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# Evolution of guava genotypes for bio-chemical, yield, and quality attributes

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**Abstract**
The present investigation was conducted at Department of Horticulture, MPKV, Rahuri with twenty genotypes of guava during winter season of 2022 and 2023. Data was statistically analysed using descriptive statistical methods. The investigation focused on biochemical, yield and quality characteristics of genotypes. Results revealed that, highest total soluble solids (TSS) (13.86 °Brix) and lycopene content (1.52 mg/100 g) were observed in genotype T3 P19. However, genotype T17 P10 exhibited the highest TSS: acidity ratio (33.00), total sugar (8.24%), reducing sugar (4.19%), and the lowest acidity (0.38%). Analysis of yield attributes showed significant variation among the genotypes. Genotype T17 P10 also demonstrated superior fruit characteristics, including the highest fruit weight (220.49 g), maximum number of fruits per tree (37), yield per plant (7.87 kg), and overall acceptability (8.30). Based on these findings this study identifies promising guava genotypes that have potential for future crop improvement programs.

**Keywords:** Guava, genotypes, bio-chemical, yield, sugars, organoleptic, quality

## 1. Introduction

Guava (*Psidium guajava* L.) belongs to family *Myrtaceae* commonly referred to as the "Apple of the Tropics" is a tropical fruit that also thrives in subtropical conditions. Known for its hardiness and prolific yield, guava is a highly profitable fruit that appeals to growers due to its wide adaptability and high returns per unit area. Genus *Psidium* comprises approximately 150 species (Hayes, 1974) [10]. Most commercial cultivars of guava are diploid (2n=22), while the seedless variety is triploid and produces fruit less frequently. Cultivated guava is native to tropical America.

Guava requires annual rainfall between 1,000 to 2,000 mm, with an optimal temperature range of 23 °C to 26 °C, although it can tolerate temperatures up to 46 °C (Radha and Mathew, 2007) [24]. In regions with distinct winters both yield and fruit quality tend to improve. The current commercial varieties of guava, such as Allahabad Safeda, Sardar, Chittidar, Dharidar, and Red fleshed, are commonly cultivated across various agro-climatic regions. Guava fruit compose 5.4% seeds, 8.3% pomace/peel, 82% pulp, and 65% juice. The primary sugars present are fructose (59%), glucose (36%), and sucrose (5%). Fructose is the dominant sugar in green fruit, while fully ripe fruit has higher sucrose content (Akash *et al*., 2009) [1]. Ascorbic acid is predominantly found in the skin, with slightly lower concentrations in the flesh (Nakasone and Paull, 1998) [14]. Nutritionally, guava is a healthy source of protein (2.3%), carbohydrates (12.16%), and dietary fiber (4.8%). It is also rich in calcium, providing 17.63 mg per 100 g. As a good source of ascorbic acid (241.86 mg per 100 g), guava is a valuable addition to various food products (Bogha *et al*., 2020) [4]. Thus, it is essential to identify, assess, and characterize high-yielding guava genotypes from available gene pool based on their biochemical composition, quality, and yield traits for future breeding initiatives.

## 2. Materials and Methods

The present experiment was conducted at the Instructional-cum-Research Orchard, and biochemical analysis of the fruits was performed in the laboratory of the Department of Horticulture at MPKV, Rahuri, Dist. Ahmednagar, during 2022 and 2023. A total of 20

guava genotypes were evaluated for winter season crops. Fruit samples were collected at maturity from all genotypes and assessed for biochemical, quality, and yield parameters.
Acidity was determined by titrating the juice with N/10 NaOH and expressed as a percentage of citric acid. Total soluble solids (TSS) were measured using an Erma hand refractometer (Erma Japan, 0 to 32 °Brix). The total sugars and reducing sugars in the guava fruit were quantified using the method described by Lane and Eynon (1923) [11] as outlined in Ranganna (1977) [23]. The difference between total sugar and reducing sugar was used to calculate non-reducing sugar, expressed as a percentage. The ascorbic acid and lycopene content of the fruit were determined following the methodology provided by Ranganna (1977) [23]. Growth and yield parameters were recorded as the number of fruits per plant, yield (kg/tree), and fruit weight (g). Organoleptic or sensory evaluations of the guava fruits were conducted by a panel of five semi-trained judges, utilizing a nine-point hedonic scale (where 1 indicated "Dislike Extremely" and 9 indicated "Like Extremely") for assessing fruit appearance, color, flavor, texture, and taste (Amerine *et al*., 1965) [2]. The averages of all evaluated characteristics were calculated and expressed as overall acceptance.

## 2.1 Data Analysis

The data was statistically analysed using descriptive methods, including population mean, standard deviation, and coefficient of variation, as reported by Panse and Sukhatme (1989) [16].

## 3. Results and Discussions

Data presented in Table 1. revealed that, composition of fruit chemical varies significantly in different guava genotypes evaluated. The fruit quality in guava is mainly judged by total soluble solids, titratable acidity, TSS: Acidity ratio, sugar content, ascorbic acid, and lycopene in all fruit except seed.

### 3.1. Biochemical parameters

### 3.1.1. Total soluble solids (⁰B)

The total soluble solids ranged from 11.85 to 13.86 °B, genoptype T3 P19 had maximum Total soluble solids was (13.86 ˚B) closely followed by T17 P10 (13.85 ˚B) and T2 P50 (13.33 ˚B) whereas minimum total soluble solids found in T15 P24 (11.85˚B). This variation may be attributed due to the favourable temperature and humidity during fruit growth period, which might be influenced the retention of higher TSS in the ripe fruits. The increase in total soluble solids may result from the conversion of polysaccharides into monosaccharides or soluble sugars which help to enhances the sweetness and the overall sugar content of the fruit, which is typically observed during fruit maturation, similar result noted by Gohil *et al*. (2006) [8], Ghosh *et al*. (2013), Singh *et al*. (2018) [28], Chandel *et al*. (2022) [5], and Patel *et al*. (2024) [19].

### 3.1.2. Titratable acidity (%)

Variability pertaining to Titratable acidity among the different genotypes (Table 1), ranging from 0.42% to 0.51%. The highest acidity was recorded in T17 P10 (0.51%), followed by T3 P19 (0.44%) and T13 P28 (0.43%), while the lowest was observed in T14 P10 (0.42%). The variation in titratable acidity may be attributed to genetic factors. Acidity tends to increase until 105 days after fruit set due to the biosynthesis of organic acids during early fruit growth. However, it declines during fruit maturity and ripening as organic acids are converted into sugars (Patel *et al.*, 2015) [17].

### 3.1.3. TSS: acidity ratio

The performance of different genotypes varied for the TSS: acidity ratio depicted in Table 4, ranging from 24.06 to 33.00. The highest TSS: acidity ratio was recorded in genotype T17 P10 (32.93), followed by T3 P19 (32.27) and T13 P28 (29.79), whereas lowest was observed in T10 P9 (24.06). The phenotypic and genetic attributes of the cultivars may have enhanced nutrient utilization and carbohydrate accumulation in fruits, contributing to a higher TSS: acidity ratio. Similar findings have been reported by Dubey *et al.*, (2016) [7], Sahoo *et al.*, (2017) [27], Bodkhe (2019) [3] and Poonam *et al.*, (2023) [21].

### 3.1.4. Ascorbic acid (mg/100 g)

Ascorbic acid content of guava genotypes was ranged from 196.80 to 206.15 mg/100 g. The maximum ascorbic acid was registered in T10 P9 (206.15 mg/100 g) followed by T3 P36 (205.42 mg/100 g) and T13 P28 (205.35 mg/100 g) however, minimum was observed in T15 P1 (196.80 mg/100 g). The variation in ascorbic acid content may be attributed as a varietal character and due to favourability of seasonal conditions. Similar trend was also recorded by Sharma *et al.* (2010) [29], Dubey *et al.* (2016) [7], Mehta *et al.* (2018) [13], Bodkhe (2019) [3], Poonam *et al.* (2023) [21] and Patel *et al.* (2024) [19].

**Table 1:** Mean performance of various biochemical parameters in guava genotypes, including total soluble solids (°B), titratable acidity (%), TSS: acidity ratio, and ascorbic acid (mg/100 g).

| Sr. No. | Genotype | TSS (⁰B) | Titratable acidity (%) | TSS: acidity ratio | Ascorbic acid (mg/100 g) |
|---|---|---|---|---|---|
| | | Average | | | |
| 1 | T2 P50 | 13.33 | 0.46 | 29.03 | 201.27 |
| 2 | T3 P9 | 12.75 | 0.49 | 26.29 | 202.19 |
| 3 | T5 P2 | 12.53 | 0.50 | 25.30 | 203.83 |
| 4 | T13 P28 | 13.10 | 0.44 | 29.79 | 205.35 |
| 5 | T14 P5 | 12.28 | 0.48 | 25.60 | 204.68 |
| 6 | T14 P10 | 12.53 | 0.51 | 24.57 | 201.96 |
| 7 | T15 P21 | 12.58 | 0.49 | 25.92 | 202.27 |
| 8 | T15 P1 | 12.40 | 0.49 | 25.26 | 196.80 |
| 9 | T15 P24 | 11.85 | 0.47 | 25.90 | 202.17 |
| 10 | T17 P2 | 12.43 | 0.48 | 26.15 | 201.59 |
| 11 | T17 P7 | 12.50 | 0.48 | 26.61 | 199.78 |
| 12 | T17 P10 | 13.85 | 0.42 | 33.00 | 203.02 |
| 13 | T18 P9 | 13.13 | 0.47 | 28.01 | 198.43 |
| 14 | T3 P19 | 13.86 | 0.43 | 32.27 | 197.93 |
| 15 | T3 P36 | 12.98 | 0.49 | 26.76 | 205.42 |
| 16 | T10 P9 | 12.28 | 0.49 | 24.06 | 206.15 |
| 17 | T10 P18 | 12.25 | 0.48 | 25.52 | 202.43 |
| 18 | T11 P26 | 13.25 | 0.50 | 26.78 | 199.78 |
| 19 | T12 P1 | 13.30 | 0.50 | 26.61 | 200.97 |
| 20 | T18 P10 | 12.73 | 0.48 | 26.80 | 202.07 |
| | Population Mean | 12.79 | 0.47 | 27.01 | 201.91 |
| | S. D. | 0.54 | 0.022 | 2.36 | 2.51 |
| | CV (%) | 4.21 | 4.80 | 8.72 | 1.24 |

### 3.1.5. Total sugars (%)

Table 2 indicating content of total sugars of different guava genotypes ranged from 7.87 to 8.24 per cent. Highest total sugars were observed in T17 P10 (8.24%) followed by T3

P19 (8.20%), T11 P26 (8.12%), whereas minimum was found in T2 P50 (7.87%). This variation of total sugar content among different genotypes may be attributed to differences in their genetic makeup, as well as agro-climatic factors *viz.*, temperature, humidity, soil type, and availability of nutrients and water during fruit growth and development. Similar results finding were documented by Patel *et al.* (2007) [18] Singh *et al.* (2018) [28], Bodkhe (2019) [3], Chandel *et al* (2022) [5], and Patel *et al.* (2024) [19].

### 3.1.6. Reducing sugars (%)
Observations regarding reducing sugars reflected in Table 2 which were varied from 3.74 to 4.19 per cent. Of which T17 P10 genotype reported maximum reducing sugars (4.19%) followed by T3 P19 (4.09%) and T15 P1 (4.06%) and T2 P50 observed minimum reducing sugars (3.74%). The reducing sugar content in fruits from different genotypes varied due to differences in their hereditary traits. The high levels of reducing sugar in genotype T17 P10 may be attributed to a more presence of monosaccharides and disaccharides, namely,glucose and fructose, in these fruits during maturity. Similar results were reported by Meena *et al.* (2013), Dubey *et al.* (2016) [7], Singh *et al.* (2018) [28], Chandel *et al* (2022) [5] and Patel *et al*. (2024) [19] in guava.

### 3.1.7. Non - reducing sugars (%)
Non-reducing sugars ranged from 3.97 to 4.21 per cent (Table 2) and the highest non-reducing sugars was recorded by guava genotype T3 P9 (4.21%), followed by T5 P2 (4.13%), T14 P5 (4.17%), T15 P21 (4.17%) and minimum found in T10 P18 (3.97%). The non-reducing sugar of fruits from different genotypes varied due to difference in the heredity characters of the genotypes. These comparable results were recorded by Patel *et al.* (2007) [18], Dubey *et al.* (2016) [7], Bodkhe (2019) [3], Chandel *et al.* (2022) [5] and Patel *et al*. (2024) [19].

### 3.1.8. Lycopene (mg/100 g)
Lycopene content of different guava genotypes under investigation was varied from 0.45 to 1.52 mg /100 g shown in Table 2. The maximum Lycopene content was recorded in T3 P19 (1.52 mg /100 g) followed by T3 P9 (1.26 mg /100 g), T17 P7 (1.05 mg /100 g) and minimum observed in T15 P21 (0.45 mg /100 g). Lycopene pigment imparts pink colouration to fruit pulp of guava. Significant variation in lycopene content can be attributed to varietal differences as well as congenial seasonal conditions. These results are incongruent with findings of Nakasone *et al.* (1976) [15], Marak and Mukunda (2005) [12], Patil *et al.* (2015) [20] and Bodkhe (2019) [3].

**Table 2:** Mean performance of different biochemical parameters of guava genotypes with respect of Total sugars (%), Reducing sugars (%), Non-reducing sugars (%) and Lycopene (mg/100 g)

| Sr. No. | Genotype | Total sugars (%) | Reducing sugars (%) | Non - reducing sugars (%) | Lycopene (mg/100 g) |
|---|---|---|---|---|---|
| | | Average | | | |
| 1 | T2 P50 | 7.87 | 3.74 | 4.13 | 0.89 |
| 2 | T3 P9 | 7.96 | 3.75 | 4.21 | 1.26 |
| 3 | T5 P2 | 8.05 | 3.91 | 4.13 | 0.90 |
| 4 | T13 P28 | 7.98 | 3.84 | 4.13 | 0.81 |
| 5 | T14 P5 | 8.06 | 3.89 | 4.17 | 0.70 |
| 6 | T14 P10 | 7.94 | 3.92 | 4.02 | 0.53 |
| 7 | T15 P21 | 8.01 | 3.84 | 4.17 | 0.45 |
| 8 | T15 P1 | 8.10 | 4.06 | 4.04 | 0.56 |
| 9 | T15 P24 | 8.00 | 3.97 | 4.02 | 0.73 |
| 10 | T17 P2 | 8.05 | 3.99 | 4.06 | 0.89 |
| 11 | T17 P7 | 7.97 | 3.89 | 4.08 | 1.05 |
| 12 | T17 P10 | 8.24 | 4.19 | 4.05 | 0.91 |
| 13 | T18 P9 | 7.93 | 3.92 | 4.01 | 0.77 |
| 14 | T3 P19 | 8.20 | 4.09 | 4.11 | 1.52 |
| 15 | T3 P36 | 7.98 | 3.86 | 4.11 | 1.03 |
| 16 | T10 P9 | 8.05 | 3.92 | 4.13 | 0.89 |
| 17 | T10 P18 | 7.92 | 3.95 | 3.97 | 0.79 |
| 18 | T11 P26 | 8.12 | 4.05 | 4.07 | 0.80 |
| 19 | T12 P1 | 8.07 | 4.01 | 4.05 | 0.81 |
| 20 | T18 P10 | 8.06 | 3.97 | 4.09 | 0.86 |
| | Population Mean | 8.03 | 3.94 | 4.09 | 0.86 |
| | S. D. | 0.091 | 0.11 | 0.062 | 0.24 |
| | CV (%) | 1.14 | 2.78 | 1.52 | 27.95 |

## 3.2. Yield parameters of fruit
### 3.2.1. Fruit weight (g)
The fruit weight varied from 78.95 g to 220.49 g. The genotype T17 P10 had highest mean fruit weight (220.49 g) followed by T11 P26 (218.67 g) and T15 P1 (213.78 g) and lowest fruit weight was recorded by genotype T13 P28 with 78.95 g. The variation in fruit size and weight may be genotypic and associated with various physiological phenomenon, such as photosynthetic efficiency, rate of translocation of photosynthates from source to sink, and photorespiration occurring within the plant. Similar results were identified by Gohil *et al.* (2006) [8], Singh *et al.* (2018) [28], Gurjar *et al.* (2018) [9], Bodkhe (2019) [3], Poonam *et al.* (2023) [21] and Singh *et al.* (2023) [25].

### 3.2.2. Number of fruits per tree
Slight variation with regards to number of fruits among different genotype was observed which presented in Table 3. Number of fruits per tree varied from 09 to 37 with higher number of fruits per tree was recorded in T17 P10 (37) followed T17 P7 (33) and T3 P19 (30.5), while lowest number of fruits per tree was found in T15 P1 as 09. In

many genotypes, the number of fruits increased while fruit yield decreased. This may be due to distribution and diversion of available nutrients among a greater number of fruits. Variability in the number of fruits per plant has also been noted by Meena *et al*. (2013), Ulemale *et al.* (2018) [31], and Ramniwas *et al.* (2023) [22].

### 3.2.3. Yield per plant (kg)

The data on yield per plant indicates variation among the genotypes (Table 3), ranging from 1.67 to 7.87 kg. The highest yield was recorded in genotype T17 P10 (7.87 kg), followed by T17 P7 (6.41 kg) and T11 P26 (4.86 kg), while the lowest was observed in T13 P28 (1.67 kg). Yield, being a polygenic trait is influenced by factors such as orchard management, plant age and season. The number of fruits per plant and their average weight contribute significantly to overall yield, with higher yields associated with a greater number of fruits. Similar findings have been reported by Marak and Mukunda (2007) [12], Deshmukh *et al.*, (2013) [6], Dubey *et al.*, (2016) [7], Bodkhe (2019) [3] and Chandel *et al*, (2022) [5].

### 3.3. Organoleptic evaluation

**Overall acceptability**

Overall acceptability of different genotypes varied among different guava genotypes reflected in Table 3. Maximum score for overall acceptability of guava fruit was recorded in the T17 P10 (8.30) which was followed by T3 P19 (8.07) and T11 P26 (7.67). While, minimum score in the T14 P5 (6.61). The finding was indicating that variation found in organoleptic evaluation of guava genotypes. The fruits of genotypes T17 P10 scored maximum score for fruit colour (8.50), texture (8.35), taste (8.00) and flavour (8.35). These results are in accordance with the findings of Mark and Mukunda (2007), Dubey *et al.* (2016) [7], Tiwari *et al.* (2016) [30], Ravi *et al.* (2023) [26].

**Table 3:** Mean performance of various yield and quality parameters of guava genotypes, including fruit weight (g), number of fruits per tree, yield per plant (kg), and overall acceptability.

| Sr. No. | Genotype | Fruit weight (g) | Number of fruits per tree | Yield per plant (kg) | Overall acceptability |
|---|---|---|---|---|---|
| | | Average | | | |
| 1 | T2 P50 | 172.40 | 17.5 | 3.88 | 7.23 |
| 2 | T3 P9 | 107.49 | 11.5 | 1.92 | 7.19 |
| 3 | T5 P2 | 97.06 | 18.5 | 2.39 | 6.95 |
| 4 | T13 P28 | 78.95 | 13.0 | 1.67 | 7.13 |
| 5 | T14 P5 | 132.48 | 13.0 | 1.83 | 6.61 |
| 6 | T14 P10 | 148.14 | 10.5 | 1.77 | 7.01 |
| 7 | T15 P21 | 174.59 | 13.0 | 2.52 | 6.99 |
| 8 | T15 P1 | 213.78 | 09 | 2.17 | 6.93 |
| 9 | T15 P24 | 184.66 | 14.5 | 2.68 | 7.17 |
| 10 | T17 P2 | 128.68 | 22.5 | 2.85 | 6.95 |
| 11 | T17 P7 | 178.14 | 33.0 | 6.41 | 7.22 |
| 12 | T17 P10 | 220.49 | 37.0 | 7.87 | 8.30 |
| 13 | T18 P9 | 180.53 | 18.0 | 3.24 | 7.14 |
| 14 | T3 P19 | 128.15 | 30.5 | 3.92 | 8.07 |
| 15 | T3 P36 | 134.60 | 30.0 | 4.27 | 7.24 |
| 16 | T10 P9 | 131.26 | 23.5 | 3.08 | 6.82 |
| 17 | T10 P18 | 152.49 | 22.5 | 3.42 | 7.01 |
| 18 | T11 P26 | 218.67 | 22.5 | 4.86 | 7.67 |
| 19 | T12 P1 | 140.73 | 21.5 | 3.11 | 7.06 |
| 20 | T18 P10 | 135.74 | 18.5 | 2.61 | 7.15 |
| | Population Mean | 152.95 | 20.00 | 3.32 | - |
| | S. D. | 39.33 | 7.87 | 1.58 | - |
| | CV (%) | 25.71 | 39.35 | 47.57 | - |

## Conclusion

Present study revealed slight variations in biochemical traits among twenty guava genotypes. Guava genotype T3 P19 recorded the highest TSS (13.86 °Brix) and lycopene content (1.52 mg/100 g), while T17 P10 had the highest TSS: acidity ratio (33.00), total sugars (8.24%), reducing sugars (4.19%) and lowest acidity (0.38%). T17 P10 also excelled in fruit weight (220.49 g), number of fruits per tree (37), yield per plant (7.87 kg) and overall acceptability (8.30). Thus, white fleshed guava genotypes T17 P10 and red fleshed guava genotype T3 P19 proved promising and elite which could be utilized for further improvement programme of guava.

## References

1. Kher AS, Wall RV, Parshant B. Effect of biofertilizers and organic manures on physic-chemical characteristics and soil nutrient composition of guava (*Psidium guajava* L.) cv. Sardar. J Res SKUAST. 2009;8(2):0972-7469.
2. Amerine MA, Pangborn RM, Rossler EB. Principles of sensory evaluation of food. New York: Academic Press; 1965. p. 104-110.
3. Bodkhe VA. Morphological, biochemical, and molecular characterization of different guava genotypes. [Thesis]. Mahatma Phule Krishi Vidyapeeth Rahuri, Dist-Ahmednagar, Maharashtra; 2019.
4. Bogha TT, Sawate AR, Kshirsagar RB, Bochare SS. Studies on physical, chemical, and mineral evaluation of guava (*Psidium guajava* L.). The Pharma Innovation J. 2020;9(3):117-119.
5. Chandel DK, Chandel Y, Chandrakar Y, Sharma GL, Panigrahi HK. Genetic variability studies of guava (*Psidium guajava* L.) in Balod District of Chhattisgarh. The Pharma Innovation J. 2022;11(9):1324-1327.

6. Deshmukh NA, Lyngdoh P, Jha AK, Patel RK, Deka BC. Comparative studies of newly developed guava hybrids with commercial cultivars under mid hills of NE India. The Bioscan. 2013;8(4):1467-1470.
7. Dubey M, Chandra K, Kumar R, Kumar A, Kohli K. Evaluation of different guava (*Psidium guajava* L.) genotypes under Tarai condition of Uttarakhand. The Bioscan. 2016;11(3):1765-1770.
8. Gohil SN, Garad BV, Shirsath HK, Desai UT. Study on physicochemical constitution in guava (*Psidium guajava* L.) under sub-arid zone of Maharashtra. Sci Hortic. 2006;10:139-147.
9. Gurjar PKS, Singh L, Kushwah RS, Gurjar JS, Lekhi R, Kansana VN, *et al*. Evaluation of guava (*Psidium guajava* L.) varieties under gird zone of Madhya Pradesh. Int J Pure Appl Biosci. 2018;6(1):174-177.
10. Hayes WB. Fruit growing in India. 3rd ed. Kitabistan, Allahabad, India; 1974.
11. Lane JH, Eynon L. Determination of reducing sugars by Fehling’s solution with methylene blue as indicator. J Soc Chem Ind. 1923;42:32-37.
12. Marak JK, Mukunda GK. Studies on the performance of open pollinated seedlings of guava cv. Apple Colour. Acta Hortic. 2007;735:79-84.
13. Mehta SK, Singh KK, Jat DK, Rana DK. Comparative studies on physic-chemical characteristics of various cultivars of guava (*Psidium guajava* L.) under subtropical valley condition of Garhwal Himalaya (Uttarakhand), India. Plant Arch. 2016;16(1):361-364.
14. Nakasone HY, Paull RE. Tropical Fruits. Wallingford: CAB International; 1998. p. 149-172.
15. Nakasone HY, Brekke JE, Cacaletto CG. Fruit and yield evaluation of ten clones of guava (*Psidium guajava* L.). Hist Hawai Ag Exp Stn. 1976;218:17.
16. Panse VC, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: ICAR; 1989. p. 199-210.
17. Patel RK, Maiti CS, Deka BC, Verma VK, Deshmukh NA, Verma MR. Genetic variability, character association and path coefficient study in guava (*Psidium guajava* L.) for plant growth, floral and yield attributes. Int J Bio-Resource Stress Manage. 2015;6(4):000-000.
18. Patel RK, Yadav DS, Babu KD, Singh A, Yadav RM. Growth, yield, and quality of various guava (*Psidium guajava* L.) hybrids/cultivars under mid hills of Meghalaya. Acta Hortic. 2007;735:57-60.
19. Patel YK, Dewangan RK, Nag JL, Nag GP, Jain DK, Kumar R. Evaluation of guava (*Psidium guajava* L.) genotypes in Bastar district of Chhattisgarh based on qualitative traits. The Pharma Innovation J. 2024;13(3):15-17.
20. Patil SP, Mokashi AN, Kale LU. Evaluation of pink pulped Navoluer guava selections. Int J Trop Agric. 2015;33(2):297-302.
21. Poonam, Singh KV, Rathour SS, Dawar IS, Uikey A, Kushwah A. Physico-chemical evaluation of different cultivars of guava under gird region of Madhya Pradesh, India. Int J Plant Soil Sci. 2023;35(1):72-76.
22. Ramniwas RA, Kaushik DK, Sarolia KL, Kumawat MK, Jat RK. Varietal performance of guava under meadow system of ultra high-density planting. Biol Forum – Int J. 2023;15(2):614-618.
23. Ranganna S. Manual of analysis of fruit and vegetable products. New Delhi: Tata McGraw-Hill Publishing Co.; 1977. p. 9-82.
24. Radha T, Mathew L. Fruit Crops. New India Publishing Agency, New Delhi; 2007. p. III:429.
25. Singh P, Pandey SK, Pandey CS, Rai RK, Parmar M. Evaluation of guava (*Psidium guajava* L.) genotypes for tree morphology and fruit characteristics. Biol Forum – Int J. 2023;15(10):548-553.
26. Ravi GK, Jholgiker P, Srinivas N, Patil SN, Praveen Kumar BN, Thippanna KS, *et al*. Biological Forum – An International Journal. 2023;15(9):631-634.
27. Sahoo J, Tarai RK, Sethy BK, Sahoo AK, Swain SC, Dash D. Flowering and fruiting behavior of some guava genotypes under East and South East Coastal Plain Zone 101 of Odisha, India. Int J Curr Microbiol Appl Sci. 2017;6:3499-3501.
28. Singh Y, Dikshit SN, Sharma GL, Ramteke V. Studies on growth parameters and fruit characters in guava (*Psidium guajava* L.) genotypes of Chhatisgarh plains. J Soils Crops. 2018;28(2):326-330.
29. Sharma A, Sehrawat SK, Singhrot RS, Tele A. Morphological and chemical characterization of Psidium species. Notulae Bot Horti Agrobot Cluj-Napoca. 2010;38(1):28-32.
30. Tiwari A, Pal AK, Singh S, Singh SP, Patidar VL. Physico-chemical attributes and organoleptic assessment of guava (*Psidium guajava* L.) cultivars grown in eastern Uttar Pradesh. J Appl Nat Sci. 2016;8(4):1731-1734.
31. Ulemale PH, Tambe TB, Satpute SB, Dhule DT. Evolution of guava genotypes for bio-chemical and yield parameters. Int J Curr Microbiol Appl Sci. Special Issue-6: 2021-2026. 2018.