ISSN 0258-7122 (Print), 2408-8293 (Online)
Bangladesh J. Agril. Res. 46(1): 13-22, March 2021

# PERFORMANCE OF MANGO GERPLASM IN PATUAKHALI CONDITION

M. M. R. TALUKDER[1], E. MAHMUD[2], M. R. KARIM[3]
N. AKHTAR[4] AND M. N. ISLAM[5]

## Abstract

A study was conducted for four consecutive years from 2014 to 2917 at the Regional Horticultural Research Station (RHRS), Bangladesh Agricultural Research Institute (BARI), Lebukhali, Patuakhali. Six mango varieties, viz. BARI Aam-1, BARI Aam-2, BARI Aam-3, BARI Aam-4, BARI Aam-5, BARI Aam-8 developed by BARI and six popular cultivars Khirshapat, Langra, Mallika, Gopalbhog, Fazli and Pahutan were evaluation for their performance. The germplasm were planted in 2010. All the cultivars bloomed in 1st to 3rd week of February. Harvesting time ranged from 2nd week of May to 1st week of July and Gopalbhog and BARI Aam-4 were earlier while Fazli was late season cultivar. In the last year of study (2017), maximum number of fruits per plant was recorded 259 in BARI Aam-3 and minimum 11 in BARI Aam-1. Individual maximum fruit weight was 663.09g in BARI Aam-4 in 2016. Average, individual fruit weight ranged from 553.92 to 183.13g where Fazli was the maximum followed by 465.94g in BARI Aam-4. Minimum individual fruit weight was measured in BARI Aam-3. Total Soluble Solids percent (TSS%) ranged from 16.83 to 21 66% and BARI Aam-3 was maximum and BARI Aam-2 was minimum. Number of fruits per plant, individual fruit and sweetness (TSS%) of variety/and cultivar fluctuated in different year although the trend of results in the succeeding years was consistent.

Keywords: Mango variety, cultivar, growth behavior, fruiting, flowering.

## Introduction

Mango production in Bangladesh is increasing day by day. According to Bangladesh Bureau of Statistics (BBS), the country has produced 1.2 million tons of mango from 95.16 thousand hectares of land in 2019-2020 (BBS, 2021). Good quality elite mangoes are produced in the north and north-western parts of Bangladesh. Mangoes grown in other parts of the country are mostly anonymous, propagated by seeds and quality is not as expected. Prevailing low temperature at flowering and fruit setting and warm to hot during fruiting favor the production of good quality mango in northern Bangladesh (Biswas et al., 2021). However, climate related changes has made mango cultivation possible

[1]Principal Scientific Officer, Regional Agricultural Research Station, Bangladesh Agricultural Research Institute (BARI), [2,3&4]Scientific Officer, RHRS, BARI, Lebukhali, Patuakhali. [5]Director General, BARI, Gazipur, Bangladesh.

in new areas of the country and the hilly areas in the south-east has become the new hot-spot for mango cultivation. In addition, existing varietal differences for their performances in wet and dry conditions will offer opportunities of expansion mango cultivation in more areas of Bangladesh particularly in the southern part (Rajan, 2016). This area consists of about 20 million hectares of arable lands of the country, enjoys a subtropical climate with high temperature, high humidity and heavy rainfall with occasionally gusty winds in April-September and less rainfall associated with moderately low temperature during October-March. Capacity to survive seasonal crops in this areas is largely irrelevant due to excessive soil salinity, inadequate irrigation facilities in dry season. Productivity of this area may be increased by introducing annual fruits in the production system. Mango might be one of the leading species for this region because of its wider climatic adaptation capability. Considering the aforesaid facts, the experiment was under taken with a view to evaluating the performance of elite mango cultivars and BARI developed varieties in southern region of Bangladesh.

**Materials and methods**

The study field was conducted at the Regional Horticultural Research Station (RHRS), Bangladesh Agricultural Research Institute (BARI), Lebukhali, Patuakhali Lebukhali, Patuakhali during 2014-2017. Geographical notation of the station is 22° 35" N latitude to 90° 31" E (Fig.1). The experiment was laid out in a randomized complete block design (RCBD) with three replications. Each plant was considered as a replication. Six BARI developed varieties BARI Aam-1, BARI Aam-2, BARI Aam-3, BARI Aam-4, BARI Aam-5, BARI Aam-8 and six commercial and exotic elite cultivars Pahutan, Khirshapat, Langra, Gopalbhog, Mollika and Fazli were included in this study. The saplings were planted on October, 2010 with a spacing of 8 m x 8 m. Regular training and pruning were done to provide good shape to the plants. Flowers were removed unto first three years to obtain a good plant vigor. Irrigation, fertilization and other intercultural operations were done as per recommended schedule by Chowdhury and Hossain (2013). Girth of the trunk was measured at a height of 15 cm from the ground level and canopy area was calculated following formula by Shaw (2005), such as $K = \pi ab$, where: K is projected crown area, a and b are the major and minor radius of the ellipse. Data on plant height, flowering and harvesting time, fruit weight, number of fruits per tree and TSS content were also recorded.


**Fig. 1. Map of Patuakhali District**

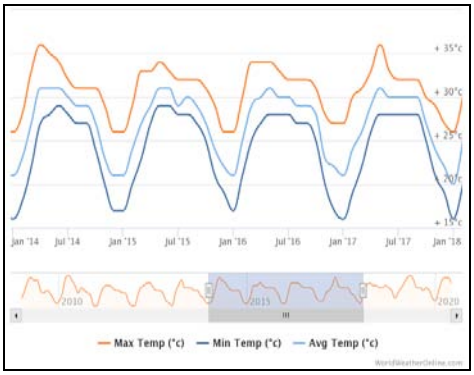


**Fig. 2. Minimum and maximum temperature of Patuakhali during the study period**

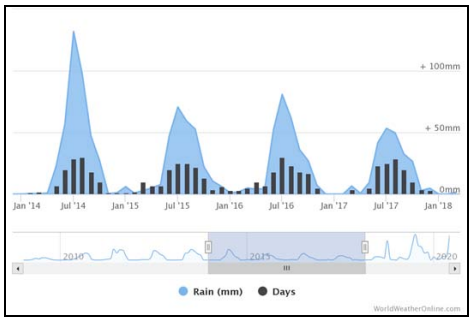


**Fig. 3. Average rainfall in number of rainy days of Patuakhali during the study period**

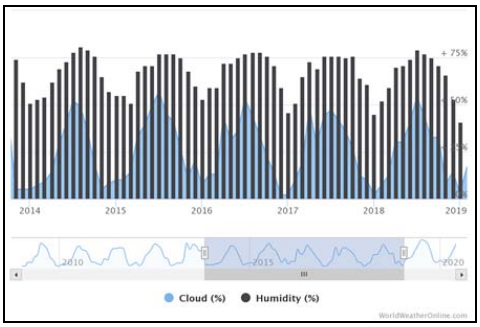


**Fig. 4. Cloud and relative humidity (RH) of Patuakhali during the study period**

Sources: [a] Google Map, [b] www.worldweatheronline.com

## Results and Discussion

### *Physiography of the study location*

Patuakhali is an administrative district in south-central part of Bangladesh, which is located at 22° 35" N latitude to 90° 31" E longitude with an altitude of 1.5 meter (Figure 1)**.** The area falls under AEZ 13 which belongs to the Ganges tidal floodplain. Patuakhali enjoys a subtropical climate with high temperature, high humidity and heavy rainfall with occasionally gusty winds in April-September and less rainfall associated with moderately low temperature during October-March. The temperature, rainfall and relative humidity data during the study period are presented in figure 2-4. The whole area lies within the cyclone affected region and affected with tidal surge and medium to high salinity. Non-calcareous Grey Floodplain soil is the major component of general soil types (Ahmed and Hussain, 2009; BBS, 2021).

### *Flowering and harvesting time*

A four year study revealed that flowering of genotypes under study occurred during 1st to 3rd weeks of February where BARI Aam-1 was consistently earlier. BARI Aam-4, BARI Aam-5, BARI Aam-8 and Pahutan flowered lately. Harvesting of fruits study started from 2nd week of May to 1st week of July and Gopalbhog was the earliest in all through the study years. In the 1st year of study it was observed that BARI Aam-1, Gopalbhog and Khirshapat were harvested in 1st week of June (earlier) while Fazli and Pahutan started harvesting in 1st week of July (Table 1). Although flowering and harvesting times of a particular variety found different from different years, the time intervals between different varieties were continued in every cropping season. Variation in air temperature, rainfall, number of rainy days, soil moisture might influence these sequences of phonological changes and harvesting period (Fig. 1-4). Rajan (2012) in a study of phonological response of mango to environmental changes similarly observed early or delay flowering in mango. Barua et al. (2013), Bally (2006) and Makhmale et al., (2016) also reported weather factors infuencing flowering and harvesting of mango.

### *Tree growth characteristics*

Considering the plant height, trunk height, base girth and canopy area a rapid growth rhytm was observed among the genotypes. Tree stature of BARI Aam-8 was found bushy while BARI Aam-1, Mallika, Langra and BARI Aam-3 found taller (Table 2). However, oberved variations between the genotypes on tree stature and vegetative growth might be genetically determined (Rajan, 2012).

### *Fruit number, individual fruit weight and percent total soluble solids (TSS%) of pulp*

BARI Aam-3 and BARI-Aam- 8 in the 1st year of study produced the highest number of fruits per plant. The lowest number of fruits per plant was recorded in BARI Aam-1 followed by Fazli, Gopalbhog and Khirshapat. No fruit was harvested in variety Mollica in the first year of study. It was observed that the number of fruits of the genotypes increased with increased of age of plant and the trend of fruit set between the genotypes was consistent in the succeeding years (Table 3).

Individual fruit weight ranged from 167g in BARI Aam-8 in 2014 to 663.09g in BARI Aam-4 in 2016. In an average, fruit weight 553.92g was measured maximum in Fazli followed by 465.94g in BARI Aam-4. Fruit weight 1883.13g in BARI Aam-3 was minimum (Table 3). It is to be noted that the weight of fruits of a particular variety/cultivar differed in different growing seasons. This variation might associated with climatic factors (Rajan et al., 2012). Normand et al., (2015) also explained that fruit size, shape, color and other qualitative traits are genetically controlled and which might be fluctuated by variability of growing environment.

**Table 1. Flowering time and harvesting time of different mango cultivars/ varieties.**

| Variety | Flowering time | | | | Harvesting time | | | |
|---|---|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2017 | 2014 | 2015 | 2016 | 2017 |
| BARI Aam-1 | 1st week of February | 1st week of February | 1st week of February | 1st week of February | 1st week of June | 1st week of June | 3rd week of May | 1st week of June |
| BARI Aam-2 | 2nd week of February | 2nd week of February | 2nd week of February | 2nd week of February | 2nd week of June | 2nd week of June | 4th week of May | 1st week of June |
| BARI Aam-3 | 2nd week of February | 2nd week of February | 2nd week of February | 3nd week of February | 3rd week of June | 3rd week of June | 1st week of June | 3rd week of June |
| BARI Aam-4 | 3nd week of February | 3nd week of February | 3nd week of February | 3nd week of February | 4th week of June | 4th week of June | 3rd week of June | 1st week of July |
| BARI Aam-5 | 3nd week of February | 3nd week of February | 3nd week of February | 3nd week of February | 1st week of June | 1st week of June | 4th week of May | 4th week of May |
| BARI Aam-8 | 3nd week of February | 3nd week of February | 3nd week of February | 3nd week of February | 4th week of June | 4th week of June | 2nd week of June | 3nd week of June |
| Gopalbhog | 1nd week of February | 2nd week of February | 2nd week of February | 2nd week of February | 1st week of June | 1st week of June | 2nd week of May | 3rd week of May |
| Pahutan | 3nd week of February | 2nd week of February | 2nd week of February | 2nd week of February | 1st week of July | 1st week of July | 4th week of June | 4th week of June |
| Mallika | 2nd week of February | 2nd week of February | 1st week of February | 2nd week of February | 4rd week of June | 4rd week of June | 3nd week of June | 3nd week of June |
| Langra | 2nd week of February | 2nd week of February | 2nd week of February | 2nd week of February | 3rd week of June | 3rd week of June | 2nd week of June | 2nd week of June |
| Fazli | 2nd week of February | 2nd week of February | 2nd week of February | 2nd week of February | 1st week of July | 1st week of July | 1st week of July | 1st week of July |
| Khirshapat | 2nd week of February | 1st week of February | 2nd week of February | 2nd week of February | 1st week of June | 1st week of June | 3nd week of May | 4th week of May |

**Table 2. Tree growth characteristics of different mango cultivars/ varieties.**

| Variety | Plant Height (cm) | | | | Trunk height (cm) | | | | Base girth (cm) | | | | Canopy area ($m^2$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2017 | 2014 | 2015 | 2016 | 2017 | 2014 | 2015 | 2016 | 2017 | 2014 | 2015 | 2016 | 2017 |
| BARI Aam-1 | 283.30 | 346.67a-c | 403.67b | 491.00a | 54.67de | 73.70d-f | 79.67de | 82.00c | 22.00d | 31.33de | 37.67f | 40.67cd | 3.51c | 6.71de | 10.37de | 11.45ef |
| BARI Aam-2 | 275.00 | 316.00cd | 410.67b | 449.67a-d | 45.67ef | 53.30g | 70.33e | 71.00de | 24.33d | 36.00cd | 44.67de | 46.00bc | 4.44b | 8.35c | 10.50c-e | 12.31e |
| BARI Aam-3 | 266.70 | 346.67a-c | 468.33a | 470.67a-c | 62.67cd | 79.70de | 100.67b | 103.00b | 22.33d | 33.33de | 57.67ab | 63.33a | 4.69b | 11.24b | 18.78a | 20.37b |
| BARI Aam-4 | 193.30 | 268.67ef | 316.33c | 352.67e | 71.00bc | 82.30de | 76.67e | 82.67c | 21.67d | 29.33e | 34.00f | 44.00bc | 2.76d | 5.88ef | 9.20ef | 11.17ef |
| BARI Aam-5 | 273.00 | 366.67ab | 429.33ab | 433.00b-d | 89.00a | 107.00a | 125.00a | 162.67a | 22.00d | 29.66e | 38.00ef | 44.33bc | 2.82d | 4.33g | 13.50b | 17.74c |
| BARI Aam-8 | 286.70 | 318.33cd | 405.00b | 481.67ab | 73.33b | 85.30b-d | 87.33cd | 94.33b | 30.00c | 39.33c | 54.67a-c | 59.33a | 6.92a | 11.44b | 16.99a | 23.75a |
| Gopalbhog | 226.00 | 336.67bc | 310.00c | 341.33e | 43.33f | 94.70b | 70.33e | 79.67cd | 34.67bc | 39.00c | 49.67cd | 50.67b | 2.83d | 6.42e | 9.96ce | 10.96ef |
| Pahutan | 231.70 | 253.33f | 398.33b | 427.33cd | 42.33f | 70.70ef | 52.00f | 69.00e | 23.67d | 31.66de | 41.33ef | 44.00bc | 3.17c | 5.58ef | 11.96b-d | 15.44d |
| Mallika | 225.00 | 250.00f | 453.67a | 474.33a-c | 38.00fg | 84.50cd | 51.00f | 57.00f | 22.43d | 28.00e | 34.00f | 36.67d | 2.99cd | 5.00fg | 17.32a | 18.87bc |
| Langra | 312.00 | 340.00bc | 401.67b | 461.33a-d | 85.00a | 97.30ab | 94.33bc | 98.33b | 41.67a | 45.66a | 57.00ab | 61.33a | 4.88b | 11.14b | 18.80a | 19.67b |
| Fazli | 292.50 | 376.67a | 392.00b | 419.67d | 31.33g | 65.50f | 56.00f | 64.67ef | 39.50ab | 50.33a | 61.33a | 63.00a | 4.43b | 12.67a | 12.31bc | 14.38d |
| Khirshapat | 264.70 | 293.33de | 323.33c | 345.33e | 69.33bc | 78.30d | 91.00bc | 94.00b | 30.00c | 33.33de | 44.67de | 46.67bc | 3.55c | 7.83cd | 7.85f | 9.67f |
| Level of Sig. | ns | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| CV (%) | 17.53 | 14.92 | 11.40 | 11.95 | 15.78 | 14.42 | 11. 28 | 11.04 | 17.49 | 14.30 | 14.09 | 12.80 | o.64 | 1.16 | 1.85 | 1.81 |

**Table 3. Fruit number, fruit weight and TSS of different mango cultivars/ varieties.**

| Variety | Fruit Number plant$^{-1}$ | | | | | Average Fruit Weight (g) | | | | | TSS (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2017 | Average | 2014 | 2015 | 2016 | 2017 | Average | 2014 | 2015 | 2016 | 2017 | Average |
| BARI Aam-1 | 5.00g | 5.66f | 19.33f | 10.67f | 10.17 | 208.50ef | 220.00ef | 145.83h | 285.67cd | 215.00 | 18.50c-e | 18.00cd | - | 16.33b | 17.61 |
| BARI Aam-2 | 29.67e | 48.66c | 99.67c | 48.33e | 56.58 | 245.00cd | 244.00e | 233.34ef | 204.00e | 231.59 | 17.25de | 17.00d | - | 16.25b | 16.83 |
| BARI Aam-3 | 58.33a | 186.67a | 394.67a | 395.00a | 258.67 | 174.00gh | 183.00g | 186.50g | 189.00e | 183.13 | 22.33a | 23.33a | - | 19.33a | 21.66 |
| BARI Aam-4 | 36.33d | 49.00c | 79.00d | 102.00c | 66.58 | 264.00bc | 409.00b | 663.09a | 527.67a | 465.94 | 20.65ab | 21.50ab | - | 18.65a | 20.27 |
| BARI Aam-5 | 45.85c | 12.00e | 13.33g | 39.67e | 27.71 | 193.00fg | 184.00g | 198.00fg | 312.67c | 221.92 | 19.30bc | 18.25cd | - | 18.25ab | 18.60 |
| BARI Aam-8 | 53.00ab | 96.66b | 193.00b | 196.00b | 134.67 | 167.00h | 208.00fg | 180.55g | 260.00d | 203.89 | 20.00bc | 20.00bc | - | 18.00ab | 19.33 |
| Gopalbhog | 23.00ef | 12.00e | 42.33e | 93.67c | 42.75 | 232.00de | 244.00e | 174.39gh | 252.00d | 225.60 | 16.72e | 16.72d | - | 18.76a | 17.40 |
| Pahutan | 33.67de | 48.33c | 46.67e | 76.67d | 51.34 | 259.90bc | 340.20c | 355.00c | 389.67b | 336.19 | 19.15b-d | 19.15c | - | 17.72ab | 18.67 |
| Mallika | 0.00h | 0.00g | 26.67f | 66.67d | 23.34 | - | - | 294.00d | 393.67b | 343.84 | - | - | - | 18.68a | 18.86 |
| Langra | 46.00bc | 10.00e | 6.00g | 74.67d | 34.17 | 275.00b | 283.00d | 287.56d | 289.00cd | 283.64 | 21.43a | 21.50ab | - | 19.68a | 20.87 |
| Fazli | 19.50f | 10.00e | 16.00fg | 19.33f | 16.21 | 650.00a | 554.00a | 523.00b | 488.67a | 553.92 | 18.76b-e | 18.00cd | - | 17.68ab | 18.15 |
| Khirshapat | 23.67ef | 22.00d | 47.00e | 86.67c | 44.84 | 198.00fg | 337.00c | 239.15e | 274.33cd | 262.12 | 18.68c-e | 18.28cd | - | 19.15a | 18.70 |
| Level of Sig. | ** | ** | ** | ** | - | ** | ** | ** | ** | - | ** | ** | - | ** | - |
| CV (%) | 20.07 | 16.05 | 13.11 | 15.47 | - | 10.07 | 11.05 | 13.11 | 12.70 | - | 10.07 | 11.05 | - | 14.47 | - |

**Table 4. Yield data of different mango cultivars/ varieties**

| Variety | Fruit Yield per Plant (kgPlant$^{-1}$) | | | | | Fruit Yield per Unit Canopy Area (kg m$^2$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2017 | Average | 2014 | 2015 | 2016 | 2017 | Average |
| BARI Aam-1 | 1.04 c | 1.25 d | 2.82 fg | 2.99 d | 2.02 | 0.30i | 0.19j | 0.27g | 0.26h | 0.25 |
| BARI Aam-2 | 7.27 bc | 11.71 c | 23.26 d | 9.74 d | 12.99 | 1.64f | 1.40d | 2.21c | 0.79gh | 1.51 |
| BARI Aam-3 | 10.18 ab | 34.22 a | 63.61 a | 74.57 a | 45.64 | 2.17e | 3.04b | 3.39b | 3.66b | 3.06 |
| BARI Aam-4 | 9.59 ab | 20.00 b | 52.38 b | 53.77ab | 33.93 | 3.47b | 3.40a | 5.69a | 4.81a | 4.34 |
| BARI Aam-5 | 8.85 ab | 2.21 d | 2.64 fg | 11.20 d | 6.22 | 3.13c | 0.51f | 0.20g | 0.63gh | 1.12 |
| BARI Aam-8 | 8.75 ab | 20.11 b | 34.85 c | 50.64a-c | 28.59 | 1.26g | 1.76c | 2.05c | 2.13cd | 1.80 |
| Gopalbhog | 12.65 a | 2.93 d | 7.38 f | 23.58 cd | 11.63 | 4.46a | 0.46f | 1.66d | 2.72c | 2.33 |
| Pahutan | 8.75 ab | 16.32 bc | 16.57 de | 29.87b-d | 17.88 | 2.76d | 2.92b | 0.94e | 1.54ef | 2.04 |
| Mallika | 0.0 d | 0.0 e | 7.84 f | 26.08b-d | 8.48 | 0.00j | 0.00k | 0.48f | 0.51h | 0.25 |
| Langra | 12.68 a | 2.83 d | 1.73 g | 21.83 cd | 9.77 | 2.60d | 0.25fj | 0.09g | 1.11fg | 1.01 |
| Fazli | 4.69 c | 5.54 d | 8.37 f | 9.61 d | 7.05 | 1.06h | 0.44f | 0.60f | 1.64de | 0.93 |
| Khirshapat | 5.34 bc | 7.41 d | 11.24 ef | 23.85 cd | 11.96 | 1.50f | 0.95e | 1.00e | 2.70c | 1.54 |
| Level of Sig. | ** | ** | ** | ** | - | ** | ** | ** | ** | - |
| CV (%) | 10.07 | 11.05 | 13.11 | 34.47 | - | 10.07 | 11.05 | 13.11 | 34.47 | - |

Percent of total soluble solid (TSS%) is the measure of the sweetness of fruits. TSS% of fruits of genotypes ranged from 16.72 to 23.33% during the study period. Minimum TSS% was recorded in Gopalbhog while it was maximum in BARI Aam-3 in harvesting season of 2015. Like fruit weight, it and was also observed that TSS% of individual variety fluctuated in different years (Table 3). Barua (2013) and Kobra et al., (2013) similarly reported fluctuation in fruit weight, fruit size and TSS% of same variety in different locations and different years. This variation might be correlated to environmental variables which are either spatial or temporal issues (Normand et al., 2015). However, overall performance of the genotypes in southern region was not found as per expectation (Sarkar et al., 2021). Similar findings were obtained from the reports of Barua (2013) and Kobra et al., (2013).

### *Fruit yield per plant and per unit canopy Area*

At the onset of the study fruit yield per plant was measured maximum in Langra which was similar to Gopalbhog. Statistically similar yields were also measured in BARI-Aam-3, BARI Aam-5, BARI-Aam-8, BARI Aam-4 and Pahutan. Yield of fruit of individual plant was found to increase in the succeeding cropping seasons. Consistently higher yield per plant was recorded in BARIAam-3 and BARI Aam-4. Regarding fruit yield per unit area, BARI Aam-4 and BARI Aam-3 also performed better than other genotypes (Table 4). Like number of fruits, per plant yield was also fluctuated in different years due to prevailing growing environmental factors.

## Conclusion

It is not possible to draw a conclusion on the basis of the findings of current study. Performance of the genotypes should be further evaluated considering regional and seasonal variability as well as soil and water salinity. However, BARI Aam-3, BARI Aam-4 and BARI Aam-8 may be considered capable to cope with the stress environment of the southern region on the basis of yield potentials and quality attributes.

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