

# Evaluation on Morphological and Quality Attributes of Mango Cultivars in Western Uttar Pradesh

## ABSTRACT

The study aimed to assess the morpho-economic and biochemical attributes of twelve mango cultivars grown in western Uttar Pradesh, using pooled data from the years 2021-22 and 2022-23 and conducted at Horticulture Research Center of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, the experiment utilized a Randomized Block Design (RBD) with four replications per treatment. The cultivars included Ambika, Pusa Arunima, Dashehari-51, Kesar, Pusa Surya, Amrapali, Mallika, Burma Surakha, NeelumChausa, MithuaMalda, Rataul, and Saurav, all planted in 10-year-old orchards with a spacing of 6x6 meters. The study aimed to evaluate the morpho-economic and biochemical attributes of twelve mango cultivars in western Uttar Pradesh, identify the most suitable cultivars for the region, and determine the cultivars with the most marketable fruit traits. Additionally, it sought to assess the genetic diversity among the cultivars for future breeding programs.

The results demonstrated significant differences in morpho-economic and quality attributes among the cultivars. Mallika, Pusa Arunima and Amrapali emerged as superior varieties, excelling in tree morpho-economic and quality attributes, while others were classified as moderate. Mallika, Pusa Arunima and Amrapali were identified as the highest-yielding varieties, based on the mean number of fruits per plant and fruit weight over the two-year period. Furthermore, the fruits of Mallika, Pusa Arunima, Amrapali, Rataul, and Kesar exhibited the most marketable attributes.

The findings underscore the significant genetic and environmental influences on mango attributes. Mallika and Pusa Arunima consistently demonstrated superior performance in yield, fruit quality, and biochemical attributes, positioning it as a promising cultivar for the region. The diversity observed among the cultivars highlights the need for targeted selection and management practices to optimize mango production and quality. The study also emphasizes the importance of preserving and conserving these unique genetic resources for future breeding programs aimed at developing new, commercially viable cultivars.

**Keywords:** Mango, Cultivars, Fruit Yield, Morpho-economic Attributes, Quality Attributes

**Comment [H1]:** Statement is not clear whether the age of mango plants under evaluation is of ten years or different?

**Comment [H2]:** No molecular studies were conducted in the manuscript to check the genetic diversity among the cultivars. Please add the genetic studies???? It is only an evaluation study.

**Comment [H3]:** Not all the cultivars but from the best cultivar for commercial cultivation only

**Comment [H4]:** Keywords doesn't include any genetic diversity????????

## 32 Introduction

33 Mango (*Mangifera indica* L.) is one of the most important and widely cultivated fruit crops in  
34 India (Dinesh *et al.* 2016), renowned for its delightful flavor, aroma and nutritional value  
35 (Dar *et al.* 2016; Kumar *et al.* 2023; Gautam *et al.* 2023). Mango, a fruit from the  
36 Anacardiaceae family, is a dicotyledonous species that is believed to have originated in the  
37 Indo-Burmese region (Subramanyam *et al.*, 1975; Tjiptono*et al.*, 1984). It is considered to be  
38 an allopolyploid, likely an amphidiploid and an outbreeding species with a chromosomal  
39 number of  $2n=40$  (Mukherjee, 1950). India is the largest producer of mango in the world with  
40 an annual production of 20.77 MT from an area of 2.35 M ha (Anon. 2021). Major mango  
41 producing states in India are Uttar Pradesh andhra Pradesh, Karnataka, Maharashtra, Bihar,  
42 Gujarat, Tamil Nadu, Odisha, West Bengal and Jharkhand. Mango is India's most important  
43 commercial fruit crop, accounting for more than 54% of global mango production (Mirta and  
44 Baldwin 1997). Western Uttar Pradesh, with its favorable agro-climatic conditions, serves as  
45 a significant region for mango production, offering a diverse range of mango varieties. This  
46 diversity not only contributes to the rich genetic reservoir but also plays a crucial role in the  
47 region's agricultural economy (Sankaran & Dinesh 2020).

48 The present study was conducted to evaluate the morpho-economic and quality attributes of  
49 various mango varieties in Western Uttar Pradesh. The findings confirm significant diversity  
50 among the mango cultivars examined, underscoring the need for the preservation and  
51 conservation of these unique genetic resources (Rajan *et al.* 2024). **Such conservation efforts  
52 are crucial for future breeding programs aimed at developing innovative, market-driven  
53 cultivars that can meet the evolving demands of consumers and the challenges of changing  
54 environmental conditions.**

55 **Mango cultivation in Western Uttar Pradesh, while thriving, faces challenges related to  
56 inconsistent fruit quality, susceptibility to pests and diseases and the impact of climate  
57 change**(Chawla *et al.* 2016; Yadav *et al.* 2013). There is a pressing need to identify and  
58 evaluate the diverse mango cultivars in this region to enhance their commercial viability and  
59 resilience. **The lack of comprehensive research on the morpho-economic and quality  
60 attributes of these varieties poses a problem for farmers seeking to optimize their yields and  
61 improve fruit quality.**

62 **The significant economic importance of mango cultivation in Western Uttar Pradesh and the  
63 observed variability in mango cultivars across the region (Kumar *et al.* 2023). Understanding**

**Comment [H5]:** This hypothesis for evaluation doesn't seem to be accurate.

**Comment [H6]:** This hypothesis is accurate for evaluation of these commercial mango cultivars under Western Uttar Pradesh.

64 the diversity in morpho-economic and quality attributes is crucial for identifying superior  
65 varieties that can be promoted for commercial cultivation. Additionally, this research aims to  
66 address the gap in knowledge regarding the genetic potential of local mango varieties, which  
67 is essential for sustainable mango production.

**Comment [H7]:** All the mango varieties are already commercial released cultivars and no local varieties has been studied under this experiment.

68 Farmers in Western Uttar Pradesh often struggle with fluctuating mango yields, inconsistent  
69 fruit quality and vulnerability to environmental stresses. These challenges are compounded  
70 by the limited availability of well-adapted, high-quality mango cultivars. The local problem is  
71 the lack of access to mango varieties that are not only resilient to local conditions but also  
72 meet market demands in terms of taste, size and shelf life (Sivakumar *et al.* 2011).

73 This research aims to overcome the identified challenges by systematically evaluating the  
74 morpho-economic and quality attributes of various mango varieties. By identifying superior  
75 cultivars with desirable attributes such as disease resistance, high yield potential and  
76 excellent fruit quality (Zahid *et al.* 2022) the study will provide valuable insights for breeding  
77 programs and help in the selection of varieties that are better suited to the local conditions.

78 The findings from this research have the potential to transform mango cultivation in Western  
79 Uttar Pradesh by identifying cultivars that are not only more resilient but also of higher  
80 quality. This will empower farmers with the knowledge and resources to cultivate mango  
81 varieties that thrive in their local climate, leading to better yields and higher market value.

82 Additionally, by focusing on the conservation of genetic diversity, the study ensures that the  
83 rich variety of mangoes in the region is preserved for future use, supporting long-term  
84 agricultural sustainability and contributing to the overall economic and nutritional health of  
85 the community.

**Comment [H8]:** ????????

## 86 **Materials and Methods**

**Comment [H9]:** Does all the cultivars are regular bearer????

87 The experiment was conducted Horticultural Research Centre, Sardar Vallabhbhai Patel  
88 University of Agriculture and Technology, during 2021-22 to 2022-23. Geographically, the  
89 experimental field is located at 29°04' North latitude, 77°42' East longitude and at an altitude  
90 of 237.75 meters above the mean sea level. The experimental materials for present  
91 investigation comprised of twelve mango cultivar collected from different parts of part of  
92 India. The cultivars viz. Ambika, Pusa Arunima, Dashehari-51, Kesar, Pusa Surya, Mallika,  
93 Amrapali, Burma Surakha, NeelumChausa, MithuaMalda, Rataul and Saurav were selected  
94 for the study and periodically observed. The age of the plants varied from 8-10 years. The

95 experiment was laid on RBD with four replications and resulting in a total of 48 trees. The  
96 crops were spaced at 6 mx 6 m. All the cultivar were provided with standard agronomic  
97 practices such as nutrient and pest management.

**Comment [H10]:** Reference of Package of Practices?

98 Observation with respect to morpho-economic and quality characters were taken during the  
99 period of observation on the selected characters are number of fruit per tree, fruit yield  
100 (kg)/tree, fruit weight (g), fruit length (cm), fruit width (cm), fruit pulp weight (g), stone  
101 weight (g), stone length (cm), kernel weight (g), kernel length (cm), kernel width (cm),  
102 acidity %, TSS (<sup>0</sup>Brix), reducing sugar (%), non-reducing sugar (%), total sugar(%),  
103 total carotenoid (mg/100g), ascorbic acid (mg/100 g), phenol content (mg GAE/100 g) and  
104 total antioxidants ( $\mu$ mol Trolox 100g). A total of four plants were selected per replication.

105 The morphological characterization was done adopting standard mango descriptors  
106 developed by the IPGRI (IPGRI 2006). The number of fruits per tree was counted for each  
107 mango cultivar. The yield per tree was recorded over the study period. Fruit weight and pulp  
108 weight, stone weight and kernel weight were measured by weighing balance. The digital  
109 Vernier calipers was used to measure the fruit length, fruit width, stone length, kernel length  
110 and kernel width.

**Comment [H11]:** Repeated words, Rewrite it again

111 The biochemical analysis conducted by following standard protocols. Total soluble solids  
112 (TSS) were measured by using hand refractometer (AOAC, 2000). Titratable acidity,  
113 reducing and non-reducing sugar was determined by method described in AOAC (2000).  
114 Total sugars were estimated as suggested by Ranganna (1986). The total carotenoid was  
115 determined through the ranganna method (Ranganna *et al.* 1999). The titration method was  
116 followed for the estimation of ascorbic acid in mango juice (Sadashivam and  
117 Theymoli, 1987). Total phenol estimation was carried out with the Folin-Ciocalteu reagent  
118 (Malick and Singh 1980). The antioxidant (AOX) activity in the mango fruits was assessed  
119 using the CUPRAC (Cupric Reducing Antioxidant Capacity) method, as described by Apak  
120 *et al.* (2004). The acquired observations were statistically analyzed using the recommended  
121 Panse & Sukhatme (1967) standard approach. This analysis ensured the accuracy and reliability  
122 of the results, with statistical C.D. at 5% validation performed to determine the significance of  
123 differences among treatments.

**Comment [H12]:** How the kernel in the stone of mango showed the superiority of mango over the other cultivars.

## 124 **Result and Discussion**

**Comment [H13]:** Which statistical software has been used to analyze the data???

**Comment [H14]:** If the mango cultivars are irregular bearers then how the data of consecutive for two years can be pooled.

### 125 **Morpho-economic Attributes**

**Comment [H15]:** If the cultivars are irregular bearers then instead of pooling, it will be better to discuss the two year data on the basis of On-Year and Off year...

126 The data presented in Table 1 and Figure 1 on mango revealed significant variations in fruit  
127 morpho-economic attributes across different cultivars grown under the agro-climatic  
128 conditions of western Uttar Pradesh. Among the twelve mango cultivars studied, the highest  
129 fruit yield per tree was recorded in cv. Mallika (108.82 kg) followed by cv. Pusa Arunima  
130 (81.41 kg) and cv. Amrapali (77.15 kg). The lowest fruit yield was observed in cv. Saurav  
131 (31.60 kg). The high yield observed in cv. Mallika could be due to its genetic potential for  
132 higher productivity, better adaptation to the western Uttar Pradesh climate and efficient  
133 utilization of available resources. On the other hand, the lower yield in cv. Saurav might be  
134 due to its lower genetic yield potential or lesser adaptability to the specific environmental  
135 conditions of the region. These variations in fruit yield among the mango cultivars can be  
136 attributed to several factors, including genetic diversity, adaptability to local environmental  
137 conditions and management practices (Khan *et al.* 2015).

**Comment [H16]:** Why Mallika Showed higher productivity and not other cultivars, if already it has higher potential then why there is a need to evaluate it with other mango cultivars?

138 The highest number of fruits per tree was recorded in cv. Rataul (351.19) followed by cv.  
139 Mallika (338.31) and cv. Amrapali (288.94). The lowest number of fruits per tree was  
140 observed in cv. Saurav (137.63). These variations in fruit numbers among the mango  
141 cultivars can be attributed to genetic factors, differences in flowering and fruit-setting habits  
142 and the ability of each cultivar to adapt to the specific environmental conditions of western  
143 Uttar Pradesh. Cultivars such as Rataul and Mallika, which showed a higher number of fruits  
144 per tree, likely possess superior genetic attributes that enhance flowering, pollination and fruit  
145 retention, thus resulting in higher productivity. On the other hand, the lower number of fruits  
146 in cv. Saurav might be due to its genetic predisposition towards lower flower-to-fruit  
147 conversion rates or its reduced adaptability to the local climate and soil conditions. Previous  
148 studies have shown that cultivar and environment interactions play a crucial role in  
149 determining the yield and quality of mango fruits. According to Makhmaleet *et al.* (2016), the  
150 performance of mango cultivars can vary significantly based on climatic conditions, soil type  
151 and cultural practices. Similarly, Iqbal *et al.* (2012) highlighted that the choice of cultivar is  
152 critical for optimizing fruit yield and quality in specific agro-climatic zones. This study's  
153 findings align with these observations, emphasizing the importance of selecting suitable  
154 cultivars for improved mango production in western Uttar Pradesh.

**Comment [H17]:** Reference showing the genetic characters superior than other cultivars?

155 The highest fruit weight was recorded in the cultivar 'Pusa Arunima' (331.33 g), followed  
156 closely by 'Ambika' (326.55 g) and 'Mallika' (321.45 g), while the lowest fruit weight was  
157 observed in 'Rataul' (144.52 g). In terms of fruit length, 'Mallika' had the greatest  
158 measurement (12.90 cm), followed by 'Pusa Arunima' (12.63 cm) and 'Pusa Surya' (12.26

159 cm). The shortest fruit length was noted in 'Rataul' (8.24 cm). For fruit width, 'MithuaMalda'  
160 exhibited the largest width (7.69 cm), with 'Pusa Surya' (7.41 cm) and 'Pusa Arunima' (7.34  
161 cm) following, whereas 'Kesar' recorded the smallest width (5.24 cm). Regarding fruit pulp  
162 weight, 'Pusa Arunima' again topped the list (248.46 g), followed by 'Mallika' (243.30 g) and  
163 'Ambika' (218.94 g), while 'Rataul' had the lowest pulp weight (74.98 g). Other cultivars such  
164 as 'Dashehari-51', 'Kesar' and 'Burma Surakha' showed moderate performance across these  
165 parameters, reflecting a diversity of fruit quality characteristics within the region. The  
166 observed variation in mango fruit characteristics among the cultivars in Western Uttar  
167 Pradesh can be attributed to several factors, including genetic differences, environmental  
168 conditions and agricultural practices. Genetically, each cultivar has distinct attributes that  
169 determine fruit size, shape and pulp content. For instance, 'Pusa Arunima' and 'Mallika'  
170 consistently show superior fruit quality attributes due to their genetic predisposition for larger  
171 fruit and higher pulp weight.

172 **The evaluated cultivars exhibited significant variation in stone and kernel characteristics.** The  
173 lowest stone weight was recorded in the cultivar 'Rataul' (21.95 g), followed by 'Saurav'  
174 (27.19 g) and 'Amrapali' (28.75 g), while the highest stone weight was observed in  
175 'MithuaMalda' (36.47 g). The shortest stone length was observed in the cultivar 'Rataul' (7.21  
176 cm), followed by 'Kesar' (8.71 cm) and 'Dashehari-51' (9.31 cm), while the longest stone  
177 length was found in 'NeelumChausa' (11.96 cm). In terms of kernel weight, the lowest was  
178 recorded in 'Rataul' (13.84 g), followed by 'Kesar' (14.90 g) and 'Saurav' (15.26 g), whereas  
179 the highest kernel weight was observed in 'Pusa Arunima' (22.63 g). The shortest kernel  
180 length was observed in the cultivar 'Kesar' (4.81 cm), followed by 'Rataul' (5.31 cm) and  
181 'Saurav' (5.36 cm), while the longest kernel length was found in 'NeelumChausa' (7.38 cm).  
182 In terms of kernel width, the narrowest was recorded in 'Kesar' (2.36 cm), followed by  
183 'Dashehari-51' (2.53 cm) and 'Saurav' (2.49 cm), whereas the widest kernel was observed in  
184 'Pusa Arunima' (3.40 cm).

185 The variations in stone and kernel characteristics among the mango cultivars in Western Uttar  
186 Pradesh can be attributed to genetic differences, environmental conditions and agricultural  
187 practices. The genetic diversity among the cultivars dictates their stone and kernel attributes,  
188 with 'Rataul' and 'Kesar' showing superior attributes in terms of stone and kernel size due to  
189 their genetic makeup. The subtropical climate of Western Uttar Pradesh, characterized by its  
190 seasonal temperature and rainfall patterns, influences the growth and development of mango  
191 stones and kernels.

**Comment [H18]:** The cultural management practices were performed uniformly in all the cultivars then how these practices enhanced only few cultivars and show superiority among the other cultivars?

192 The impact of climate change on agriculture must consider the increasing levels of  
193 atmospheric CO<sub>2</sub>, a key driver of climate change, which plays a vital role in essential plant  
194 functions such as photosynthesis (Dusengeet *et al.* 2019; Soares *et al.* 2019; Hussain *et al.*  
195 2021). In mango cultivation, flowering has been negatively affected by irregular sequences of  
196 cool evenings and unusually warm winters, while rising average temperatures are already  
197 impacting mango production. Therefore, rapid climate change should be a significant concern  
198 for mango growers, scientists and consumers alike. The rich genetic diversity of mangoes is  
199 beneficial for breeding and selection programs aimed at adapting to climate changes (Bally &  
200 Dillon 2018). Although rising temperatures may benefit mango fruit development, they can  
201 also induce physiological changes in the fruit. High temperatures, coupled with increased  
202 light, may enhance photosynthesis and fruit size (Urban *et al.*, 2003). Increased CO<sub>2</sub>  
203 concentrations may further improve fruit quality by enhancing photosynthesis and increasing  
204 fruit dry mass. In non-irrigated orchards, drought is known to have both positive and negative  
205 effects on fruit quality. While drought reduces fruit size, it enhances fruit quality by  
206 increasing dry matter and sugar concentration (Léchaudelet *et al.*, 2005; Liu *et al.* 2021) in  
207 mangoes.

Comment [H19]: Data related to increase and decrease of CO<sub>2</sub>???

## 208 Biochemical Attributes

209 The data presented in Table 2 and Figure 2 highlighted significant variations in the  
210 biochemical attributes among the twelve mango cultivars studied. The highest TSS was  
211 recorded in the cultivar 'Mallika' (22.03 °Brix), followed by 'Ambika' (20.46 °Brix) and  
212 'Amrapali' (19.89 °Brix), while the lowest TSS was observed in 'MithuaMalda' (17.06  
213 °Brix). In terms of acidity, 'Mallika' exhibited the highest acidity (0.28%), followed by 'Pusa  
214 Surya', 'Amrapali' and 'Rataul' (all at 0.26%). The lowest acidity was found in 'Pusa Arunima'  
215 (0.20%), with 'Burma Surakha' (0.21%) and 'Kesar' (0.22%) closely following. Other  
216 cultivars such as 'Dashehari-51' and 'MithuaMalda' displayed moderate acidity levels  
217 (0.25%). The variation in TSS and acidity among mango cultivars in western Uttar Pradesh  
218 can be attributed to genetic factors, environmental influences and cultivation practices.  
219 Genetically, each cultivar has unique attributes that affect its sugar content and acidity.  
220 'Mallika' and 'Ambika,' with high TSS levels, are likely genetically predisposed to produce  
221 sweeter fruit, while cultivars like 'MithuaMalda' and 'Burma Surakha' exhibit lower  
222 sweetness. The climatic conditions in western Uttar Pradesh, characterized by its hot summers  
223 and distinct wet and dry seasons, can impact sugar accumulation and acid levels in mango  
224 fruit (Mishra *et al.* 2016). Cultivars such as 'Mallika' and 'Amrapali' may benefit from these

Comment [H20]: Temperature and rainfall data, Also write about whether the experiment was done under irrigated or unirrigated conditions

225 conditions, enhancing their sweetness and flavor profile. Soil properties, including fertility  
226 and pH, also affect nutrient uptake and fruit quality.

227 The data presented in Table 1 and Figure 1 reveal significant variations in reducing sugar,  
228 non-reducing sugar and total sugar content among the twelve mango cultivars studied. The  
229 highest total sugar content was recorded in the cultivar 'Mallika' (20.31%), followed by 'Pusa  
230 Arunima' (18.09%) and 'Ambika' (17.85%), while the lowest total sugar content was  
231 observed in 'MithuaMalda' (12.83%). In terms of reducing sugar, 'Dashehari-51' exhibited the  
232 highest content (6.61%), followed by 'Pusa Surya' (6.33%) and 'Pusa Arunima' (6.15%). The  
233 lowest reducing sugar content was found in 'NeelumChausa' (4.23%). For non-reducing  
234 sugar, 'Mallika' again led the cultivars (14.62%), with 'Ambika' (11.97%) and 'Amrapali'  
235 (11.83%) following closely. The lowest non-reducing sugar content was recorded in  
236 'MithuaMalda' (7.50%).

237 The variation in sugar content among mango cultivars in Western Uttar Pradesh can be  
238 attributed to genetic factors, environmental influences and cultivation practices. Genetically,  
239 each cultivar has distinct sugar profiles, which determine their sweetness and flavor.  
240 'Mallika,' with the highest total sugar content, benefits from a high non-reducing sugar level,  
241 contributing to its rich sweetness. The climatic conditions in Western Uttar Pradesh,  
242 including its warm temperatures and seasonal rainfall, can affect sugar accumulation in  
243 mango fruit. Cultivars like 'Mallika' and 'Pusa Arunima' are well-suited to these conditions,  
244 enhancing their sugar content and overall taste. Soil characteristics, such as nutrient  
245 availability and pH, also play a role in determining sugar profiles (Ahmad *et al.* 2018).

246 The significant variations in total carotenoid and ascorbic acid content among the twelve  
247 mango cultivars studied. The highest total carotenoid content was recorded in the cultivar  
248 'Amrapali' (8.94 mg/100g), followed closely by 'Kesar' (8.74 mg/100g) and 'Mallika' (7.73  
249 mg/100g), while the lowest carotenoid content was observed in 'NeelumChausa' (1.39  
250 mg/100g). In terms of ascorbic acid content, 'Pusa Arunima' exhibited the highest level  
251 (45.31 mg/100g), followed by 'Pusa Surya' (42.64 mg/100g) and 'Mallika' (37.94 mg/100g).  
252 The lowest ascorbic acid content was found in 'Kesar' (20.58 mg/100g).

253 The variation in total carotenoid and ascorbic acid content among mango cultivars in Western  
254 Uttar Pradesh can be attributed to genetic factors, environmental conditions and cultivation  
255 practices (Pandey, 2015). Genetically, each cultivar has unique characteristics that determine  
256 their levels of carotenoids and vitamin C. 'Amrapali' and 'Kesar,' with the highest carotenoid

**Comment [H21]:** Repeated reasons for all the attributes taken into study???? It may include some edaphic factors also which showed the nutrient uptake and biochemical activities during developmental processes responsible for improved chemical characteristics of fruits.

257 levels, are likely genetically predisposed to produce richly colored fruit with high antioxidant  
258 content.

259 The phenol content across the evaluated cultivars varied significantly. The lowest phenol  
260 content was observed in the cultivar 'Burma Surakha' (41.29 mg GAE/100 g) followed by  
261 'Kesar' (50.99 mg GAE/100 g) and Pusa Surya' (52.82 mg GAE/100 g), while the highest  
262 phenol content was observed in 'Mallika' (119.73 mg GAE/100 g). Regarding total  
263 antioxidants, 'Mallika' also exhibited the highest level (1.28  $\mu\text{mol Trolox}/100\text{ g}$ ), followed by  
264 'Pusa Arunima' (0.82  $\mu\text{mol Trolox}/100\text{ g}$ ) and 'Ambika' (0.79  $\mu\text{mol Trolox}/100\text{ g}$ ). The lowest  
265 total antioxidant content was found in 'Kesar' (0.42  $\mu\text{mol Trolox}/100\text{ g}$ ) and 'Burma Surakha'  
266 (0.42  $\mu\text{mol Trolox}/100\text{ g}$ ).

267 In Western Uttar Pradesh, environmental factors like **temperature, rainfall and soil conditions**  
268 significantly influence mango growth, fruit development and nutritional quality. The region's  
269 subtropical climate and soil fertility impact phenol, antioxidant, carotenoid and vitamin C  
270 levels in different cultivars, with genetic attributes also playing a role. Cultivation practices  
271 such as fertilization and irrigation further affect nutrient content and fruit quality (Sarkar *et*  
272 *al.* 2016; Sun *et al.* 2022; Peng *et al.* 2023). Understanding these factors is vital for selecting  
273 mango cultivars that offer superior nutritional benefits and align with consumer preferences  
274 in the region.

## 275 **Conclusion**

276 The evaluation of twelve mango varieties in this study indicates that all are promising  
277 cultivars for cultivation in Western Uttar Pradesh, with potential for inclusion in further  
278 research trials, mass multiplication programs and eventual adoption by farmers and  
279 orchardists. Among these, Mallika and Pusa Arunima emerged as particularly superior based  
280 on their morpho-economic and quality attributes, while Mallika, Pusa Arunima, Amrapali,  
281 Rataul and Kesar also demonstrated favorable marketable fruit characteristics. **The study**  
282 **highlights the significant diversity among the mango cultivars, underscoring the importance**  
283 **of preserving and conserving these genetic resources.** This diversity is crucial for future  
284 breeding programs aimed at developing innovative, market-driven cultivars that can adapt to  
285 changing environmental conditions and meet consumer demands. The findings contribute to  
286 the sustainable development of mango production in the region, offering valuable insights for  
287 both current and future agricultural practices.

**Comment [H22]:** Recommendations needs to be clear that which one cultivar followed by other is superior for commercial cultivation under Western Uttar Pradesh?/

288 **Future Scope**

289 Future research should focus on utilizing this genetic diversity to develop new cultivars with  
290 enhanced resilience to climate change and improved commercial traits. Additionally, targeted  
291 breeding programs can further optimize the identified superior cultivars, ensuring sustained  
292 productivity and quality in mango production for the region.

293

294

295 **DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

296 Author(s) hereby declare that NO generative AI technologies such as Large Language  
297 Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used  
298 during writing or editing of manuscripts.

299

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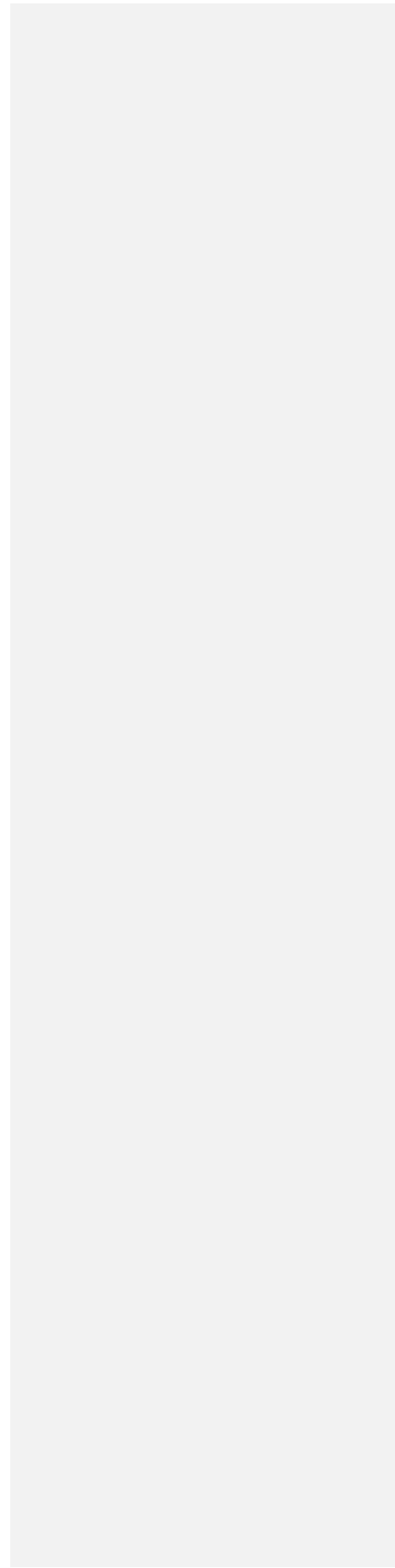
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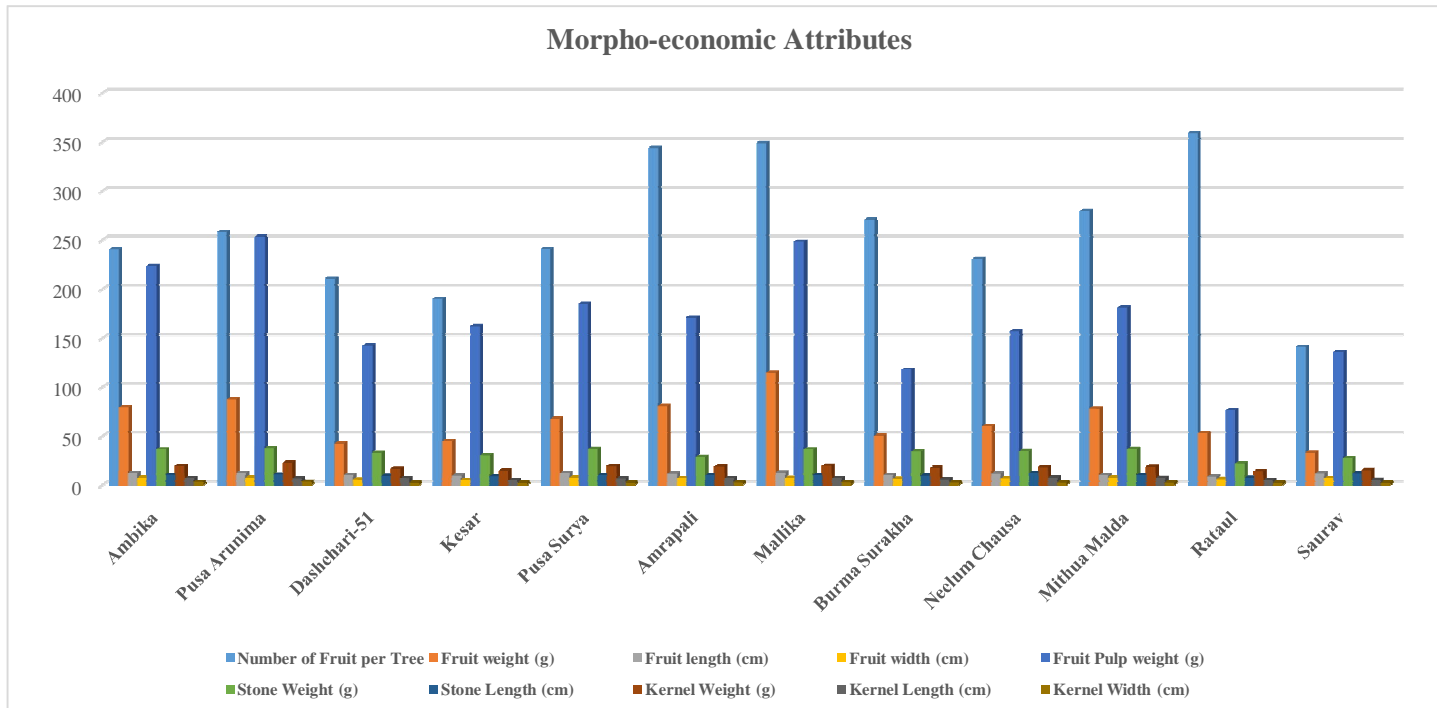
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UNDER PEER REVIEW



**Table 1. Mean performance values of different morpho-economic attributes for twelve mango varieties based on pooled data from the years 2021-22 and 2022-23**

Cultivars	Fruit Yield (kg)/Tree	Number of Fruit per Tree	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Fruit Pulp weight (g)	Stone Weight (g)	Stone Length (cm)	Kernel Weight (g)	Kernel Length (cm)	Kernel Width (cm)
Ambika	79.18	240.25	79.18	12.35	7.35	223.56	36.31	10.53	19.19	6.73	3.30
Pusa Arunima	87.35	258.13	87.35	12.65	7.40	253.19	37.23	10.75	22.69	6.48	3.43
Dashehari-51	42.49	210.75	42.49	10.30	5.78	142.13	32.99	9.38	16.56	6.70	2.55
Kesar	44.88	189.75	44.88	9.51	5.33	161.90	30.38	8.72	14.73	4.78	2.37
Pusa Surya	67.46	240.50	67.46	12.35	7.46	184.85	36.51	10.01	19.10	6.49	2.64
Amrapali	80.70	343.88	80.70	11.53	6.75	170.82	28.81	9.90	18.87	6.76	2.82
Mallika	114.55	348.88	114.55	12.95	7.10	248.38	36.24	10.23	19.40	6.86	2.98
Burma Surakha	50.00	270.50	50.00	10.18	6.28	117.66	34.06	9.48	17.19	5.88	2.85
NeelumChausa	59.87	230.75	59.87	11.55	6.48	156.85	34.49	11.97	17.94	7.39	2.80
MithuaMalda	78.31	279.50	78.31	9.93	7.78	180.95	36.51	10.35	18.69	7.04	2.78
Rataul	52.94	358.88	52.94	8.43	6.00	76.29	21.96	7.22	13.88	5.32	2.65
Saurav	33.13	141.00	33.13	11.68	6.73	135.72	27.31	11.73	15.30	5.49	2.50
Mean	<b>65.91</b>	<b>259.40</b>	<b>65.91</b>	<b>11.12</b>	<b>6.70</b>	<b>171.02</b>	<b>32.73</b>	<b>10.02</b>	<b>17.79</b>	<b>6.33</b>	<b>2.81</b>
Min	33.13	141.00	33.13	8.43	5.33	76.29	21.96	7.22	13.88	4.78	2.37
Max	114.55	358.88	114.55	12.95	7.78	253.19	37.23	11.97	22.69	7.39	3.43
SE(d) ±	2.25	9.83	2.25	0.39	0.22	5.70	1.06	0.32	0.61	0.19	0.10
C.D. at 5%	4.71	20.52	4.71	0.81	0.47	11.90	2.21	0.67	1.27	0.40	0.20
C.V.(%)	4.19	4.64	4.19	4.26	4.08	4.08	3.96	3.90	4.19	3.67	4.21



**Figure 1. Mean performance values of different morpho-economic attributes for twelve mango varieties based on pooled data from the years 2021-22 and 2022-23**

**Table 2. Mean performance values of different biochemical attributes for twelve mango varieties based on pooled data from the years 2021-22 and 2022-23**

Cultivars	TSS (°Brix)	Acidity (%)	Reducing Sugar (%)	Non-reducing Sugar (%)	Total Sugar (%)	Total Carotenoid (mg/100g)	Ascorbic acid (mg/100 g)	Phenol Content (mg GAE/100 g)	Total antioxidants (µmol Trolox 100g )
Ambika	20.48	0.23	5.26	11.97	17.86	4.30	31.76	56.27	0.79
Pusa Arunima	19.14	0.20	6.19	11.29	18.10	4.37	45.31	55.05	0.83
Dashehari-51	18.64	0.26	6.61	9.59	16.73	5.13	30.76	60.17	0.67
Kesar	17.91	0.22	4.43	8.69	13.40	8.77	20.58	51.03	0.43
Pusa Surya	19.41	0.27	6.33	9.61	16.45	3.56	42.68	52.83	0.45
Amrapali	19.90	0.27	5.37	11.82	17.85	8.95	31.96	69.13	0.76
Mallika	22.03	0.28	4.91	14.61	20.32	7.74	37.94	119.98	1.28
Burma Surakha	17.64	0.21	4.44	10.04	15.01	2.66	26.41	41.27	0.42
NeelumChausa	18.13	0.24	4.23	8.53	13.37	1.41	26.11	85.89	0.54
MithuaMalda	17.06	0.25	4.94	7.49	12.83	3.56	33.00	54.01	0.49
Rataul	17.58	0.27	4.91	9.66	15.09	4.55	24.77	64.89	0.63
Saurav	18.88	0.26	5.71	9.75	15.99	3.12	27.83	64.10	0.66
Mean	<b>18.90</b>	<b>0.25</b>	<b>5.28</b>	<b>10.25</b>	<b>16.08</b>	<b>4.84</b>	<b>31.59</b>	<b>64.55</b>	<b>0.66</b>
Min	17.06	0.20	4.23	7.49	12.83	1.41	20.58	41.27	0.42
Max	22.03	0.28	6.61	14.61	20.32	8.95	45.31	119.98	1.28
SE(d) ±	0.54	0.01	0.17	0.35	0.54	0.16	1.05	2.55	0.02
C.D. at 5%	1.14	0.02	0.35	0.72	1.13	0.33	2.19	5.33	0.05
C.V.(%)	3.52	3.65	3.94	4.14	4.13	4.03	4.06	4.85	4.32

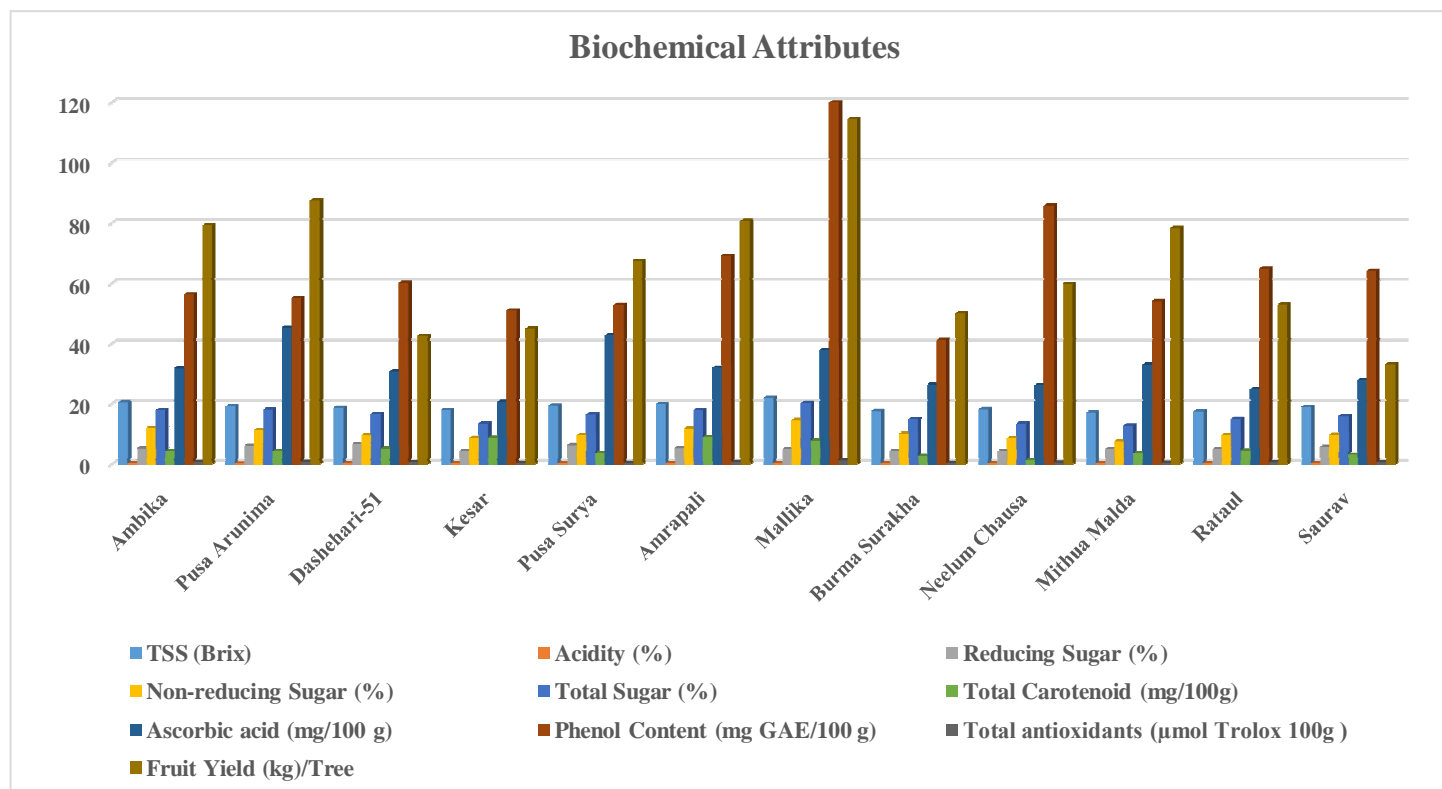


Figure 2. Mean performance values of different biochemical attributes for twelve mango varieties based on pooled data from the years 2021-22 and 2022-23