

# **Assessment of different varieties of okra for yield, quality and economical feasibility cultivated under Hadoti region of South-East Rajasthan**

## **ABSTRACT**

The study focuses on the cultivation of okra, a prominent Indian vegetable with significance in both export and family consumption. Emphasizing the potential for increased okra production through the selection of high-yielding varieties, the research specifically targets the Hadoti region, aiming to identify varieties suitable for its agro-climatic conditions. The lack of such screening in the region prompted the study. The trial was conducted during the summer seasons of 2022 and 2023 at the Instructional Farm of Career Point University, Kota, Rajasthan and the research evaluated 12 okra varieties using a randomized block design with three replications. The analysis of variance revealed significant differences among all varieties for various traits, including yield, quality and **economical feasibility**. The study underscores the presence of a substantial varietal effect, offering insights into optimizing okra cultivation in the South-East climatic conditions of Rajasthan's Hadoti region. The results showed presence of significant varietal effect. However, the present study demonstrated the superiority of Punjab Selection variety over other varieties in terms of maximum mean fruit length (13.07 cm), fruit diameter (3.77 cm) and fruit weight (15.56 g), minimum mean titratable acidity (0.22%), maximum TSS (3.18 °B), ascorbic acid (19.64 mg/100g) and mucilage content (0.91%), maximum mean fruit yield per plant (0.53 kg), fruit yield per plot (11.68 kg) and fruit yield per hectare (124.30 q). However, the net return of Rs. 248575 Rs./ha and 249325 Rs./ha along with benefit cost ratio 5.02 and 5.05 in 2022 and 2023 respectively was also obtained from okra variety Punjab Selection.

**KEYWORDS:** *Assessment, Mucilage, TSS, Weight*

## **INTRODUCTION**

Okra [*Abelmoschus esculentus* (L.) Moench] holds a significant position among vegetables, known by various names globally such as lady's finger in England, Gumbo in the

U.S.A., and Bhindi in India. In India, it stands as a crucial vegetable crop, cultivated for its tender green fruits during the summer and rainy seasons. Propagated through seeds, okra is valued for its delectable green fruits used in diverse culinary applications, including curries and soups. Notably remunerative, it surpasses leafy vegetables in economic returns. While not commonly consumed as a leafy vegetable in India, okra's roots and stems are utilized in the preparation of gur or jaggery. Ripe okra seeds find use as a coffee substitute in Turkey. Despite its economic importance, okra cultivation faces challenges, particularly from various insect pests and diseases such as jassid, fruit and shoot borer, powdery mildew, and yellow vein mosaic. The imperative to meet the growing world population's food requirements underscores the need for enhanced crop yield and resilience. Okra is widely cultivated in plains of India mostly in Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh, Karnataka and Assam. In India, okra shares 5.28 million hectare area and 61.46 million tonnes production with a productivity of 12.2 million tonnes per hectare (Anonymous, 2022). Rajasthan has 1.3 million hectare area under okra cultivation with production of 8.34 million tonnes and productivity of 5.15 MT per ha (Anonymous, 2022)

The study's primary focus is to identify superior-performing okra varieties in the Hadoti region of Rajasthan, specifically tailored for the South-East climatic conditions. This research aims to pinpoint varieties that not only adapt well to the local environment but also demonstrate resistance to biotic and abiotic stresses, ensuring optimal yield and quality. The understanding that a variety excelling in one locality may not be suitable for another emphasizes the need for region-specific assessments to enhance okra cultivation and contribute to sustainable food production.

## **Materials and Methods**

### ***Location***

Kota district is located at 25.18° N to 75.83° E Latitude in South Eastern Rajasthan. It covers an area of 221.36 km<sup>2</sup>. Agro-climatically, the district falls in Zone V, known as Humid South Eastern Plain. The average rainfall in the region is 660.6. mm. Maximum temperature range in the summer is 40 to 48°C and minimum 1.0- 2.6°C during winter..

### ***Experimental Details***

The present studies were carried out at the Department of Horticulture, School of Agricultural Sciences, Career Point University, Kota (Rajasthan) during the year 2022 and 2023. Twelve varieties of okra viz. Parbhani Kranti, Parbhani Bhindi, Arka Anamika, Shahiba, Shan, No. 55, Harita, Jhilmil, No. 64, Sonal, Shakti, and Punjab Selection were evaluated in randomized block design, replicated thrice. Raised bed planting system at 60 x 30 cm spacing was adapted to grow the crop. The FYM 20 tonnes and RDF 150:100:100 NPK applied per hectare respectively, as basal dose.

#### ***Measurement of the yield parameters***

Fruit yield per plant (kg) was calculated from picking of fresh marketable fruits were done from the observational plants separately throughout the harvesting period at an interval of 3 days. It was totaled and then average yield per plant was worked out for each genotype. The fruits yield per plot (kg) harvested from all the plants in each plot including 5 observational plants were weighted at each harvest. The yield of fruit per hectare was obtained from yield per plot by multiplying with the factor.

$$\text{Fruit yield per ha (q)} = \frac{\text{Fruit yield per plot (kg)}}{\text{Gross plot area (m}^2\text{)}} \times \frac{10000 \text{ m}^2}{100}$$

#### ***Measurement of the quality parameters***

Colour of fruit was observed by visual observation and categorized in dark green light green and yellow green. The fruit length was measured from randomly selected five fruits from every genotype with the help of scale and then average was recorded. The widths of the randomly selected fruits were recorded with different position such as at base, at middle and at top with the help of Vernier caliper and average was worked out. The average fruit weight was calculated as weight of fruit in gram from five fruits from observational plants were selected randomly from each treatment and weighed. Total soluble solids content of the fruit was determined by using a digital hand refractometer. The acidity was determined by the method (A.O.A.C. 1990). Ascorbic acid content of juice was determined by (A.O.A.C. 1990). The mucilage was extracted the method given by Ahiakpa, *et al.* (2014).

#### ***Measurement of the economic feasibility***

Cost of cultivation will be taken into account by calculating total expenses incurred for inputs such as seeds, fertilizers and chemicals, to reach particular level of output. Gross return calculated as the total amount of revenue that can be obtained by the yield of okra during the total life time of the plants. The gross returns calculated by considering the prices of green fruit prevailing at the time of harvest. The net returns calculated by deducting the cost of cultivation from the gross returns. The sale rate of okra was Rs. 25/kg.

Net returns (Rs.) = Gross income/ha (Rs.) – Total cost of cultivation/ha (Rs.)

The benefit cost ratio will be calculated as follows;

$$\text{B:C ratio} = \frac{\text{Gross returns (Rs. ha-1)}}{\text{Cost of cultivation (Rs. ha-1)}}$$

## **RESULTS**

### ***Yield parameters of okra***

The fruit yield was found significantly different during the both years 2022 and 2023. Significant differences were observed amongst the different varieties of okra with respect to fruit yield per plant which ranged from 0.36 to 0.53 kg. The highest fruit yield per plant was recorded in “Punjab Selection” (0.53 kg) which was significantly highest over rest of the varieties but at par to “Sonal” (0.49 kg), whereas the minimum fruit yield per plant (0.36 kg) was found in “Parbhani Bhindi.” The fruit yield per plot was found significantly different during the both years 2022 and 2023. Significant differences were observed amongst the different varieties of okra with respect to fruit yield per plot which ranged from 9.48 to 11.68 kg. The maximum fruit yield per plot was recorded in “Punjab Selection” (11.68 kg) which was significantly highest over rest of the varieties but at par to “Sonal” (9.48 kg), whereas the minimum fruit yield per plot was found in “Parbhani Bhindi” (11.08 kg). The maximum mean fruit yield per hectare was recorded in “Punjab Selection” (124.30 q) which was significantly highest over rest of the varieties but at par to “Sonal” (121.52 q), whereas the minimum fruit yield per hectare was found in “Parbhani Bhindi” (103.74 q).

### ***Quality parameters of okra***

The fruit length was found significantly different during the both years 2022 and 2023. Significant differences were observed amongst the different varieties of okra with respect to fruit length which ranged from 11.06 to 13.07 cm. The maximum fruit length was recorded in “Punjab Selection” (13.07 cm) which was significantly highest

over rest of the varieties but at par to “Sonal” (12.72 cm), where as the minimum fruit length was found in “Parbhani bhindi” (11.06 cm). The maximum fruit diameter was recorded in “Punjab Selection” (3.77 cm) which was significantly highest over rest of the varieties but at par to “Sonal” (2.97 cm), where as the minimum fruit diameter was found in “Parbhani bhindi” (2.69 mm). The fruit weight was found significantly different during the both years 2022 and 2023. Significant differences were observed amongst the different varieties of okra with respect to fruit weight which ranged from 12.96 to 15.20 g. The maximum mean fruit weight was recorded in “Punjab Selection” (15.56 g) which was significantly highest over rest of the varieties but at par to “Sonal” (15.20 g), where as the minimum fruit weight (12.96 g) was found in “Parbhani Bhindi” (Table 1). The fruits of all the okra varieties were observed for qualitative trait study of fruit colour and fruits of all the varieties were found to be dark green in colour except “Shan, No.55 and Harita” which were light green in colour (Table 1).

The TSS in okra was found significantly different during the both years 2022 and 2023. Significant differences were observed amongst the different varieties of okra with respect to TSS in which ranged from 1.60 to 3.18 °B. The maximum mean TSS in okra was recorded in “Punjab Selection” (3.18 °B) which was significantly highest over rest of the varieties but at par to “Arka Anamika” (2.86 °B), where as the minimum TSS in okra was found in “No. 64” (1.60 °B). The minimum mean acidity percentage in okra was recorded in “Punjab Selection” (0.22 %) which was significantly lowest over rest of the varieties but at par to “Arka Anamika” (0.23 %), where as the maximum acidity percentage in okra was found in “No. 64” (0.44 %). The highest ascorbic acid was recorded in “Punjab Selection” (19.64 mg/100g) which was significantly highest over rest of the varieties but at par to “Arka Anamika” (18.37 mg/100g), where as the minimum ascorbic acid was found in “No. 64” (14.82 mg/100g). The mucilage content was found significantly different during the both years 2022 and 2023. Significant differences were observed amongst the different varieties of okra with respect to mucilage content which ranged from 0.71 to 0.91 per cent. The highest mean mucilage content was recorded in “Punjab Selection” (0.91%) which was significantly highest over rest of the varieties but at par to “Arka Anamika” (0.85%), where as the minimum mucilage content was found in “No. 64” (0.71 %).

### *Economic feasibility of okra*

Higher money value and less cost of cultivation are desirable characters for getting higher returns. Hence, economics of the genotypes was worked out. It is revealed from the data obtained that a significantly highest marketable fruit yield of 124.15 in 2022 and 124.45 q/ha in 2023 was found under variety "Punjab Selection". The net return of Rs 248575 Rs/ha and 249325 Rs/ha along with benefit cost ratio 5.02 and 5.03 in 2022 and 2023 respectively was obtained under okra variety "Punjab Selection" followed by "Sonal" gave fruit yield 121.37 and 121.67 q/ha and net return of Rs 2,41,625/ha and 2,42,375 with benefit cost ratio of 4.91 and 4.9203 in 2022 and 2023 respectively. While, the lowest marketable fruit yield 103.59 and 103.89 q/ha and net return of Rs 1,97,175/ha and 1,97,925/ha along with benefit cost ratio 4.19 and 4.20 03 in 2022 and 2023 respectively, was recorded in genotype "Parbhani Bhindi" (Table 3 & 4).

## DISCUSSION

Significant differences were observed among the different varieties of okra with respect to the physical parameters *viz.* fruit length, fruit diameter, fruit weight and colour of okra fruit and yield parameters *viz.* fruit yield per plant, fruit yield per plot and fruit yield per hectare. Chemical parameters *viz.* TSS, acidity, ascorbic acid and mucilage percentage.

The maximum fruit length at marketable stage was found in "Punjab Selection" (13.07 cm) while the minimum fruit length was found in "Parbhani bhindi" (11.06 cm). The significant differences for fruit length in the varieties may be due to their genetic makeup leading to differential synthesis, translocation and accumulation of photosynthates in the sink (fruit). Similar results have been reported by Singh *et al.* (2013), Yona *et al.* (2014), Chandramouli *et al.* (2016), Kumar *et al.* (2017) and Rajesh *et al.* (2018).

The thickest fruits (3.77 cm diameter) were recorded in 'Arka Anamika', while the thinnest (2.69 cm) in 'Parbhani Kranti'. The fruit size (length and diameter) of okra at marketable maturity stage is an important varietal characteristic that is primarily governed by its genotypic constitution and secondarily by availability of water and nutrients coupled with influence of the growing climate. The differences obtained in fruit diameter among the varieties and hybrids of okra could be attributed to their genetic makeup and the prevailing environmental factors. Similar results have been reported by Akotkar *et al.* (2010) and Chandra *et al.* (2014).

The maximum mean fruit weight at marketable maturity stage was recorded in 'Punjab

Selection' (15.56 g), while the minimum mean fruit weight in 'Parbhani Bhindi'(12.96 g). The observed variation in fruit weight amongst the varieties and hybrids of okra might be due to their genetic makeup governing the fruit size and sink-source relationship in diversion of photosynthates to the fruit. The results find support from Deepanshu and Shamad (2017) and Kumari *et al.* (2017).

The fruits of all the okra varieties were observed for qualitative trait study of fruit colour and fruits of all the varieties and hybrids were found to be dark green in colour except "Shan, No.55 and Harita" which were light green in colour.

The highest mean fruit yield per plant was recorded in "Punjab Selection" (0.53 kg) whereas the minimum fruit yield per plant was found in "Parbhani Bhindi" (0.36 kg). The yield per plant had high positive genotypic and phenotypic correlation with high number of branches per plant with more number of nodes on the plant, providing the site for fruit production. The observed variation in yield per plant amongst the varieties of okra might be due to their genetic makeup governing the number and size of fruits due to varying sink-source relationships. The findings lend support from Akotkar *et al.* (2010) and Bagwale *et al.* (2016) for fruit yield per hectare; Mishra *et al.* (2015), Darshan *et al.* (2016) and Kumari *et al.* (2019) for fruit yield per plant and fruit yield per plot;

The maximum mean fruit yield per plot (11.68 kg) and estimated fruit yield per hectare (124.30 q) were recorded in 'Punjab Selection' whereas the lowest fruit yield per plot (11.08 kg) and per hectare (103.74 q) were recorded in 'Parbhani Bhindi'. It is evident from the results that fruit yield per plant had directly influenced the fruit yield per unit area which had high positive correlation with fruit yield per plant for genotypic as well as phenotypic correlation. Similar results have been reported by Chandra *et al.* (2014), Deepanshu and Shamad (2017) and Chandramouli *et al.* (2016).

The minimum mean acidity percentage in okra was recorded in "Punjab Selection" (0.22 %) which was significantly lowest over rest of the varieties while the maximum acidity percentage in okra was found in "No. 64" (0.44 %). Similarly maximum mean TSS in okra was recorded in "Punjab Selection" (3.18 °B) which was significantly highest over rest of the varieties whereas the minimum mean TSS in okra was found in "No. 64" (1.60 °B). It is evident from the results directly influenced the chemical quality of okra might be due to

for genotypic correlation. The finding of Bendale *et al.* (2003), Yonas *et al.* (2014) and Priyanka *et al.* (2018) were similar to the present findings.

The ascorbic acid was found significantly different during the both years 2022 and 2023. The highest ascorbic acid was recorded in “Punjab Selection” (19.64 mg/100g) which was significantly highest over rest of the varieties whereas the minimum ascorbic acid was found in “No. 64” (14.82 mg/100g). On the other hand highest mucilage content was recorded in “Punjab Selection” (0.91 %) whereas the minimum mucilage content was found in “No. 64” (0.71 %). It is evident from the results directly influenced the chemical quality of okra might be due to for genotypic correlation. Similar results have been reported by Chandra *et al.* (2014), Deepanshu and Shamad (2017) and Chandramouli *et al.* (2016).

It is revealed from the data obtained that a significantly highest marketable fruit yield of 124.15 in 2022 and 124.45 q/ha in 2023. The net return of Rs 248575 Rs/ha and 249325 Rs/ha along with benefit cost ratio 5.02 and 5.05 in 2022 and 2023 respectively was obtained under okra variety “Punjab Selection” followed by “Sonal” gave fruit yield 121.37 and 121.67 q /ha and net return of Rs 2,41,625/ha and 2,42,375 with benefit cost ratio of 4.91 and 4.9203 in 2022 and 2023 respectively. While, the lowest marketable fruit yield 103.59 and 103.89 q/ha and net return of Rs 1,97,175/ha and 1,97,925/ha along with benefit cost ratio 4.19 and 4.20 in 2022 and 2023 respectively, was recorded in genotype “Parbhani Bhindi”. It is evident from the results that maximum benefit cost ratio had directly influenced due to the fruit yield per unit area which had high positive correlation with economic feasibility for genotypic as well as phenotypic correlation. Similar results have been reported by Chandra *et al.* (2014), Deepanshu and Shamad (2017) and Chandramouli *et al.* (2016).

## CONCLUSION

Based on the overall effect the variety Punjab Selection was highest in terms of physical, chemical and yield characteristics hence, variety Punjab Selection may be considered worth for better harvest of the crop under Hadoti region of South-East Rajasthan.

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**Table 4.1 Performance of different varieties of okra with respect to physical parameters**

| Treatment       | Varieties           | Fruit length (cm) |             |             | Fruit diameter (cm) |             |             | Fruit weight (cm) |             |             |
|-----------------|---------------------|-------------------|-------------|-------------|---------------------|-------------|-------------|-------------------|-------------|-------------|
|                 |                     | 2022              | 2023        | Pooled      | 2022                | 2023        | Pooled      | 2022              | 2023        | Pooled      |
| T <sub>1</sub>  | Parbhani Kranti     | 11.98             | 12.41       | 12.20       | 3.05                | 3.26        | 3.16        | 13.50             | 13.80       | 13.65       |
| T <sub>2</sub>  | Parbhani Bhindi     | 10.84             | 11.27       | 11.06       | 2.58                | 2.79        | 2.69        | 12.81             | 13.11       | 12.96       |
| T <sub>3</sub>  | Arka Anamika        | 12.42             | 12.85       | 12.64       | 3.42                | 3.63        | 3.53        | 14.95             | 15.25       | 15.10       |
| T <sub>4</sub>  | Shahiba             | 12.06             | 12.49       | 12.28       | 3.17                | 3.38        | 3.28        | 14.92             | 15.22       | 15.07       |
| T <sub>5</sub>  | Shan                | 11.14             | 11.57       | 11.36       | 2.63                | 2.84        | 2.74        | 13.35             | 13.65       | 13.50       |
| T <sub>6</sub>  | No. 55              | 11.53             | 11.96       | 11.75       | 2.71                | 2.92        | 2.82        | 13.75             | 14.05       | 13.90       |
| T <sub>7</sub>  | Harita              | 11.43             | 11.86       | 11.65       | 2.81                | 3.02        | 2.92        | 13.49             | 13.79       | 13.64       |
| T <sub>8</sub>  | Jhilmil             | 11.56             | 11.99       | 11.78       | 2.90                | 3.11        | 3.01        | 13.67             | 13.97       | 13.82       |
| T <sub>9</sub>  | No. 64              | 12.13             | 12.56       | 12.35       | 2.53                | 2.74        | 2.64        | 13.86             | 14.16       | 14.01       |
| T <sub>10</sub> | Sonal               | 12.50             | 12.93       | 12.72       | 3.54                | 3.75        | 3.65        | 15.05             | 15.35       | 15.20       |
| T <sub>11</sub> | Shakti              | 12.46             | 12.89       | 12.68       | 2.86                | 3.07        | 2.97        | 13.93             | 14.23       | 14.08       |
| T <sub>12</sub> | Punjab Selection    | 12.85             | 13.28       | 13.07       | 3.66                | 3.87        | 3.77        | 15.41             | 15.71       | 15.56       |
|                 | <b>SEm±</b>         | <b>0.33</b>       | <b>0.34</b> | <b>0.35</b> | <b>0.24</b>         | <b>0.17</b> | <b>0.16</b> | <b>0.47</b>       | <b>0.51</b> | <b>0.35</b> |
|                 | <b>C.D.(p=0.05)</b> | <b>0.98</b>       | <b>1.01</b> | <b>1.05</b> | <b>0.72</b>         | <b>0.49</b> | <b>0.48</b> | <b>1.35</b>       | <b>1.52</b> | <b>1.05</b> |

**Table 4.2 Performance of different varieties of okra with respect to yield parameters**

| Treatment       | Varieties           | Yield per plant (kg) |             |             | Yield per plot (kg) |             |             | Yield per hectare (q) |             |             |
|-----------------|---------------------|----------------------|-------------|-------------|---------------------|-------------|-------------|-----------------------|-------------|-------------|
|                 |                     | 2022                 | 2023        | Pooled      | 2022                | 2023        | Pooled      | 2022                  | 2023        | Pooled      |
| T <sub>1</sub>  | Parbhani Kranti     | 0.41                 | 0.43        | 0.42        | 9.37                | 9.69        | 9.53        | 104.15                | 104.45      | 104.30      |
| T <sub>2</sub>  | Parbhani Bhindi     | 0.42                 | 0.44        | 0.36        | 9.32                | 9.64        | 9.48        | 103.59                | 103.89      | 103.74      |
| T <sub>3</sub>  | Arka Anamika        | 0.50                 | 0.52        | 0.48        | 9.97                | 10.29       | 10.13       | 110.81                | 111.11      | 110.96      |
| T <sub>4</sub>  | Shahiba             | 0.46                 | 0.48        | 0.47        | 9.72                | 10.04       | 9.88        | 108.04                | 108.34      | 108.19      |
| T <sub>5</sub>  | Shan                | 0.36                 | 0.38        | 0.37        | 9.51                | 9.83        | 9.67        | 105.70                | 106.00      | 105.85      |
| T <sub>6</sub>  | No. 55              | 0.38                 | 0.40        | 0.39        | 9.40                | 9.72        | 9.56        | 104.48                | 104.78      | 104.63      |
| T <sub>7</sub>  | Harita              | 0.41                 | 0.43        | 0.42        | 9.99                | 10.31       | 10.15       | 111.04                | 111.34      | 111.19      |
| T <sub>8</sub>  | Jhilmil             | 0.40                 | 0.42        | 0.41        | 9.92                | 10.24       | 10.08       | 110.26                | 110.56      | 110.41      |
| T <sub>9</sub>  | No. 64              | 0.38                 | 0.40        | 0.39        | 10.12               | 10.44       | 10.29       | 112.48                | 112.78      | 112.63      |
| T <sub>10</sub> | Sonal               | 0.48                 | 0.50        | 0.49        | 10.92               | 11.24       | 11.08       | 121.37                | 121.67      | 121.52      |
| T <sub>11</sub> | Shakti              | 0.34                 | 0.43        | 0.41        | 10.23               | 10.55       | 10.39       | 113.70                | 114.00      | 113.85      |
| T <sub>12</sub> | Punjab Selection    | 0.52                 | 0.54        | 0.53        | 11.17               | 11.49       | 11.67       | 124.15                | 124.45      | 124.30      |
|                 | <b>SEm±</b>         | <b>0.04</b>          | <b>0.02</b> | <b>0.03</b> | <b>0.33</b>         | <b>0.35</b> | <b>0.51</b> | <b>2.01</b>           | <b>1.66</b> | <b>2.44</b> |
|                 | <b>C.D.(p=0.05)</b> | <b>0.11</b>          | <b>0.06</b> | <b>0.09</b> | <b>0.98</b>         | <b>1.05</b> | <b>1.50</b> | <b>5.90</b>           | <b>4.89</b> | <b>6.59</b> |

**Table 4.3 Performance of different varieties of okra with respect to colour and chemical parameters**

| Treatment       | Varieties           | Fruit colour |             |             | Acidity (%) |             |             | TSS (B <sup>0</sup> ) |             |             |
|-----------------|---------------------|--------------|-------------|-------------|-------------|-------------|-------------|-----------------------|-------------|-------------|
|                 |                     | 2022         | 2023        | Pooled      | 2022        | 2023        | Pooled      | 2022                  | 2023        | Pooled      |
| T <sub>1</sub>  | Parbhani Kranti     | Dark green   | Dark green  | Dark green  | 0.35        | 0.36        | 0.36        | 2.52                  | 2.67        | 2.60        |
| T <sub>2</sub>  | Parbhani Bhindi     | Dark green   | Dark green  | Dark green  | 0.36        | 0.37        | 0.37        | 2.67                  | 2.82        | 2.75        |
| T <sub>3</sub>  | Arka Anamika        | Dark green   | Dark green  | Dark green  | 0.22        | 0.23        | 0.23        | 2.78                  | 2.93        | 2.86        |
| T <sub>4</sub>  | Shahiba             | Dark green   | Dark green  | Dark green  | 0.28        | 0.29        | 0.29        | 1.92                  | 2.07        | 2.00        |
| T <sub>5</sub>  | Shan                | Light green  | Light green | Light green | 0.23        | 0.24        | 0.24        | 1.70                  | 1.85        | 1.78        |
| T <sub>6</sub>  | No. 55              | Light green  | Light green | Light green | 0.37        | 0.38        | 0.38        | 1.57                  | 1.72        | 1.65        |
| T <sub>7</sub>  | Harita              | Light green  | Light green | Light green | 0.25        | 0.26        | 0.26        | 1.82                  | 1.97        | 1.90        |
| T <sub>8</sub>  | Jhilmil             | Dark green   | Dark green  | Dark green  | 0.33        | 0.34        | 0.34        | 2.32                  | 2.47        | 2.40        |
| T <sub>9</sub>  | No. 64              | Dark green   | Dark green  | Dark green  | 0.43        | 0.44        | 0.44        | 1.52                  | 1.67        | 1.60        |
| T <sub>10</sub> | Sonal               | Dark green   | Dark green  | Dark green  | 0.34        | 0.35        | 0.35        | 2.43                  | 2.58        | 2.51        |
| T <sub>11</sub> | Shakti              | Dark green   | Dark green  | Dark green  | 0.32        | 0.33        | 0.33        | 1.97                  | 2.12        | 2.05        |
| T <sub>12</sub> | Punjab Selection    | Dark green   | Dark green  | Dark green  | 0.21        | 0.22        | 0.22        | 3.10                  | 3.25        | 3.18        |
|                 | <b>SEm±</b>         | -            | -           | -           | <b>0.04</b> | <b>0.03</b> | <b>0.01</b> | <b>0.22</b>           | <b>0.16</b> | <b>0.24</b> |
|                 | <b>C.D.(p=0.05)</b> | -            | -           | -           | <b>0.11</b> | <b>0.10</b> | <b>0.04</b> | <b>0.65</b>           | <b>0.48</b> | <b>0.72</b> |

**Table 4.4 Performance of different varieties of okra with respect to chemical parameters**

| Treatment       | Varieties           | Ascorbic Acid (mg/100g) |             |             | Mucilage (%) |             |             |
|-----------------|---------------------|-------------------------|-------------|-------------|--------------|-------------|-------------|
|                 |                     | 2022                    | 2023        | Pooled      | 2022         | 2023        | Pooled      |
| T <sub>1</sub>  | Parbhani Kranti     | 17.47                   | 17.77       | 17.62       | 0.77         | 0.88        | 0.83        |
| T <sub>2</sub>  | Parbhani Bhindi     | 17.82                   | 18.12       | 17.97       | 0.78         | 0.89        | 0.84        |
| T <sub>3</sub>  | Arka Anamika        | 18.22                   | 18.52       | 18.37       | 0.79         | 0.90        | 0.85        |
| T <sub>4</sub>  | Shahiba             | 15.62                   | 15.92       | 15.77       | 0.70         | 0.81        | 0.76        |
| T <sub>5</sub>  | Shan                | 15.07                   | 15.37       | 15.22       | 0.65         | 0.76        | 0.71        |
| T <sub>6</sub>  | No. 55              | 16.82                   | 17.12       | 16.97       | 0.64         | 0.75        | 0.70        |
| T <sub>7</sub>  | Harita              | 15.37                   | 15.67       | 15.52       | 0.75         | 0.86        | 0.81        |
| T <sub>8</sub>  | Jhilmil             | 14.37                   | 14.67       | 14.52       | 0.63         | 0.74        | 0.69        |
| T <sub>9</sub>  | No. 64              | 14.67                   | 14.97       | 14.82       | 0.67         | 0.78        | 0.73        |
| T <sub>10</sub> | Sonal               | 17.12                   | 17.42       | 17.27       | 0.76         | 0.87        | 0.82        |
| T <sub>11</sub> | Shakti              | 15.92                   | 16.22       | 16.07       | 0.74         | 0.85        | 0.80        |
| T <sub>12</sub> | Punjab Selection    | 19.42                   | 19.72       | 19.57       | 0.85         | 0.96        | 0.91        |
|                 | <b>SEm±</b>         | <b>0.50</b>             | <b>0.80</b> | <b>0.44</b> | <b>0.02</b>  | <b>0.04</b> | <b>0.02</b> |
|                 | <b>C.D.(p=0.05)</b> | <b>1.46</b>             | <b>2.33</b> | <b>1.31</b> | <b>0.06</b>  | <b>0.12</b> | <b>0.08</b> |

**Table 4.5 Economics of different varieties for okra (2022).**

| <b>Treatments<br/>ymbol</b> | <b>Treatments</b> | <b>Fruityie<br/>ld<br/>(q/ha)</b> | <b>Cost of<br/>Cultivation(Rs/<br/>ha)</b> | <b>GrossRetu<br/>rns<br/>(Rs/ha)</b> | <b>NetRetur<br/>ns<br/>(Rs/ha)</b> | <b>B:C<br/>ratio</b> |
|-----------------------------|-------------------|-----------------------------------|--------------------------------------------|--------------------------------------|------------------------------------|----------------------|
| <b>T<sub>1</sub></b>        | Parbhani Kranti   | 104.15                            | 61800                                      | 260375                               | 198575                             | 4.21                 |
| <b>T<sub>2</sub></b>        | Parbhani Bhindi   | 103.59                            | 61800                                      | 258975                               | 197175                             | 4.19                 |
| <b>T<sub>3</sub></b>        | Arka Anamika      | 110.81                            | 61800                                      | 277025                               | 215225                             | 4.48                 |
| <b>T<sub>4</sub></b>        | Shahiba           | 108.04                            | 61800                                      | 270100                               | 208300                             | 4.37                 |
| <b>T<sub>5</sub></b>        | Shan              | 105.70                            | 61800                                      | 264250                               | 202450                             | 4.28                 |
| <b>T<sub>6</sub></b>        | No. 55            | 104.48                            | 61800                                      | 261200                               | 199400                             | 4.23                 |
| <b>T<sub>7</sub></b>        | Harita            | 111.04                            | 61800                                      | 277600                               | 215800                             | 4.49                 |
| <b>T<sub>8</sub></b>        | Jhilmil           | 110.26                            | 61800                                      | 275650                               | 213850                             | 4.46                 |
| <b>T<sub>9</sub></b>        | No. 64            | 112.48                            | 61800                                      | 281200                               | 219400                             | 4.55                 |
| <b>T<sub>10</sub></b>       | Sonal             | 121.37                            | 61800                                      | 303425                               | 241625                             | 4.91                 |
| <b>T<sub>11</sub></b>       | Shakti            | 113.70                            | 61800                                      | 284250                               | 222450                             | 4.60                 |
| <b>T<sub>12</sub></b>       | Punjab Selection  | 124.15                            | 61800                                      | 310375                               | 248575                             | 5.02                 |

**Table 4.6 Economics of different varieties for okra (2023).**

| <b>Treatments<br/>ymbol</b> | <b>Treatments</b> | <b>Fruityie<br/>ld<br/>(q/ha)</b> | <b>Cost of<br/>Cultivation(<br/>Rs/ha)</b> | <b>GrossReturn<br/>s<br/>(Rs/ha)</b> | <b>NetRetur<br/>ns<br/>(Rs/ha)</b> | <b>B:C<br/>ratio</b> |
|-----------------------------|-------------------|-----------------------------------|--------------------------------------------|--------------------------------------|------------------------------------|----------------------|
| <b>T<sub>1</sub></b>        | Parbhani Kranti   | 104.45                            | 61800                                      | 261125                               | 199325                             | 4.23                 |
| <b>T<sub>2</sub></b>        | Parbhani Bhindi   | 103.89                            | 61800                                      | 259725                               | 197925                             | 4.20                 |
| <b>T<sub>3</sub></b>        | Arka Anamika      | 111.11                            | 61800                                      | 277775                               | 215975                             | 4.49                 |
| <b>T<sub>4</sub></b>        | Shahiba           | 108.34                            | 61800                                      | 270850                               | 209050                             | 4.38                 |
| <b>T<sub>5</sub></b>        | Shan              | 106.00                            | 61800                                      | 265000                               | 203200                             | 4.29                 |
| <b>T<sub>6</sub></b>        | No. 55            | 104.78                            | 61800                                      | 261950                               | 200150                             | 4.24                 |
| <b>T<sub>7</sub></b>        | Harita            | 111.34                            | 61800                                      | 278350                               | 216550                             | 4.50                 |
| <b>T<sub>8</sub></b>        | Jhilmil           | 110.56                            | 61800                                      | 276400                               | 214600                             | 4.47                 |
| <b>T<sub>9</sub></b>        | No. 64            | 112.78                            | 61800                                      | 281950                               | 220150                             | 4.56                 |
| <b>T<sub>10</sub></b>       | Sonal             | 121.67                            | 61800                                      | 304175                               | 242375                             | 4.92                 |
| <b>T<sub>11</sub></b>       | Shakti            | 114.00                            | 61800                                      | 285000                               | 223200                             | 4.61                 |
| <b>T<sub>12</sub></b>       | Punjab Selection  | 124.45                            | 61800                                      | 311125                               | 249325                             | 5.05                 |