhavana

P.G., Department of Floriculture and Landscape Architecture, Dr. Y.S.R Horticultural University, College of Horticulture, Anantharajupeta, Annamayya, Andhra Pradesh, India

Morphological characterization of tuberose (*Polianthes tuberosa* L.) mutants of cv. Hyderabad single in VM₄ generation

K Bhavana, Dr. K Swarajya Lakshmi, Dr. V Vijaya Bhaskar, Dr. VV Padmaja and Dr. M Jayaprada

Abstract

An experiment was conducted to study the variation in VM₄ mutants at Dr. YSRHU-College of Horticulture, Anantharajupeta, Annamayya district, Andhra Pradesh during the period of 2022-2023. The experiment was laid out in Completely Randomized Design with two replications and 25 treatments. The results revealed that the morphological traits that contributed significantly to the variability were those related leaf length, days to flowering, bud and flower color, flower type, rows of tepals, tepal tip, inflorescence, flower shape, flower tube shape, tepal color on the abaxial side, bud length, flower diameter and days taken for flowering. The morphological characterization highlighted distinct differences for 11 qualitative traits and 7 quantitative traits.

Keywords: Tuberose, Hyderabad single, morphological traits, DUS, floral characters

Introduction

Tuberose (*Polianthes tuberosa* L.) is commonly known as Nela Sampangi in Telugu, Nela Sampangi in Tamil, Nishigandha in Marathi and Rajanigandha in Bengali (Jawaharlal *et al.*, 2006) ^[1], belongs to the family Amaryllidaceae and native to Mexico.

It is one of the most important fragrant bulbous plants and is commercially grown in tropical and subtropical regions. In India, tuberose cultivation covered an extensive area of about 22,000 ha, with a production of 2,16,790 MT. Among this, loose flower production alone constituted 1,20,520 MT, while cut flower production was restricted to 96,270 MT (NHB, 2022) ^[2]. It is mostly cultivated in West Bengal, Tamil Nadu, Karnataka, Andhra Pradesh, Chhattisgarh, Odisha, Assam, Telangana and Haryana.

Tuberose leaves are bright green, linear and elongated grass like foliage. Spikes bear pairs of florets that open in an acropetal (i.e., from base to top of the spike) manner. The flowers are bisexual, funnel shaped, with a waxy white and fragrant perianth tube. Flower colour is limited to white, although certain varieties exhibit a pinkish tinge at bud stage. Stamens are six in number with the anthers dorsifixed in the middle of the tube. Gynoecium has trilobular ovary with numerous ovules and the fruit is a capsule. Bulbs consist of scales and leaf bases and the stem remain concealed within the scales. The roots are adventitious and shallow.

The tuberose cultivar 'Hyderabad Single' is a single type plant that produces superior quality loose flowers. Morphological characterization of a tuberose cultivar, such as 'Hyderabad Single' in accordance with the DUS (Distinctiveness, Uniformity, and Stability) guidelines is a critical step in protecting plant breeders' rights as well as proper identification and classification of the cultivar, while many methods are available to explore cultivar connections, including various types of molecular markers, morphological characterization is the initial step in description and classification (Bharati *et al.*, 2015) ^[3].

Material and Methods

The experiment entitled "Genetic variability of mutants in VM₄ generation of Tuberose (*Polianthes tuberosa* Linn.) cv. Hyderabad Single", was conducted at Dr. YSRHU-College of Horticulture, Anantharajupeta, Annamayya district, Andhra Pradesh during the year 2022-2023. The experiment was laid in Completely Randomized Design (CRD) with two replications, using 24 variants of mutant population and untreated bulbs of cv. 'Hyderabad Single' as control. The bulbs were planted in polybags with dimensions of 13 x 16 inches and soil capacity of 10 kg.

The Poly bags were filled with a potting medium consisting of red earth, FYM and cocopeat in the ratio of 3:1:1. The morphological characterization was done as per DUS guidelines developed by Dr. Meenakshi Srinivas, Principal Scientist at IIHR, Bangalore (Kannan *et al.*, 2013) [4].

Results and Discussion

This study focused on 18 descriptors to assess both qualitative and quantitative traits, in accordance with the DUS guidelines presented in Table 2. Out of 18 descriptors, 7 were measured, while the remaining 11 were evaluated visually. Qualitative characters are more reliable for characterization as they are stable over generations (Raut, 2003) [5].

In the present study, there was no variation among mutants for few traits/characters *viz.* leaf variegation and stigmatic lobes. However, mutants examined for the remaining features differed significantly from one another and formed a credible morphological descriptor profile.

Differences were observed in various characters, such as leaf length was found short (<40cm) for 17 mutants and medium (40-50cm) for 8 mutants. Similarly, early flowering (90-100 days) was noticed in 14 mutants, while late flowering (>100 days) was observed in 11 mutants. Medium bud length (5-6cm) was found in 4 mutants, whereas 21 variants had a short (<5cm) bud length. A straight type of inflorescence was noticed for 21 variants, while a crooked type of inflorescence was noticed in one mutant and a slightly bent type of inflorescence in 3 mutants.

The bud color was pink in 4 mutants, while the remaining 21 variants were green. These findings are similar to those of (Gogoi and Talukdar, 2019) [6]. A semi-double type of flower was observed in one mutant, while the remaining 24 mutants exhibited normal single type of flower. The flower diameter was small (<4 cm) in 19 mutants, whereas 6 mutants had a medium flower diameter.

Flower tube shape was straight in 23 variants, while a bent shape was observed in 2 mutants. Flower opening was wide in the case of 21 variants, while a shy flower opening was noticed in 4 mutants.

A narrow funnel shape of floret was observed in one mutant, while tubular floret shape was observed in 2 mutants and broad funnel shape was noticed in 22 variants

Tepal tip is obtuse in case of 21 variants, while an acute tepal tip was observed in 2 mutants and an apiculate tepal tip was noticed in 2 mutants. Tepal colour on abaxial side, pinkish tinge on lower side of flowers were noticed in 2 mutants, whereas remaining 23 variants exhibited white colour on the lower side of flowers.

Perianth tube length is medium (3.5-4 cm) in 5 mutants and short perianth tube (<3.5 cm) length was noticed in 19 variants. Regarding perianth tube diameter, it is medium (8-9 cm) in case of 2 mutants, while thin (<8 mm) in 23 variants.

In terms of the rows of tepals, some mutants displayed a greater number of tepals, with 7 tepals observed in one mutant, and another mutant exhibited 8 tepals, forming a second row of tepals.

Table 1: Characteristics based on DUS guidelines

S. No.	Character	State	Note	Stage of observation	Type of Assessment
1. QL	Leaf variegation	Absent Present	25 --	02	VG
2. QN	Leaf length	Short <40 cm Medium 40-50 cm Long >50 cm	17 8 --	02	MS
3. QN	Days taken for flowering	Early 90-100 days Late >100days	14 11	05	MG
4. QL	Inflorescence	Straight Crooked Slightly Bent	21 1 3	05	VG
5. QN	Bud length	Short <5 cm Medium 5-6 cm Long >6 cm	21 4 --	05	MS
6. QL	Bud colour	Green Pink	21 4	05	VG
7. QL	Flower colour	White Yellow Pink	23 - 2	05	VG
8. QL	Flower type	Single Semi-double Double	24 1 --	05	VG
9. QN	Flower diameter	Small < 4 cm Medium 4-4.5 cm Large > 4.5 cm	19 6 --	05	MS
10. QL	Flower shape	Tubular Narrow funnel Broad Funnel	2 1 22	05	VG
11. QL	Flower tube shape	Bent Straight	2 23	05	VG
12. QL	Flower opening	Wide open Shy	21 4	05	VG
13. QL	Tepal tip	Acute Apiculate Obtuse	2 2 21	05	VG
14.	Rows of tepals	1	25	05	MG

QN		>3	--		
15. QL	Tepal colour on abaxial side	Greenish Tinge Pinkish Tinge	23 2	05	VG
16. QN	Perianth tube diameter	Thin <8mm Medium 8-9mm Thick >9mm	23 2 --	05	MS
17. QN	Perianth tube length excluding tepals	Short < 3.5 cm Medium 3.5-4 cm Long >4 cm	19 5 1	05	MS
18. QL	Stigmatic lobes	Trifid Tetrafid	25 --	05	VG

QL: Qualitative characteristics QN: Quantitative characteristics 02-leaf emergence

MG: Measurement by a single observation of a group of plants or parts of plants 05- Opening of 1st pair of florets

MS: Measurement of a number of individual plants or parts of plants

VG: Visual assessment by a single observation on a group of plants or parts of plant



Pinkish tinge at bud stage



7 tepals

6 tepals

8 tepals



Acute tepal tip

Apiculate tepal tip

Obtuse tepal tip

the VM₄ generation. while clear differences were recorded for 11 qualitative traits and 7 quantitative traits. Bharti *et al.*, (2015) [3] also got similar results and noticed distinct differences in floral and vegetative characters in tuberoses. The studies successfully revealed that the variations among mutants displayed distinct morphological characteristics in accordance with the DUS guidelines.

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Conclusion

Based on the morphological characterization done for 18 descriptors as per DUS guidelines for tuberoses, significant variations were observed. Specifically, changes were observed in bud colour in four mutants, flower colour and tepal colour on the abaxial side in two mutants. Additionally, one mutant displayed a crooked type of inflorescence, while three mutants exhibited a slightly bent type of inflorescence in