

## PERFORMANCE ASSESSMENT OF COMMERCIAL CULTIVARS IN WETLAND PRODUCTION SYSTEM

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### ABSTRACT

Under polyclonal system of cultivation, different cultivars are adopted to environmental conditions, resource availability, production system and also for extended harvesting. Present studies was undertaken to evaluate 8 commercial cultivars, belonging to different genomic groups for growth, yield and quality as well as its reaction to diseases and salt tolerance so that cost-effectiveness of cultivars under wetland production system of banana can be analysed. From the evaluation of the data for growth, yield and quality parameters, it was evident that Nendran has the shortest crop cycle, while Karpuravalli requires longer crop cycle. No leaf spot diseases was observed in Karpuravalli, while Robusta has high incidence. Incidence of wilt was noted in Rasthali and to little extent on Karpuravalli. Rasthali also showed high susceptibility to salinity. At the same level of soil pH and conductivity, Monthan produced high bunch mass. It was inferred that Nendran, Rasthali and Robusta require high inputs, while Monthan and Karpuravalli can be grown under low input conditions. Growing Karpuravalli and Monthan under the marginal condition was cost-effective. The paper discusses the factors associated with differential behaviour of the cultivars.

### INTRODUCTION

Banana is grown in India in 443,000 ha, contributing 13.2 million tonnes of production. Except in northern states of India, banana is grown in all Indian states, of which Tamil Nadu has the largest area of 59,000 ha under banana production (Singh and Uma, 1996). It is a crop of humid tropics but well suited for cultivation from humid subtropics to semi-arid subtropics and from sea level up to an elevation of 2,000 m above sea-level. Banana responds very well to temperature and has active growth phase when the minimum temperature does not fall below 23°C and maximum does not exceed 36°C. With low temperature it expresses, 'choke throat' and 'November dump' problems. Flower differentiation coinciding with low temperatures leads to suppression of morphogenesis by a few months. At the same time 'Phyllochron' period between the emergence of two consecutive leaves is prolonged at sub-optimal temperature, resulting in extended crop cycle. High temperature and high humidity play a vital role in disease development (Robinson, 1996). Fungal diseases, especially yellow sigatoka (*Cercospora musae*) becomes predominant during rainy season when relative humidity build-up is up to 90%. This becomes the major constraint in the production of Cavendish, plantain and other susceptible commercial cultivars. Though banana comes up well in a wide range of soil conditions, drainage and depth are the major limiting factors. Soil pH of 6.5 - 7.0 is optimum for banana production. Though on slightly alkaline soils, banana can be successfully raised, but sodic soils are inhibitive (Lahav, 1995).

In Tamil Nadu, Trichy district accounts for 50% area under banana with 25,000 ha under intensive cultivation. Being Cauvery delta, it has clayey soils with poor drainage and pH ranging from 8.0 to 10.5. With these limiting factors banana is successfully grown with intensive cultivation under wetland system, where 2 feet deep horizontal and vertical trenches are made after every two or three rows, accommodating 4-6 plants in each level. General survey of Trichy district shows pH 7.0 - 10.5 and EC values 2.7 - 5.5 dS/m. Even under such adverse soil conditions banana is the major commercial crop of this district. The temperature varies from 20° - 28°C in winter up to 36 - 41°C in summer. Distribution of rainfall is restricted to only 3 months of the year: October, November and December. Relative humidity is as low as 52.5% in summer to 89.5% in winter. With these prevailing weather conditions, monoculture of banana has been practised with a record productivity of 35 tonnes/ha compared with 28.3 tonnes/ha of the state. Hence a trial was initiated to evaluate commercial clones of various genomes for growth, yield, quality and tolerance to biotic and abiotic factors to determine the cost effectiveness of cultivars under wetland production.

### MATERIALS AND METHODS

Eight commercial cultivars of different genomic groups were evaluated, viz. Robusta (AAA), Rasthali (AAB-silk), Poovan (AAB-Mysore), Plantain (AAB-Plantain), Pachanadan (AAB-Pome), Monthan (ABB-Monthan), Karpuravalli (ABB - Pisang Awak) and Sakkai (ABB-Bluggoe). Details of the varieties are mentioned here.

#### Robusta (AAA)

This is the leading variety of commerce. Plant comes to harvesting in 11-12 months of planting with 25-30 kg bunch. Fruits large with thick skin that develop an attractive colour when ripened at uniform low temperature. Flesh is creamy white, fine textured, melting, sweet and aromatic. Though Robusta is not affected by Fusarium wilt in India, it is highly susceptible to yellow sigatoka when grown in humid tropics. If this coincides with shooting, bunch becomes very poor and often gets choked.

#### Rasthali (AAB)

In India it is a very popular dessert cultivar of choice. Fruit is small to medium and turns golden yellow on ripening. Flesh is ivory white, powdery and has an excellent blend of sweet and sourness. Crop cycle is completed within 12-14 months depending on weather conditions. Plant is highly susceptible to Fusarium wilt and a physiological disorder, 'fruit cracking'. In the market, fruit fetches double the price of other varieties.

#### Nendran (AAB)

It is a food-fruit variety of Kerala state, eaten as dessert fruit and after cooking. Crop completes its life cycle in 11 months. Fruits are large, weighing 250-300 g, with comparatively less than other varieties but fetches high price in the market. Plant is susceptible to sigatoka leaf spot and Banana Bract Mosaic Virus (BBMV). Neer Vazhai is another malady reported from Trichy district of Tamil nadu.

#### Poovan (AAB)

It is the hardy variety well suited for marginal lands. Plant has a cropping cycle of 14-15



months, putting forth bunch weighing about 15-18 kg. Fruits are slightly sour upon ripening with golden yellow skin. Poovan is highly susceptible to Banana Streak Virus (BSV) and Banana Bract Mosaic Virus (BBMV) - Kotta Vazhai is another malady reported in the recent past. With these limitations it has advantages like immunity to Fusarium wilt, salt tolerance and negligible yield losses under low-input conditions.

#### Pachanadan (AAB)

It is a variety of Tamil Nadu belonging to Pome group. Crop life-cycle is completed in 12-13 months with an average bunch weight of 14-16 kg. Fruits are relished for their acidic apple taste and therapeutic uses. Fruit pulp is enclosed in a thick skin, turning yellowish green upon ripening. Though it does not suffer much from other diseases, occasional occurrence of Fusarium wilt is reported.

#### Karpuravalli (ABB)

It is a dual-purpose variety with slightly long duration of 14-15 months. Average bunch yield can go as high as 30-35 kg under optimal conditions. Fruits are very sweet, firm and have a long green and yellow life. It is immune to many of the biotic and abiotic factors but susceptible to Fusarium wilt.

#### Monthan (ABB)

It is a culinary variety under much demand. Plant yields in 11-12 months and average bunch weight is 14-17 kg. It is susceptible to Fusarium wilt and banana bract mosaic virus (BBMV), whose attack either fully or partially brings down the yields. It can grow very well in any kind of soil conditions.

Fifty plants of each variety were planted in RCBD. Yield and quality parameters were recorded at harvest, disease occurrence was recorded at fortnightly intervals and salt injury during summer months (April-August) at monthly intervals. Depending on the intensity of injury, a scale of 0-6 was used and varieties were visually evaluated on this scale.

### RESULTS AND DISCUSSION

Performance of different commercial cultivars under wetland production system for growth and yield is summarized in Table 1 and quality performance in Table 2.

Table 1. Plant growth parameters

| Cultivar     | Plant height (cm) | No. of leaves | Days to flowering | Days taken for bunch maturation | Yield/day |
|--------------|-------------------|---------------|-------------------|---------------------------------|-----------|
| Rasthali     | 236.91            | 5.08          | 392.53            | 118.4                           | 36.37     |
| Nendran      | 232.05            | 3.65          | 293.18            | 70.2                            | 35.97     |
| Robusta      | 214.04            | 3.65          | 306.92            | 79.4                            | 57.88     |
| Poovan       | 225.54            | 6.82          | 389.14            | 110.0                           | 39.72     |
| Monthan      | 330.28            | 7.30          | 343.33            | 98.5                            | 55.68     |
| Pachanadan   | 308.28            | 5.83          | 340.00            | 86.8                            | 40.90     |
| Karpuravalli | 419.45            | 8.33          | 426.72            | 124.7                           | 53.54     |
| CD (0.05)    | -                 | 1.78          | 66.32             | 124.7                           | -         |

Table 2. Yield and quality parameters

| Cultivar     | Bunch weight (kg) | No. of hands | Total no. of fingers | Weight of each finger (g) | TSS ("Brix) |
|--------------|-------------------|--------------|----------------------|---------------------------|-------------|
| Rasthali     | 14.26             | 5.85         | 78.34                | 152.33                    | 18.01       |
| Nendran      | 10.01             | 4.03         | 48.61                | 238.53                    | 20.72       |
| Robusta      | 18.08             | 10.63        | 152.12               | 170.09                    | 23.47       |
| Poovan       | 15.46             | 8.03         | 131.05               | 138.11                    | 20.18       |
| Monthan      | 16.12             | 5.08         | 50.01                | 246.58                    | 19.73       |
| Pachanadan   | 13.91             | 5.66         | 72.39                | 139.80                    | 20.14       |
| Karpuravalli | 20.99             | 13.42        | 176.33               | 150.03                    | 28.03       |
| CD (0.05)    | 3.15              | 3.72         | 22.52                | 49.3                      | 3.83        |

Biotic stresses like diseases, a major hurdle in banana cultivation, were recorded. Mainly two each fungal, viral and physiological disorders were noted on different test varieties. The disease details are summarized in Table 3.

Table 3. Disease incidence on commercial cultivars at harvesting

| Variety      | Fungal         |                              | Viral |       | Physiological disorders* |             | Salt injury rating (0-6) |
|--------------|----------------|------------------------------|-------|-------|--------------------------|-------------|--------------------------|
|              | Fusarium wilt* | Sigatoka* (infectious index) | BSV*  | BBMV* | Kotta vazhai             | Neer vazhai |                          |
| Rasthali     | 10.2           | 18.6                         | -     | -     | -                        | -           | 5.0                      |
| Nendran      | -              | 28.4                         | -     | 4.6   | -                        | 4.2         | 4.8                      |
| Robusta      | -              | 3.3                          | -     | 0.9   | -                        | -           | 2.6                      |
| Poovan       | -              | 23.8                         | 94.4  | 12.3  | 2.5                      | -           | 2.8                      |
| Monthan      | 0.3            | 8.2                          | -     | 0.4   | -                        | -           | 4.0                      |
| Pachanadan   | 0.6            | 9.3                          | -     | -     | -                        | -           | 2.9                      |
| Karpuravalli | 2.8            | 3.4                          | -     | -     | -                        | -           | 1.3                      |

\* Percentage of plants affected

Table 4. Yield Performance of commercial cultivars under wetland cultivation

| Variety      | Yield/day (g) | Returns/day (Rs) | Yield reduction | Cost (%) on plant protection |
|--------------|---------------|------------------|-----------------|------------------------------|
| Rasthali     | 36.3          | 254.1            | 22.3            | 0.9                          |
| Nendran      | 35.9          | 323.5            | 36.8            | 1.1                          |
| Robusta      | 57.8          | 346.0            | 37.2            | 1.6                          |
| Poovan       | 39.7          | 158.8            | 12.6            | 0.0                          |
| Monthan      | 55.6          | 222.4            | 9.3             | 0.0                          |
| Pachanadan   | 40.9          | 164.6            | 12.0            | 0.0                          |
| Karpuravalli | 53.5          | 214.0            | 8.5             | 0.0                          |

Performance of different cultivars under marginal input conditions in wetland cultivation was statistically significant with respect to days taken for flowering and yield parameters. Karpuravalli took maximum time for flowering (426.72 days) followed by Rasthali, Poovan and Pachanadan.



Under polyclonal system of cultivation in India, selection of a variety greatly depends on its suitability to prevailing climatic conditions and net returns. Hence yield potential plays a major role. In the present study though both Robusta (AAA) and Karpuravalli are high-yielding varieties, under marginal wetland conditions yield reduction was more in Robusta (37.2%) but only 8.5% in Karpuravalli. Rasthali and Nendran recorded a significant yield decrease of 22.3 % and 26.8%. Yield reduction of Poovan (12.6%) was on a par with that of Pachanadan (12.0%), whereas the reduction in Monthan was comparable with that in Karpuravalli. Yield reduction was manifested in terms of number of hands and weight of each finger in all the cases, but number of fingers/hand was not affected.

Among the biotic stresses, diseases, especially sigatoka and Fusarium wilt pose the major problem. Chemical control of these diseases is prohibitively expensive and adds substantially to the production cost (Rowe and Rosales, 1990). Farmers cultivating bananas on marginal lands are forced to go for varieties suiting such conditions with marginal yield reduction and still can fetch reasonable price in the market. In this study, Robusta showed the maximum infection index of 32.3 for sigatoka followed by Nendran (28.4) and Poovan (23.8). Pachanadan and Monthan showed incidence of 9.3 and 8.2, whereas Karpuravalli suffered the least (3.4). Similarly, with respect to occurrence of Fusarium wilt, Rasthali had maximum incidence (10.2%). Though Karpuravalli, Pachanadan and Monthan are susceptible to *Fusarium oxysporum* sp. *cubense* race 2, it is not as high as in Silk subgroup. Among viral diseases, banana streak virus (BSV) was serious and 94.4 % of Poovan showed the symptoms with varying degrees. Banana bract mosaic virus (BBMV), which has become serious in recent days, was found on Poovan (12.3%) and Nendran (4.6%). Kotta vazhai, a physiological disorder unique to Poovan with conspicuously enlarged ovules and immature dark green fruits, was found to affect 2.5% of its plants. Neer vazhai, another malady of unknown etiology of Nendran variety, showed poor plant growth, delayed shooting, lanky bunch with few hands, and immature unfilled fingers affecting 4.2% of its test plants.

Among the abiotic factors affecting banana production, salinity forms a major constraint. Though banana comes up well in a wide pH range, pH beyond 7.2 affects normal growth and production. Salt injury manifested in terms of leaf injury was scored on a scale ranging from 0 to 6.

The soil salinity ranged from 0.112 to 0.3999 dS/m and the sodicity ranged from 495 to 986 ppm. The salt injury levels varied from 9.95 to 61.51%. Rasthali was found to be highly susceptible with an injury score as high as 5.3, followed by Nendran with a score of 4.8. Monthan showed salt injury of scale 4.0. Least injury was observed on Karpuravalli (1.3).

Keeping in view the response of varieties under marginal wetland conditions to growth, yield, quality and reaction to biotic and abiotic factors, it is inferred that Nendran, Rasthali and Monthan require high inputs, without which they suffer from significant yield reduction. Though Karpuravalli and Poovan suffer from least yield reduction, Monthan produced normal biomass even with reduced photosynthetic area due to salt injury. Yield/day and returns/day are high in Robusta, Nendran and Rasthali due to per cent yield reduction under marginal wetland conditions due to biotic and abiotic factors. Karpuravalli, Monthan and Poovan proved to be the better substitutes.

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