

COMPARATIVE STUDIES ON GROWTH PERFORMANCE IN ELITE GENOTYPES OF NAGPUR MANDARIN (*Citrus reticulata*

Blanco.)

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MS Received: 27.06.2025; MS Revised: 28.07.2025; MS Accepted: 29.07.2025)

MS 3421

(RESEARCH PAPER IN FRUIT SCIENCE)

Abstract

The present study, titled “Comparative Studies on Growth Performance in Elite Genotypes of Nagpur Mandarin (*Citrus reticulata* Blanco)” was carried out during the Ambia bahar seasons of 2022-23. with the objective of identifying superior genotypes for varietal improvement and commercial adoption in the Vidarbha region of Maharashtra. Extensive field surveys were conducted in five prominent citrus growing talukas: Kalameshwar, Katol, and Narkhed in Nagpur district and Morshi and Achalpur in Amravati district. Based on field observations and grower input eight elite genotypes were shortlisted with Nagpur mandarin as a standard check evaluated for key morphological growth parameters. The study revealed considerable variation among the genotypes in both plant and leaf morphological characteristics. Plant height ranged from 4.65 m to 6.99 m, with a general mean of 6.03 m. Plant spread varied from 4.73 m to 5.35 m, with an average of 5.02 m, while plant volume ranged from 41.37 m³ to 70.39 m³, with general mean 59.42 m³. These parameters reflect differences in vegetative vigor and canopy architecture. Leaf morphological traits also showed significant diversity. Leaf length ranged from 71.60 mm to 96.70 mm with population mean 80.90 mm, while leaf width varied between 29.90 mm and 45.50 mm with general mean 36.51 mm. The leaf length-to-width ratio ranged from 2.05 to 2.57, with an average of 2.23. Leaf area showed a broad range of 19.99 cm² to 32.73 cm², with a pooled mean of 24.41 cm².

The results revealed significant genotypic variation in plant height, plant canopy spread, plant volume, and leaf morphology, underscoring the potential genetic diversity within the local Nagpur mandarin population.

Key words: Nagpur mandarin, genotypic variation, morphological traits, leaf morphology

Introduction:

Citrus is one of the world's most important fruit crops, belonging to the family Rutaceae, and is widely cultivated across tropical and subtropical regions. The genus includes several commercially significant fruits such as oranges, mandarins, lemons, limes, grapefruits, and pummelos (Gmitter *et al.*, 1992). Among these, mandarins (*Citrus reticulata* Blanco) are extensively grown due to their appealing flavor, nutritional richness, and high consumer acceptance. In India, mandarins account for the largest share area 4.74 lakh hectares, yielding around 60.75 lakh metric tonnes (Anon., 2024), with the Nagpur mandarin standing out for its exceptional fruit quality and market preference. The Vidarbha region of Maharashtra is the principal area for Nagpur mandarin cultivation. However, despite its commercial importance, variability in plant growth, among genotypes poses a challenge to sustainable cultivation. Growth parameters such as plant height, canopy spread, and plant volume are critical for assessing tree vigor, orchard management efficiency, and yield potential. Leaf morphological traits, including leaf size and area, are also important as they are closely associated with photosynthetic capacity and tree health. Comparative evaluation of genotypes based on vegetative traits provides insight into their performance under field conditions and helps identify superior types for varietal improvement and commercial deployment. Morphological variability among genotypes reflects underlying genetic diversity, which is essential for breeding programs aimed at improving yield, stress tolerance, and adaptability. Previous studies have highlighted the importance of regional surveys and genotype characterization for crop enhancement and germplasm conservation (Bhattacharya and Dutta, 1956; Dubey *et al.*, 2014). Despite earlier efforts, limited systematic work has been conducted to evaluate growth parameters across elite Nagpur mandarin genotypes in the Vidarbha region. The present study, therefore, aims to fill this gap by conducting a comparative assessment of key morphological growth traits across nine elite genotypes during the Ambia bahar seasons of 2022-23

and 2023-24. This research is expected to aid in identifying genotypes with desirable vegetative characteristics for further selection, breeding, and recommendation for commercial cultivation under Vidarbha conditions.

Materials and Methods:

The present investigation, titled “Comparative Studies on Growth Performance in Elite Genotypes of Nagpur Mandarin (*Citrus reticulata* Blanco)” was conducted during the Ambia Bahar seasons of 2022-23. The study aimed to assess the vegetative growth performance of selected genotypes under field conditions typical of the Vidarbha region. The experiment was undertaken in the Nagpur and Amravati districts, which lie in a subtropical agro-climatic zone characterized by hot summers and mild winters, with an average annual rainfall of 1250 mm received primarily through the southwest monsoon. A preliminary survey was carried out in 2017-18 across 295 orchards located in five major mandarin-growing talukas: Kalameshwar, Katol, and Narkhed (Nagpur district), and Morshi and Achalpur (Amravati district). Based on performance indicators such as regular bearing, superior fruit quality, yield, and physical appearance, 30 promising genotypes were initially identified. From these, 8 elite genotypes were finalized for detailed morphological evaluation. Observations were recorded on key growth attributes. Plant height was measured from ground level to the apex using a graduated bamboo pole. Canopy spread was recorded in East-West and North-South directions. Plant canopy volume was estimated using the formula: Plant canopy volume (m³) = (mean)² x Canopy height x 0.5236. For leaf analysis, the fourth pair of fully mature leaves from the previous season's flush was used to record leaf length, width, length-to-width ratio, and leaf area. Leaf area was calculated using the graph paper tracing method and expressed in cm². This methodological approach facilitated the comparative analysis of growth performance across elite genotypes under regional conditions.

Results and Discussion:

Plant characters:**Plant height:**

The data pertaining to plant height among different Nagpur mandarin genotypes are presented in Table 1. During the year 2022-23 significant range in plant height was observed, extending from 4.60 m to 6.92 m, with a general mean of 5.95 m. The genotype M-22 exhibited the maximum plant height (6.92 m), followed by genotype N-45 (6.62 m), genotype KAL-4 (6.42 m), genotype KAL-14 (6.10 m) and genotype KAL-19 (6.05 m). The minimum plant height was recorded in genotype

N-16/2 (4.60 m). The wide range of variability in plant height among genotypes may be attributed to differences in their inherent genetic potential, growth vigour, and environmental conditions. These findings are in agreement with the results reported by Patil and Panchal (2016) in Sweet orange, Tripathi *et al.* (2016) in Coorg mandarin, Paithankar (2018) in Acid lime, Barbora *et al.* (2019) in Khasi mandarins, and Gathul *et al.* (2024) in Nagpur mandarin, all of whom observed significant genotypic differences in vegetative growth parameters.

Table 1: Comparative study of plant height, plant spread, and plant volume in different Nagpur Mandarin Genotypes.

Tr.	Genotypes	Plant height (m)	Plant spread (m)	Plant volume (m ³)	Leaf length (mm) Leaf length (mm)	Leaf width (mm) Leaf width (mm)	Leaf length: width ratio Leaf length: width ratio	Leaf area (cm ²) Leaf area (cm ²)
1	ACH-37/20	5.95	5.05	58.49	88.00	40.80	2.16	28.06
2	KAL-19	6.05	5.20	61.30	80.40	38.80	2.07	22.31
3	KAL-14	6.10	4.80	56.70	79.40	36.80	2.16	21.95
4	KAL-4	6.42	4.95	60.30	69.60	31.60	2.20	19.87
5	N-16//2	4.60	4.65	39.43	95.60	45.40	2.11	31.55
6	N-45	6.62	4.85	64.05	92.20	42.80	2.15	28.37
7	K-1/03	5.60	5.30	59.27	75.80	31.40	2.42	24.23
8	M-22	6.92	5.05	67.43	73.40	33.60	2.19	22.81
9	NM(Check)	5.30	4.70	42.80	72.20	31.60	2.29	20.88
Range		4.60-6.92	4.65-5.30	39.43-67.43	69.60 - 95.60	31.40-45.40	31.40-45.40	19.87-31.55
General Mean		5.95	4.95	56.64	80.73	36.98	36.98	24.45
S. D.		0.71	0.22	9.39	9.23	5.28	5.28	3.97
S.E. (m) ±		0.24	0.07	3.13	3.08	1.76	1.76	1.32
C. V. %		11.90	4.46	16.57	11.44	14.28	14.28	16.24

Plant spread:

The data related to plant spread among different Nagpur mandarin genotypes are presented in Table 1. Plant spread exhibited during the year 2022-23 significant variability ranging from 4.65 m to 5.30 m, with a general mean of 4.95 m. The maximum plant spread was observed in genotype K-1/03 (5.30 m), followed by genotype KAL-19 (5.20 m), genotype ACH-37/20 (5.05 m) genotype M-22 (5.05 m), genotype KAL-4 (4.95 m) and genotype N-45 (4.85 m), while the minimum spread was recorded in N-16/2 (4.65 m). The considerable variation in plant spread among genotypes may be attributed to inherent genetic differences and the influence of environmental factors. These findings are supported by Kale *et al.* (2018) in Sweet orange, Barbora *et al.* (2019) in Khasi mandarin, Raghavan *et al.* (2022) in mandarin, Kumar *et al.* (2023) in Jamun, Rajamanickam *et al.* (2024) in Acid lime and Gathul *et al.* (2024) in Nagpur mandarins, all of whom reported significant genotypic variation in plant spread.

Plant volume:

The plant volume data of various Nagpur mandarin genotypes during the year 2022-23 and 2023-24 are presented in Table 1. A considerable variation was observed in plant volume among the genotypes. In 2022-23, the plant volume ranged from 39.43 m³ to 67.43 m³, with a general mean of 56.64 m³. The genotype M-22 recorded the maximum volume (67.43 m³), followed by genotype N-45 (64.05 m³), genotype KAL-19 (61.30 m³), genotype KAL-4 (60.30 m³) and genotype K-1/03 (59.27 m³). On the other hand, N-16/2 exhibited the lowest plant volume (39.43 m). The variation in plant volume may be attributed to differences in vegetative vigour, which are influenced by both genetic potential and environmental factors. Similar trend in canopy development has been reported by Yadlod *et al.* (2018) in Kagzi lime, Barbora *et al.* (2019) in Khasi mandarin, Rahman *et al.* (2021) in mandarins, and Gathul *et al.* (2024) in Nagpur mandarin.

Leaf characters:**Leaf length:**

The data on leaf length of different Nagpur mandarin genotypes as presented in Table 2. they revealed significant genotypic variation across the evaluation years. During 2022-23, leaf length ranged from 69.60 mm to 95.60 mm, with a population mean of 80.73 mm. The genotype N-16/2 exhibited the maximum leaf length (95.60 mm), followed by genotype N-45 (92.20 mm), genotype ACH-37/29 (88.00 mm), genotype KAL-19 (80.40 mm) and genotype KAL-14 (79.40 mm). In contrast, the shortest leaves were observed in genotype KAL-4 (69.60 mm). The observed variation in leaf length among the genotypes could be attributed to inherent genetic potential and differential response to environmental factors. These results align with the findings reported by Gaikwad *et al.* (2015) in Pummelo, Barbora *et al.* (2019) in Khasi mandarin, Kumari *et al.* (2021) in Acid lime and Rajamanickam *et al.* (2024) in Acid lime.

Leaf width:

The data pertaining to leaf width among various Nagpur mandarin genotypes are presented in Table 6. Indicated significant genotypic variation over both years of study. In 2022-23, leaf width ranged from 31.40 mm to 45.40 mm, with a population mean of 36.98 mm. The maximum leaf width was observed in genotype N-16/2 (45.40 mm), followed by genotype N-45 (42.80 mm), genotype ACH-37/29 (40.80 mm), genotype KAL-19 (38.80 mm) and genotype KAL-14 (36.80 mm), whereas the minimum leaf width was recorded in genotype K-1/03 (31.40 mm). The observed differences in leaf width among genotypes may be attributed to genotypic potential and their differential responses to environmental factors. These findings are in line with earlier studies conducted by Gaikwad *et al.* (2015) in Pummelo, Barbora *et al.* (2019) in Khasi mandarin, Kumari *et al.* (2021) in Acid lime, and Raghavan *et al.* (2022) in mandarin.

Leaf length: width ratio:

The data on the leaf length to width ratio of Nagpur mandarin genotypes are presented in Table 7. showed significant variation among the evaluated genotypes. During 2022-23, the ratio ranged from 2.07 to 2.42, with a population mean of 2.19. The highest leaf length: width ratio was observed in K-1/03 (2.42), followed by Nagpur mandarin (Check) (2.29), KAL-4 (2.20), ACH-37/29 (2.16) and KAL-14 (2.16), while the lowest ratio was recorded in KAL-19 (2.07). The significant variation in leaf length: width ratio among genotypes could be attributed to inherent genetic differences and interaction with environmental factors influencing leaf morphology. These observations are consistent with earlier reports by Malik *et al.* (2006) in *Citrus indica*, Dorji and Yapwattanaphun (2011) in Bhutanese mandarin, Gaikwad *et al.* (2015) in Pummelo, Kumari *et al.* (2021) in Acid lime, Raghavan *et al.* (2022) in Mandarin, Singh *et al.* (2022) in Mandarin.

Leaf area:

The data on leaf area of various Nagpur mandarin genotypes, as summarized in Table 8. revealed a significant variation across both years of evaluation. During 2022-23, the leaf area ranged from 19.87 cm² to 31.55 cm², with a population mean of 24.45 cm². The maximum leaf area was observed in genotype N-16/2 (31.55 cm²), followed by genotype N-45 (28.37 cm²), genotype ACH-37/29 (28.06 cm²), genotype K-1/03 (24.23 cm²) and genotype M-22 (22.81 cm²), whereas the minimum leaf area was recorded in genotype KAL-4 (19.87 cm²). The observed variation in leaf area among genotypes may be attributed to differences in leaf morphology driven by both genetic constitution and prevailing environmental conditions. These findings are in close agreement with the results of Kamatyanatti *et al.* (2016) in Kagzi lime, Gaikwad *et al.* (2015) in Pummelo and Rajiv *et al.* (2024) in Nagpur mandarin.

Conclusions:

The study revealed considerable genotypic variation in both vegetative growth and leaf morphological traits among elite Nagpur mandarin genotypes. Genotype M-22 recorded the highest plant height and canopy volume, reflecting strong vegetative vigor. Similarly, K-1/03 showed the widest canopy spread. In terms of leaf traits, N-16/2 exhibited the largest leaf size, while K-1/03 had the highest leaf length-to-width ratio, indicating variation in leaf architecture. These differences highlight significant genetic diversity, which can be effectively harnessed for selecting superior genotypes for commercial cultivation and future breeding programs in the Vidarbha region.

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