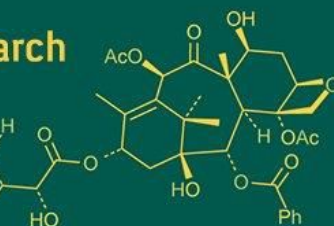
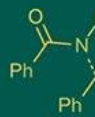


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(8): 1329-1335
www.biochemjournal.com
Received: 12-05-2025
Accepted: 15-06-2025

Lalge PM

Ph.D. Scholar, Department of
Fruit science, Post Graduate
Institute, Dr. P. D. K. V.,
Akola, Maharashtra, India

Dr. Panchbhair DM

Professor and Dean Faculty of
Agriculture, Dr. P. D. K. V.,
Akola, Maharashtra, India

Dr. Bharad SG

Professor and Head
Department of Fruit Science,
Dr. P. D. K. V., Akola,
Maharashtra, India

Dr. Patil SR

Professor, Department of Fruit
Science, Dr. P. D. K. V.,
Akola, Maharashtra, India

Dr. Bhuyar SA

Assistant Professor, College of
Horticulture, Dr. P. D. K. V.,
Akola, Maharashtra, India

Dr. Walke RD

Associate Professor,
Department of Agricultural
Economics and Statistics, Dr.
P. D. K. V., Akola,
Maharashtra, India

Dr. Ramteke NH

Associate Professor,
Department of Fruit science,
Dr. P. D. K. V., Akola,
Maharashtra, India

Dr. Janbandhu MS

Ph.D. Scholar, Department of
Fruit science, Post Graduate
Institute, Dr. P. D. K. V.,
Akola, Maharashtra, India

Corresponding Author:**Lalge PM**

Ph.D. Scholar, Department of
Fruit science, Post Graduate
Institute, Dr. P. D. K. V.,
Akola, Maharashtra, India

Comparative studies on growth performance in elite genotypes of Nagpur mandarin (*Citrus reticulata* Blanco.)

Lalge PM, Panchbhair DM, Bharad SG, Patil SR, Bhuyar SA, Walke RD, Ramteke NH and Janbandhu MS

DOI: <https://www.doi.org/10.33545/26174693.2025.v9.i8Ss.5347>

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 and 2023-24 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.

Keywords: 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) [6]. 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) [11], 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) [2, 3]. 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 and 2023-24. 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 and illustrated in Fig. 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 N-45 (6.62 m), KAL-4 (6.42 m), KAL-14 (6.10 m), and KAL-19 (6.05 m). The minimum plant height was recorded in N-16/2 (4.60 m). In the subsequent year 2023-24, the trend remained consistent with plant heights ranging from 4.70 m to 7.05 m, and a mean value of 6.11 m. The maximum height was again observed in M-22 (7.05 m), followed by N-45 (6.80 m), KAL-4 (6.50 m), KAL-14 (6.30 m), and KAL-19 (6.25 m), whereas N-16/2 (4.70 m) recorded the minimum value. On the basis of pooled analysis, plant height among the genotypes varied significantly from 4.65 m to 6.99 m, with an overall mean of 6.03 m. The tallest genotype remained M-22 (6.99 m), followed by N-45 (6.71 m), KAL-4 (6.46 m), KAL-14 (6.20 m), and KAL-19 (6.15 m). The shortest plant height continued to be observed in N-16/2 (4.65 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) [12] in Sweet orange, Tripathi *et al.* (2016) [18] in Coorg mandarin, Paithankar (2018) [11] in Acid lime, Barbora *et al.* (2019) in Khasi mandarins, and Gathul *et al.* (2024) [5] 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)		
		2022	2023	Pooled mean	2022	2023	Pooled mean	2022	2023	Pooled mean
1	ACH-37/20	5.95	6.10	6.03	5.05	5.23	5.14	58.49	64.75	61.62
2	KAL-19	6.05	6.25	6.15	5.20	5.35	5.28	61.30	67.89	64.60
3	KAL-14	6.10	6.30	6.20	4.80	4.98	4.89	56.70	63.50	60.10
4	KAL-4	6.42	6.50	6.46	4.95	5.08	5.01	60.30	64.46	62.38
5	N-16//2	4.60	4.70	4.65	4.65	4.80	4.73	39.43	43.31	41.37
6	N-45	6.62	6.80	6.71	4.85	5.05	4.95	64.05	68.94	66.49
7	K-1/03	5.60	5.80	5.70	5.30	5.40	5.35	59.27	62.21	60.74
8	M-22	6.92	7.05	6.99	5.05	5.20	5.13	67.43	73.34	70.39
9	NM(Check)	5.30	5.45	5.38	4.70	4.90	4.80	42.80	48.40	45.60
	Range	4.60-6.92	4.70-7.05	4.65-6.99	4.65-5.30	4.80-5.40	4.73-5.35	39.43-67.43	43.31-73.34	41.37-70.39
	General Mean	5.95	6.11	6.03	4.95	5.10	5.02	56.64	61.87	59.42
	S. D.	0.71	0.71	0.71	0.22	0.19	0.20	9.39	9.76	9.70
	S.E. (m)±	0.24	0.24	0.24	0.07	0.06	0.07	3.13	3.25	3.23
	C. V.%	11.90	11.71	11.80	4.46	3.65	4.02	16.57	15.77	16.32

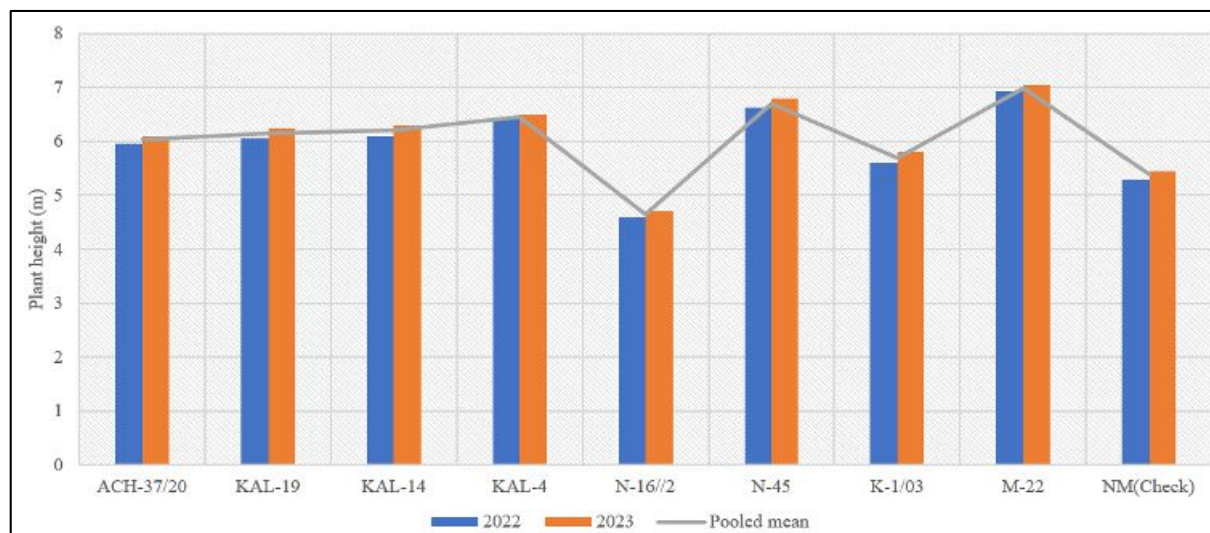


Fig 1: Comparative study of plant height in different Nagpur Mandarin Genotypes.

Plant spread

The data related to plant spread among different Nagpur mandarin genotypes are presented in Table 1 and depicted graphically in Fig. 2, 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 K-1/03 (5.30 m), followed by KAL-19 (5.20 m), ACH-37/20 and M-22 (5.05 m), KAL-4 (4.95 m), and N-45 (4.85 m), while the minimum spread was recorded in N-16/2 (4.65 m). In the year 2023-24, plant spread ranged from 4.80 m to 5.40 m, with a mean of 5.10 m. The maximum spread was again registered in K-1/03 (5.40 m), followed by KAL-19 (5.35 m), ACH-37/20 (5.23 m), M-22 (5.20 m), and N-45 (5.05 m), whereas N-16/2 (4.80 m) showed the least spread. Based on pooled data, the

plant spread varied significantly from 4.73 m to 5.35 m, with a population mean of 5.02 m. The genotype K-1/03 maintained the widest plant spread (5.35 m), followed by KAL-19 (5.28 m), ACH-37/20 (5.14 m), M-22 (5.13 m), and KAL-4 (5.01 m). The minimum spread was again observed in N-16/2 (4.73 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) [7] in Sweet orange, Barbora *et al.* (2019) in Khasi mandarin, Raghavan *et al.* (2022) [13] in mandarin, Kumar *et al.* (2023) [9] in Jamun, Rajamanickam *et al.* (2024) [15] in Acid lime and Gathul *et al.* (2024) [5] in Nagpur mandarins, all of whom reported significant genotypic variation in plant spread.

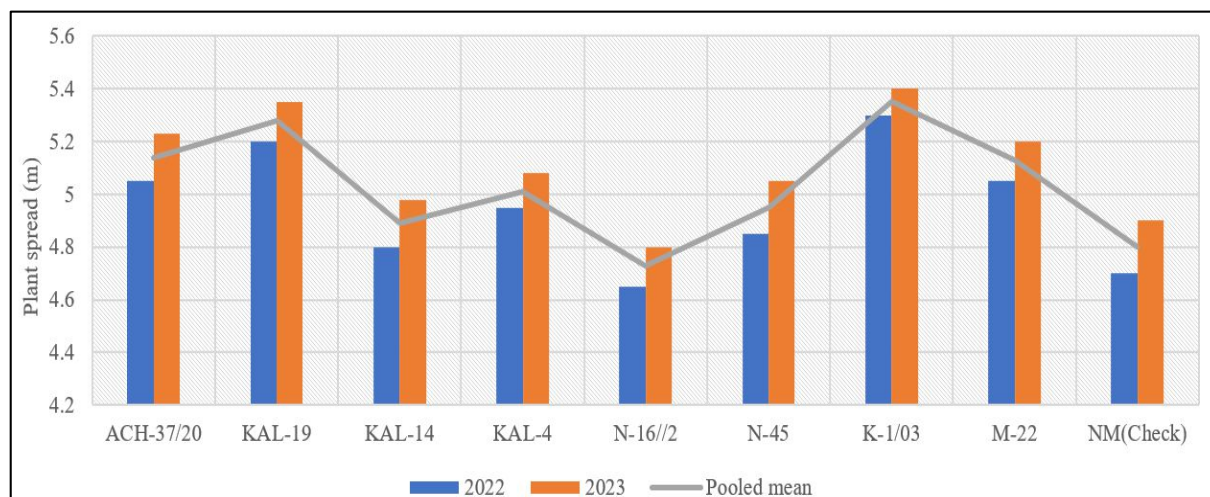


Fig 2: Comparative study of plant spread Nagpur Mandarin Genotypes.

Plant volume

The plant volume data of various Nagpur mandarin genotypes during the year 2022-23 and 2023-24 are presented in Table 1 and depicted graphically in Fig. 3. 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 N-45 (64.05 m³), KAL-19 (61.30 m³), KAL-4 (60.30 m³) and K-1/03 (59.27 m³). On the other hand, N-

16/2 exhibited the lowest plant volume (39.43 m³). In 2023-24, the canopy volume ranged between 43.31 m³ and 73.34 m³, with a mean value of 61.87 m³. M-22 again showed the highest volume (73.34 m³), followed by N-45 (68.94 m³), KAL-19 (67.89 m³), ACH-37/20 (64.75 m³), and KAL-4 (64.46 m³), while the lowest was again noted in N-16/2 (43.31 m³). The pooled analysis across both years revealed a significant variation in plant volume ranging from 41.37 m³ to 70.39 m³, with a pooled mean of 59.42 m³. The genotype M-22 consistently recorded the largest canopy volume

(70.39 m³), followed by N-45 (66.49 m³), KAL-19 (64.60 m³), KAL-4 (62.38 m³), and ACH-37/20 (61.62 m³), whereas N-16/2 remained the lowest performer (41.37 m³). 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) ^[19] in Kagzi lime, Barbora *et al.* (2019) in Khasi mandarin, Rahman *et al.* (2021) ^[14] in mandarins, and Gathul *et al.* (2024) ^[15] in Nagpur mandarin.

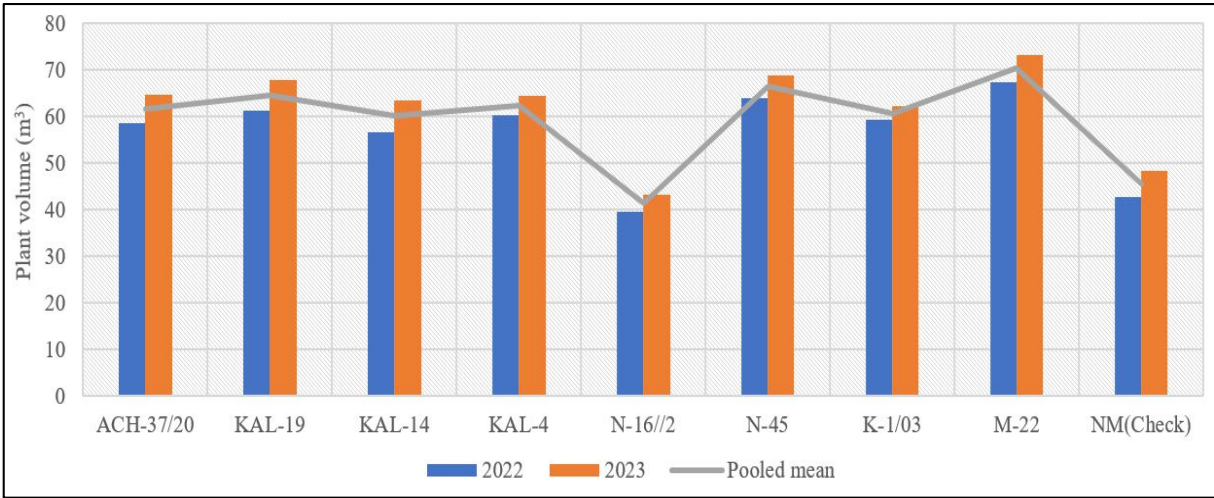


Fig 3: Comparative study of plant volume in different Nagpur Mandarin Genotypes.

Leaf characters
Leaf length

The data on leaf length of different Nagpur mandarin genotypes as presented in Table 2 and graphically illustrated in Fig. 4 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 N-45 (92.20 mm), ACH-37/29 (88.00 mm), KAL-19 (80.40 mm) and KAL-14 (79.40 mm). In contrast, the shortest leaves were observed in KAL-4 (69.60 mm). For the subsequent year 2023-24, the leaf length varied from 70.80 mm to 97.80 mm, general mean 81.07 mm. Again, N-16/2 recorded the longest leaves (97.80 mm), followed by N-45 (90.80 mm), ACH-37/29 (89.40 mm), KAL-19 (80.80 mm) and KAL-14 (78.20 mm),

while the shortest leaves were observed in M-22 (70.80 mm). Pooled analysis across the two years confirmed significant genotypic differences, with leaf length ranging from 71.60 mm to 96.70 mm and a pooled mean of 80.90 mm. The maximum leaf length was consistently recorded in N-16/2 (96.70 mm), followed by N-45 (91.50 mm), ACH-37/29 (88.70 mm), KAL-19 (80.60 mm), and KAL-14 (78.80 mm). The minimum leaf length was shared by KAL-4 and Nagpur mandarin (check), both recording 71.60 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) ^[4] in Pummelo, Barbora *et al.* (2019) in Khasi mandarin, Kumari *et al.* (2021) ^[10] in Acid lime and Rajamanickam *et al.* (2024) ^[15] in Acid lime.

Table 2: Comparative study of leaf length, leaf width, leaf length: width ratio and leaf area in different Nagpur Mandarin Genotypes.

Tr.	Genotypes	Leaf length (mm)			Leaf width (mm)			Leaf length: width ratio			Leaf area (cm ²)		
		2022	2023	Pooled mean	2022	2023	Pooled mean	2022	2023	Pooled mean	2022	2023	Pooled mean
1	ACH-37/20	88.00	89.40	88.70	40.80	40.60	40.70	2.16	2.20	2.18	28.06	27.89	27.97
2	KAL-19	80.40	80.80	80.60	38.80	40.00	39.40	2.07	2.02	2.05	22.31	23.98	23.14
3	KAL-14	79.40	78.20	78.80	36.80	37.20	37.00	2.16	2.10	2.13	21.95	21.74	21.85
4	KAL-4	69.60	73.60	71.60	31.60	32.40	32.00	2.20	2.27	2.24	19.87	22.00	20.93
5	N-16//2	95.60	97.80	96.70	45.40	45.60	45.50	2.11	2.16	2.13	31.55	33.91	32.73
6	N-45	92.20	90.80	91.50	42.80	39.00	40.90	2.15	2.33	2.24	28.37	27.80	28.08
7	K-1/03	75.80	77.20	76.50	31.40	28.40	29.90	2.42	2.72	2.57	24.23	22.49	23.36
8	M-22	73.40	70.80	72.10	33.60	30.80	32.20	2.19	2.30	2.24	22.81	20.46	21.63
9	NM (Check)	72.20	71.00	71.60	31.60	30.60	31.10	2.29	2.32	2.30	20.88	19.11	19.99
	Range	69.60-95.60	70.80-97.80	71.60-96.70	31.40-45.40	28.40-45.60	29.90-45.50	31.40-45.40	2.07-2.42	2.02-2.72	19.87-31.55	19.11-33.91	19.99-32.73
	General Mean	80.73	81.07	80.90	36.98	36.04	36.51	36.98	2.19	2.27	24.45	24.38	24.41
	S. D.	9.23	9.55	9.33	5.28	5.73	5.44	5.28	0.10	0.20	3.97	4.67	4.24
	S.E. (m)±	3.08	3.18	3.11	1.76	1.91	1.81	1.76	0.03	0.07	1.32	1.56	1.41
	C. V.%	11.44	11.78	11.54	14.28	15.90	14.89	14.28	4.67	8.77	16.24	19.15	17.38

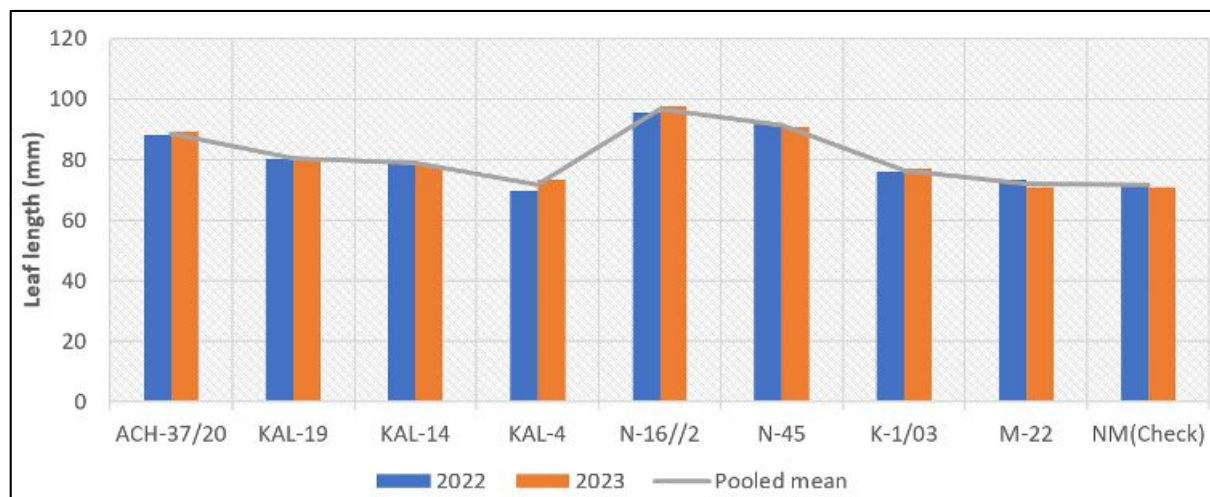


Fig 4: Comparative study of leaf length in different Nagpur Mandarin Genotypes.

Leaf width

The data pertaining to leaf width among various Nagpur mandarin genotypes are presented in Table 6 and illustrated in Fig. 5 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 N-16/2 (45.40 mm), followed by N-45 (42.80 mm), ACH-37/29 (40.80 mm), KAL-19 (38.80 mm) and KAL-14 (36.80 mm), whereas the minimum leaf width was recorded in K-1/03 (31.40 mm). In the following year (2023-24), the trend remained consistent, with values ranging from 28.40 mm to 45.60 mm and a population mean of 36.04 mm. The genotype N-16/2 again exhibited the maximum leaf width (45.60 mm), followed by ACH-37/29 (40.60 mm), KAL-19 (40.00 mm), N-45 (39.00

mm) and KAL-14 (37.20 mm). The narrowest leaf width in this year was also observed in K-1/03 (28.40 mm). Pooled data analysis revealed that the leaf width significantly varied from 29.90 mm to 45.50 mm, with an overall population mean of 36.51 mm. The genotype N-16/2 (45.50 mm) remained superior in terms of leaf width, followed by N-45 (40.90 mm), ACH-37/29 (40.70 mm), KAL-19 (39.40 mm) and KAL-14 (37.00 mm). The lowest value was again recorded in K-1/03 (29.90 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)^[4] in Pummelo, Barbora *et al.* (2019) in Khasi mandarin, Kumari *et al.* (2021)^[10] in Acid lime, and Raghavan *et al.* (2022)^[13] in mandarin.

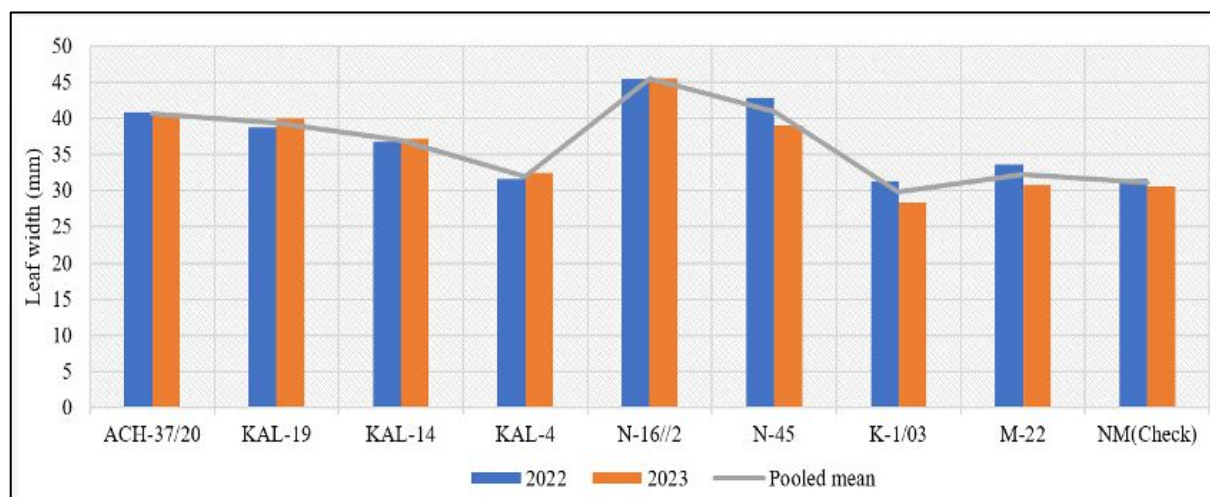


Fig 5: Comparative study of leaf width in different Nagpur Mandarin Genotypes.

Leaf length: width ratio

The data on the leaf length to width ratio of Nagpur mandarin genotypes are presented in Table 7 and illustrated in Fig. 6 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). In the subsequent year (2023-24), the ratio varied from 2.02 to 2.72, with a mean value of

2.27. The maximum ratio was again recorded in K-1/03 (2.72), followed by N-45 (2.33), Nagpur mandarin (2.32), M-22 (2.30), KAL-4 (2.27), and ACH-37/29 (2.20), while the minimum was once again noted in KAL-19 (2.02). Pooled analysis revealed that the leaf length: width ratio among genotypes ranged from 2.05 to 2.57, with a population mean of 2.23. The highest pooled ratio was exhibited by K-1/03 (2.57), followed by Nagpur mandarin (2.30), N-45 (2.24), KAL-14 (2.24), ACH-37/29 (2.18), and N-16/2 (2.13). The lowest pooled ratio was again observed in KAL-19 (2.05). 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) ^[4] in Pummelo, Kumari *et al.* (2021) ^[10] in Acid lime, Raghavan *et al.* (2022) ^[13] in Mandarin, Singh *et al.* (2022) ^[17] in Mandarin.

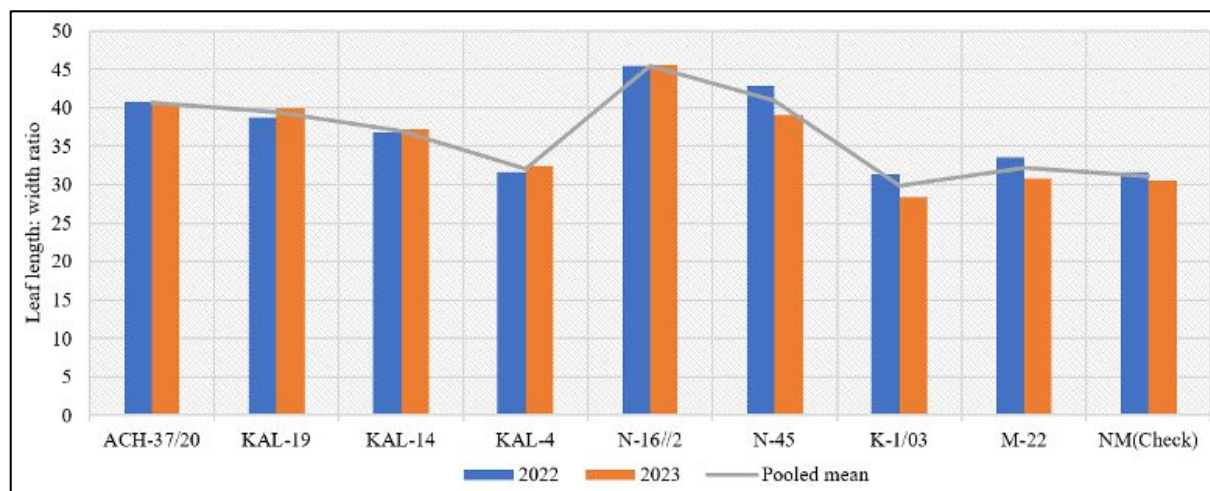


Fig 6: Comparative study of leaf length: width ratio in different Nagpur Mandarin Genotypes.

Leaf area:

The data on leaf area of various Nagpur mandarin genotypes, as summarized in Table 8 and graphically illustrated in Fig. 7, 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 N-16/2 (31.55 cm²), followed by N-45 (28.37 cm²), ACH-37/29 (28.06 cm²), K-1/03 (24.23 cm²) and M-22 (22.81 cm²), whereas the minimum leaf area was recorded in KAL-4 (19.87 cm²). In 2023-24, the leaf area ranged from 19.11 cm² to 33.91 cm², with a population mean of 24.38 cm². Genotype N-16/2 (33.91 cm²) again recorded the maximum leaf area, followed by ACH-37/29 (27.89 cm²), N-45 (27.80 cm²), KAL-19 (23.98 cm²), and K-1/03 (22.00 cm²), while

the minimum leaf area was recorded in Nagpur mandarin (Check) (19.11 cm²). Based on the pooled data analysis, the leaf area varied significantly from 19.99 cm² to 32.73 cm², with an overall mean of 24.41 cm². The maximum leaf area was recorded in N-16/2 (32.73 cm²), followed by N-45 (28.08 cm²), ACH-37/29 (27.97 cm²), K-1/03 (23.36 cm²) and KAL-19 (23.14 cm²), while the minimum pooled leaf area was found in Nagpur mandarin (19.99 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) ^[8] in Kagzi lime, Gaikwad *et al.* (2015) ^[4] in Pummelo and Rajiv *et al.* (2024) ^[6] in Nagpur mandarin.

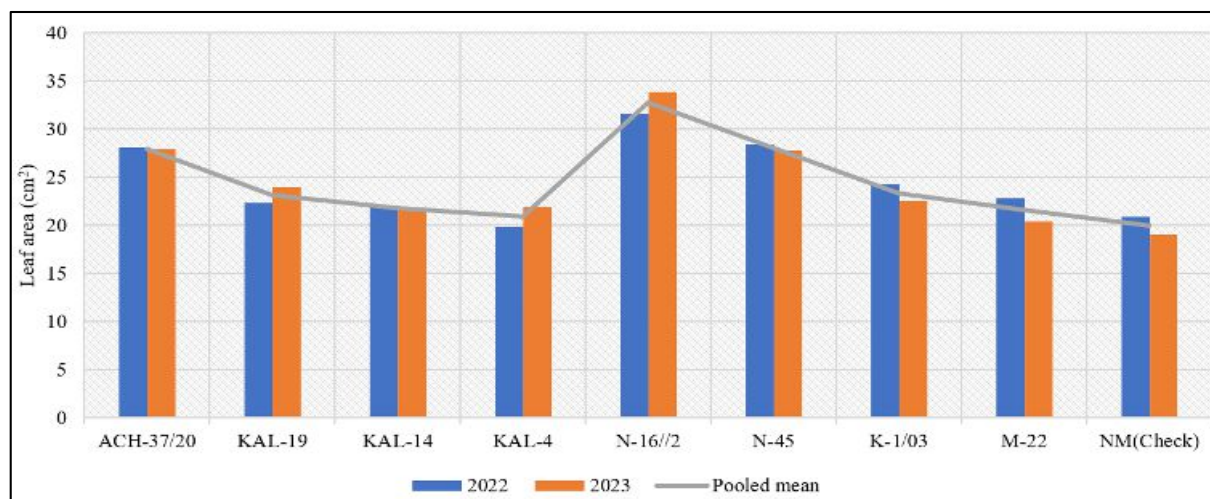


Fig 7: Comparative study of leaf area in different Nagpur Mandarin Genotypes.

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.

References

1. Anonymous. Ministry of Agriculture and Farmer Welfare, database. 2024.
2. Bhattacharya SC, Dutta S. Classification of citrus fruits of Assam. Scientific Monograph No. 20. ICAR. 1956:39-41.
3. Dubey AK, Srivastav M, Kaur C. Fruit quality, antioxidant enzymes activity and yield of six cultivars of grapefruit (*Citrus paradisi*) grown under subtropical conditions. Indian J Agric Sci. 2014;83:842-846.
4. Gaikwad KA, Haldavanekar PC, Parulekar YR, Haldankar PM. Survey and characterization of pummelo genotypes (*Citrus grandis* Osbeck) grown in coastal region of Maharashtra. An Int Q J Environ Sci. 2015;8:371-380.
5. Ghatul ID, Dhemre JK, Pawar PS, Magar SD, Patil NS. Evaluation of elite mandarin (*Citrus reticulata* Blanco) genotypes for growth parameters. Int J Adv Biochem Res. 2024;8(12):691-698.
6. Gmitter JFG, Grosser JW, Moore GA. Citrus. In: Hammerschlag FA, Litz RE, editors. Biotech Peren Fruit Crops. Wallingford: CABI; 1992. p. 335-369.
7. Kale AS, Patil MB, Patil SG. Studies on performance of nucellar and sathgudi varieties of sweet orange (*Citrus sinensis* Osbeck) under Jalna condition. J Pharmacognosy Phytochem. 2018;7(2):2611-2613.
8. Kamatyanatti M, Nagre PK, Ramteke V, Baghel MM. Genetic variability and character association studies in identified Kagzi lime (*Citrus aurantifolia* Swingle) genotypes. The Ecoscan. 2016;9:271-276.
9. Kumar AK, Rekha A, Venugopalan R, Honnabhyraiah MK, Mohankumar S, Shivashankara KS. Variability in morphological parameters of Jamun (*Syzygium cumini* Skeels) genotypes. Int J Minor Fruits Med Aromat Plants. 2023;9(2):94-101.
10. Kumari S, Sharma A, Salgotra R, Sharma M, Singh P. Morphological studies of acid lime (*Citrus aurantifolia* Swingle) genotypes of north western regions of India. Biol Forum-An Int J. 2021;13(4):1020-1032.
11. Paithankar DH, Nagre P, Ingle YV, Megha, Jadhao GG. Evaluation of acid lime clones for growth, yield and quality. Int J Curr Microbiol Appl Sci. 2018;6:2737-2745.
12. Patil MB, Panchal VM. Comparative studies on 'Nucellar', 'Sathgudi' and 'Local' sweet orange (mosambi) (*Citrus sinensis* Osbeck) under Marathwada conditions. J Horti Sci. 2016;11(1):44-46.
13. Raghavan M, Singh SR, Hazarika BN, Wangchu L, Kumar A. Genetic diversity of mandarins from Northeast India along with three other wild species using morphological markers. Pharma Innov J. 2022;11(2):1762-1771.
14. Rahman SML, Sarker JC, Ahmed F, Bhuyan MHMB. Performance of mandarin orange genotypes in net house at Jaintapur, Sylhet. Bangladesh J Agric Res. 2021;46(3):245-259.
15. Rajamanickam C, Rangaraj T, Sankar C. Evaluation of acid lime (*Citrus aurantifolia* Swingle) genotypes for growth, yield and quality traits. Int J Plant Soil Sci. 2024;36(9):516-524.
16. Rajiv H, Panchbhai DM, Laharia P, Meena S, Deshmukh R. Influence of different polybag size on budding success of Nagpur mandarin. Int J Adv Biochem Res. 2024;8(10):1361-1363.
17. Singh G, Rattanpal HS, Gupta M, Sidhu GS. Genetic variability and heritability among mandarin (*Citrus reticulata* Blanco) genotypes under Indian sub-tropical conditions. Appl Ecol Environ Res. 2022;20(4):2913-2930.
18. Tripathi PC, Karunakaran G, Sakthivel T, Ravishankar H, Sankar V, Kumar RS. Evaluation of Coorg mandarin (*Citrus reticulata*) clones for yield and quality. Indian J Agric Sci. 2016;86(7):901-905.
19. Yadlod SS, Bhalerao RV, Ingle SN. Variability studies of strains of Kagzi lime (*Citrus aurantifolia* Swingle) in Latur district of Maharashtra, India. Agric Sci Digest. 2018;38(1):48-51.