

Yield performance of Arecanut (*Areca catechu* L.) varieties in maidan region of Karnataka

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(Manuscript Received : 23-11-2001; Revised : 18-01-2002; Accepted : 15-3-2002)

Abstract

A comparative yield trial involving five high yielding varieties of arecanut viz., Mangala, Sumangala, Sreemangala, Mohitnagar and Hirehalli local was carried out at Hirehalli for 13 years from 1988-2001 to identify a suitable variety for cultivation in the maidan region of Karnataka. The study conducted on growth parameters of arecanut varieties for 6 years revealed that Mangala exhibited semi-tall habit of growth with significantly lower height, smaller internode length and less number of nodes/palm and high percentage of flowering palms compared to other varieties, in the 4th year of planting. 'Hirehalli local' was vigorous with more number of nodes/palm with highest girth both at fixed mark and below crown. Individual year data from 1993-2001 as well as pooled analysis of yield data of 8 years has indicated that Mangala gave consistently higher yield, closely followed by Hirehalli Local. Mohitnagar and Sreemangala were moderate yielders while Sumangala recorded low yields compared to other high yielding varieties. Fruit component analysis of different varieties showed that Sreemangala had higher values for fruit length and circumference, fresh weight and kernel weight. The recovery of processed products namely 'Unde' and 'Podi' were high in Mangala and Hirehalli Local.

Key words: Arecanut, tendernut yield, comparative yield trial

Introduction

The Arecanut palm (*Areca catechu* L.) is one of the major cash crops cultivated on an area of 88,400 ha in Karnataka. The production under this crop is 1,28,300 tonnes (1997-98). The major arecanut growing districts in the state are Dakshina Kannada, Udupi, Tumkur, Shimoga, Uttara Kannada, Chikmagalur and Chitradurga contributing to 75 per cent of the total area under arecanut in the state (Appaiah, 1985). The present productivity of arecanut is 1451 kg ripenuts/year/ha in Karnataka (1997-98 statistics) and there is scope to increase yields by growing high yielding varieties. Besides being a highly cross-pollinated and heterogeneous population, the arecanut varieties need to be tested for different locations to identify location specific varieties since their performance over locations is highly inconsistent. The

arecanut varieties have earlier been evaluated in the maidan region of Karnataka for growth and yield parameters (Ananda *et al.*, 2000). The present experiment was initiated with the objective of identifying suitable high yielding arecanut varieties for cultivation in the maidan region of Karnataka.

Materials and Methods

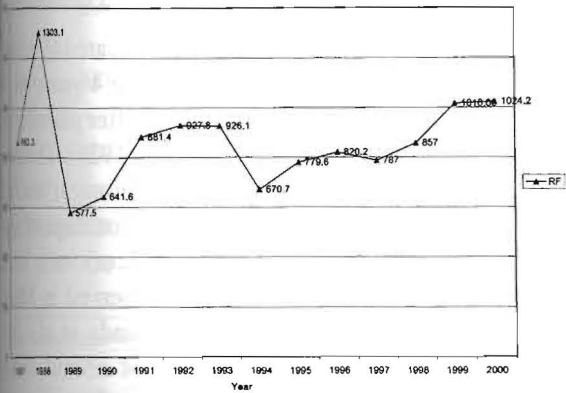
The comparative evaluation of high yielding arecanut varieties released by CPCRI was carried out at the Central Plantation Crops Research Centre, Hirehalli for 13 years from 1988-2001. The experimental area, which represents maidan region of Karnataka, is located at an elevation of 900 m with an annual average rainfall of 860 mm (Fig. 1). The experiment was laid out in Randomized Block Design with five treatments replicated five times. The treatments were Mangala, Sumangala, Sreemangala, Mohitnagar and Hirehalli Local.

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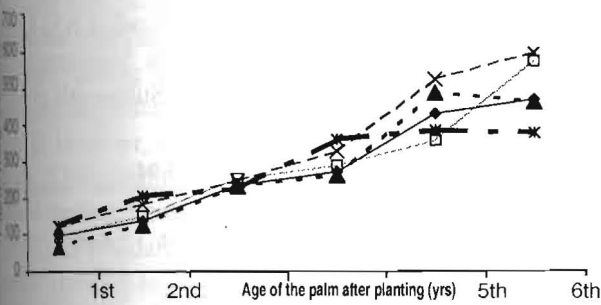
Hirehalli Local (check). Each treatment block had 8



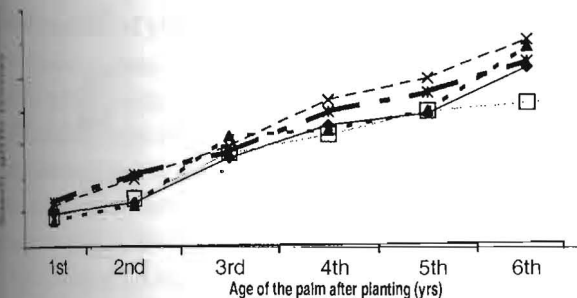
1. Rainfall distribution in Hirehalli during the experimental period

The soil of experimental area is clayey loam in nature, slightly acidic in reaction (pH 6.35) and low in fertility status with respect to organic matter, available P₂O₅ and K₂O. Arecanut palms were irrigated through drip-irrigation (i.e., 100-150 litres/palm/day) at a frequency of 7-15 days. Palms received annual dose of P₂O₅, K₂O at the rate of 100, 40, 140 g/palm/yr. The observations were recorded on growth and yield parameters viz., plant height (cm), girth of the stem at 30 cm above ground level (cm) and below crown (cm), number of leaves produced / palm, number of leaflets/

Growth increment in terms of plant height in arecanut varieties during growth period



Growth increment in terms of stem girth in arecanut varieties during early growth period



frond, leaf length (cm), leaf breadth (cm), number of nodes formed / palm, internodal length (cm), leaf sheath length (cm), leaf sheath breadth (cm), flowering percentage and weight of tender nuts per palm (kg/palm). Tendernuts of 6-8 months age were harvested for further processing into different grades. Nuts were processed for two commercial grades namely 'Unde' and 'Podi'. Processing was done by boiling the dehusked nut in water for 30-40 minutes. Boiled nuts were drained and dried in open sun for a week. Recovery of the final product was calculated by

$$\frac{\text{Weight of the processed product} \times 100}{\text{Weight of the kernel}}$$

Weight of the kernel

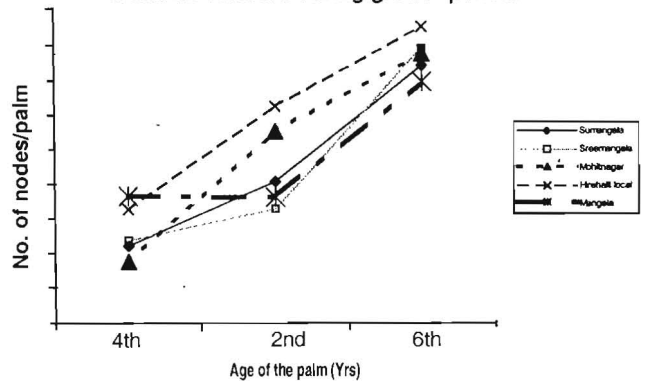
Fruit component analysis for tendernuts was done by drawing random samples of 20 nuts in each variety for nut characters such as fruit length (cm), fruit circumference (cm), fresh weight of the fruit (g), husk weight (g) and fresh kernel weight (g).

Results and Discussion

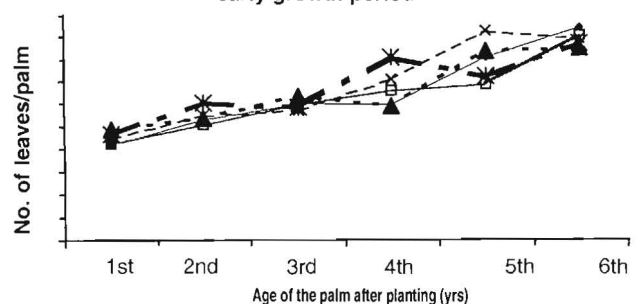
Initial establishment

The survival of arecanut seedlings in the initial years of planting in maidan region showed that Mangala (95%), Sumangala (92%), Sreemangala (95%) and Hirehalli Local (97.5%) had more survival percentage compared to Mohitnagar variety (86%). The high yielding

Growth increment in terms of number of nodes/palm in arecanut varieties during growth period.



Annual leaf production in different varieties of arecanut during early growth period



varieties except Hirehalli local were recommended for cultivation in coastal climate. Nevertheless, in the present experiment, high yielding varieties exhibited good survival and establishment in the Maidan region also.

Growth parameters

Growth parameters like plant height, stem girth, and number of leaves were recorded for six consecutive years. Number of leaves did not show significant difference among varieties throughout the growing period indicating that all varieties put forth more or less equal number of leaves during the growth period (Fig. 2).

Stem girth was more in Mangala in 1st, 2nd and 4th year while in the 5th and 6th year, Hirehalli Local recorded highest girth while Mohitnagar recorded lowest girth compared to other varieties. Though mangala is a semi-tall palm, its growth in terms of height was vigorous with significantly more height in the 1st, 2nd and 4th years. In the 6th year, Mangala had attained its typical semi-tall nature by recording lowest plant height, lowest internodal length and least number of nodes/palm (Table 1). Mangala also had least number of leaflets/frond, lowest leaflet breadth, lowest leaf sheath length and lowest leaf sheath breadth. Similar reports are available where in Mangala attained highly significant lower height compared to Mohitnagar in Konkan region of Maharashtra (Salvi *et al.*, 1985) malnad region of Karnataka (Ananda *et al.*, 2000). and coastal region of Karnataka (Ananda *et al.*, 2001) This indicates that the semi-tall character of Mangala is expressed irrespective of different agro-climatic conditions. In the 6th year, Hirehalli Local recorded maximum height with widest stem girth both at 30 cm above ground level and below

crown. Besides plant height and stem girth, it exhibited more number of nodes/palm and recorded higher values for leaf sheath length and breadth.

The reproductive growth as indicated by initiation of spadix started when the palms were 4 years old. arecanut flowers in about four years after planting when grown under best conditions (Sands, 1926). The Spadix emergence varied between 9% (Mohitnagar) to 33% (Mangala). Mangala with highest percentage of spadix emergence at 4th year appear to be precocious in bearing. Similar flowering behaviour was observed in Mangala in Malnad region of Karnataka (Ananda *et al.*, 2000). However in coastal region (hot and humid climate) Mangala flowers as early as 3rd year (Bavappa, 1991 and Ananda *et al.*, 2001). The variation in the time taken for flowering is probably due to variation in agro-climatic condition, which are bound to affect growth and reproductive phases.

Yield parameters

In the 1st yr of bearing. (i.e., 4th yr after planting) arecanut varieties produced a mean yield of 1.82 kg tendernuts/palm/ with Mangala recording significantly higher yield of 2.99 kg tendernuts/palm (Table 1) followed by Sumangala with 1.98 kg/palm/. In the 2nd yr, weight of tendernuts showed significant difference among varieties. Mangala produced 6.84 kg tendernuts/palm, which was 212% increase over the check followed by Mohitnagar with 3.32 kg/palm/yr. Other varieties were on par with one another.

In the 3rd year, Mangala recorded 6.52 kg tendernuts followed by varieties Sreemangala and Hirehalli local. Mohitnagar and Sumangala produced

Table 1. Mean performance of varieties for growth characters recorded in the 6th year after planting (1993-94)

| Varieties | Height (cm) | Girth at 30 cm (cm) | Girth at last node (cm) | Internode length at 30 cm (cm) | Internode length below crown (cm) | No. of nodes | Length of oldest leaf (cm) | No. of leaflets | Leaflet length (cm) | Leaflet breadth (cm) | Leafsheath Length (cm) |
|-----------------------|---------------|---------------------|-------------------------|--------------------------------|-----------------------------------|--------------|----------------------------|-----------------|---------------------|----------------------|------------------------|
| Sumangala (VTL-11) | 473.20 | 39.93 | 32.03 | 18.02 | 15.49 | 14.82 | 132.13 | 109.13 | 70.67 | 4.63 | 75.41 |
| Sreemangala (VTL-17) | 577.90 | 40.77 | 35.49 | 16.4 | 14.99 | 15.79 | 160.59 | 116.40 | 70.16 | 4.24 | 78.55 |
| Mohitnagar | 465.90 | 40.52 | 36.88 | 15.34 | 12.99 | 15.49 | 186.05 | 114.72 | 73.27 | 4.15 | 77.16 |
| Hirehalli Local (chk) | 600.90 | 43.98 | 37.25 | 16.47 | 14.15 | 17.05 | 146.43 | 113.39 | 70.43 | 4.59 | 79.45 |
| Mangala (VTL-3) | 380.60 | 40.45 | 32.72 | 14.50 | 11.62 | 13.95 | 145.98 | 108.42 | 70.84 | 4.09 | 71.08 |
| Grand Mean | 556.83 | 41.13 | 34.87 | 16.15 | 13.85 | 15.42 | 154.29 | 112.41 | 71.07 | 4.34 | 76.33 |
| CV (%) | 21.18 | 13.53 | 13.55 | 21.81 | 21.12 | 13.21 | 17.92 | 10.26 | 9.07 | 10.96 | 11.77 |
| CD at 5% | 158.10 | 7.46 | 6.33 | 4.72 | 3.92 | 2.73 | 37.08 | 15.46 | 8.64 | 0.64 | 12.04 |

2. Mean yield performance of arecanut varieties over the years

| Year | 1993-94 | %↓↑ | 1994-95 | %↓↑ | 1995-96 | %↓↑ | 1996-97 | %↓↑ | 1997-98 | %↓↑ | 1998-99 | %↓↑ | 1999-2000 | %↓↑ | 2000-2001 | %↓↑ |
|-----------------|-------------|--------------|-------------|---------------|-------------|-------------|-------------|--------------|-------------|--------------|-------------|---------------|-------------|--------------|--------------|---------------|
| Mangala | 1.98 | 19.28 | 3.06 | 39.73 | 3.89 | -34.25 | 3.09 | -9.32 | 4.54 | -47.8 | 5.03 | 228.99 | 3.12 | -55.81 | 4.020 | -57.63 |
| Mangala | 0.87 | -47.5 | 2.31 | 5.48 | 5.18 | -16.34 | 7.47 | 20.75 | 4.05 | 26.18 | 6.40 | 193.48 | 5.17 | -26.77 | 6.010 | -36.67 |
| Mohitnagar | 1.60 | -3.61 | 3.32 | 51.60 | 3.61 | -24.18 | 3.86 | -15.85 | 3.91 | -34.8 | 5.80 | 183.33 | 4.71 | -33.29 | 6.652 | -29.93 |
| Hirehalli local | 1.66 | - | 2.19 | - | 4.29 | - | 5.92 | - | 1.38 | - | 7.65 | - | 7.06 | - | 9.488 | - |
| Mangala (VTL-3) | 2.99 | 80.12 | 6.84 | 212.33 | 6.52 | 7.58 | 8.28 | 51.98 | 4.14 | 39.86 | 8.23 | 200.00 | 9.37 | 32.72 | 8.250 | -13.07 |
| Mangala | 1.82 | - | 3.54 | - | 4.70 | - | 5.72 | - | 3.60 | - | 6.62 | - | 5.89 | - | 6.884 | - |
| Mangala | 2.21 | - | 3.15 | - | - | - | 4.92 | - | 1.86 | - | - | - | 3.36 | - | 2.710 | - |

% = % increase or decrease over the local variety, Hirehalli Local

er yields compared to Hirehalli Local. In the 4th yr bearing (1996-97), varieties produced an average yield of 7.1 kg with Mangala recording significantly higher yield (8.28 kg) closely followed by Sreemangala (7.47 kg) and Hirehalli Local (5.92 kg).

In the 5th year, due to water scarcity, and incidence of bunch drying, yields were generally low with an average of 3.6 kg in Sumangala (4.54 kg) followed by Mangala (4.14 kg) which registered higher yields compared to other varieties. In the 6th year, Hirehalli Local picked up its yield potential with 7.65 kg next only to Mangala with 8.23 kg. In the 7th year, Mangala recorded 9.37 kg of tendernut yield while Mohitnagar and Sumangala continued to yield poor. In the 8th year Hirehalli Local exceeded Mangala and other varieties in bearing capacity producing 9.49 kg of tendernuts.

Year wise yield data from 1993-94 to 2000-2001 revealed that Mangala gave consistently higher yield than other high yielding varieties. Mangala exhibited linear trend in yielding behaviour from 1st to 8th year of bearing (Table 2). However, in the 6th year the yield in general was low (5.88 kg/palm) owing to drought and scarcity of water. Mangala exhibits alternate bearing habit (Rekha *et al.*, 1991). In Maidan region, no such observation was recorded. Hirehalli local was the next best variety, which consistently produced better yields. Mohitnagar was a good yielder in the initial three years of bearing, whereas Mangala and Sreemangala were moderate yielders.

Pooled analysis of yield data

Pooled analysis of yield data for 4 yrs from 1993-97 (Table 3), before varieties attained stabilization showed non-significant difference among varieties. All varieties yielded more or less equally with Mangala recording relatively higher yields compared to other varieties. Arecanut varieties are reported to give stabilized yields after 10 yrs of planting. However, Mangala is an early bearing variety, which attains stability in 8 yrs (Bavappa, 1977).

Table 3. Pooled ANOVA for yield of tendernuts during pre-stabilized period (1993-1996) and post-stabilized period (1997-2001)

| Varieties | Pre-stabilized period 1993-97 | Post-stabilized period 98-01 | 1993-2001 |
|-----------------|-------------------------------|------------------------------|--------------|
| Mangala | 6.157 | 8.617 | 6.827 |
| Mohitnagar | 3.097 | 5.720 | 4.183 |
| Sumangala | 3.005 | 4.057 | 3.591 |
| Hirehalli local | 3.515 | 8.067 | 4.955 |
| Sreemangala | 3.957 | 5.860 | 4.683 |
| Mean | 3.946 | 6.464 | 4.850 |
| CV (%) | 49.73% | 14.32% | 27.20% |
| CD at P=0.05 | - | 0.89 | 1.35 |

The pooled analysis of yield data, for four years (10 to 13 yrs after planting) from 1998-2001 (Table 3), after varieties attained stability, showed that Mangala produced significantly higher yields compared to other varieties with a mean of 8.617 kg tendernuts. Mangala is closely followed by Hirehalli local, which produced a mean of 8.067 kg. Mohitnagar and Sreemangala were moderate yielders while Sumangala produced lowest tender nut yield.

The pooled analysis of 8 years yield data from 1993-2001 showed significant differences among varieties for yield. Mangala gave significantly higher yield (6.83 kg) compared to other varieties. The yielding behaviour of Mangala was superior to other high yielding varieties such as Sumangala and Sreemangala in Coimbatore conditions too (Thangaraj *et al.*, 1985). Hirehalli local (Check) was the next high yielding cultivar with a mean 4.95 kg yield of tendernuts/palm/yr. In malnad region, Mangala produced nut yield as high as 11.27 kg per palm/yr followed by the check Thirthahalli with 9.97 kg per palm (Ananda *et al.*, 2000). Relatively lower yields recorded by all varieties in maidan region may be due to climatic factors and drought.

Fruit component analysis

Fruit component analysis for the nut characters revealed that Sreemangala produced bigger size fruits (42.45 g) with more kernel weight (15.69 g) (Table 4). Sreemangala recorded higher values for fruit length and fruit circumference as well. Mohitnagar, Sumangala and Mangala produced medium sized nuts. The kernel weight varied greatly from 7.81 g to 15.69 g among the five varieties. The older nuts were harvested from Sreemangala (15.69 g) followed by Hirehalli local (12.01 g). The kernel weight was lowest in Sumangala (7.61 g).

Recovery of processed nuts

Kalipak is an important processed product in maidan region of Karnataka. The tendernuts are dehusked and cut into small pieces, boiled and finally dried. The dehusked nuts of all varieties were processed for commercial grades namely 'Unde' and 'Podi' 'Unde' is one type which is processed without any cutting. In Another variety namely 'Podi', the nuts are cut both transversely and longitudinally 3-4 times. The recovery of unde was more in case of Mangala (14.87%) followed by Hirehalli local (14.25%). The recovery of podi was more in Hirehalli (14.15%) followed by Mangala (12.38%). The processing out turn was lowest in Sumangala for unde and podi (Table 5).

Table 4. Fruit component analysis of tender nuts

| Variety | Fresh weight (g) | Fruit length (cm) | Fruit circumference (cm) | Husk weight (g) | Fresh kernel weight (g) |
|----------------------|------------------|-------------------|--------------------------|-----------------|-------------------------|
| Mangala (VTL-3) | 28.88 | 6.21 | 10.53 | 15.33 | 8.81 |
| Sumangala (VTL-11) | 29.56 | 6.77 | 12.84 | 21.81 | 7.89 |
| Sreemangala (VTL-17) | 42.45 | 7.28 | 12.93 | 26.76 | 15.69 |
| Mohitnagar | 36.47 | 6.65 | 11.69 | 25.53 | 11.35 |
| Hirehalli Local | 24.14 | 5.87 | 11.07 | 16.55 | 12.01 |
| Grand Mean | 32.30 | 6.56 | 11.81 | 21.19 | 11.15 |
| CV (%) | 3.44 | 2.14 | 1.80 | 4.89 | 2.71 |
| CD at 5% | 2.09 | 0.26 | 0.40 | 1.95 | 0.60 |

Though all high yielding varieties are recommended for coastal region, the present experiment on the comparative yield trial of high yielding varieties in maidan region is first of its kind indicating the performance of different varieties in maidan region. Due to low level of acclimatization of arecanut varieties to this new environment coupled with low relative humidity, intermittent drought and scarcity of water, they have not performed to their full potential. Mangala has been performing exceedingly well in Maidan region with

Table 5. Recovery of final processed products from one kilo of tendernuts

| Variety | Unde | | | Podi | | |
|----------------------|--------|-----------|--------------|--------|-----------|------------|
| | Weight | Weight of | % Recovery | Weight | Weight of | % Recovery |
| Sumangala (VTL-11) | 360 | 126.7 | 12.67 | 290 | 79.2 | 7.92 |
| Sreemangala (VTL-17) | 345 | 138.3 | 13.83 | 340 | 99.1 | 9.91 |
| Mohitnagar | 310 | 137.1 | 13.71 | 370 | 79.4 | 7.94 |
| Mangala (VTL-3) | 350 | 148.7 | 14.87 | 410 | 123.8 | 12.38 |
| Hirehalli local | 350 | 142.5 | 14.25 | 415 | 141.5 | 14.15 |
| Mean | 343 | 138.66 | 13.87 | 365 | 104.6 | 10.46 |

good adaptation at the seedling level and subsequent bearing. Mangala has retained its bearing potential for 1st year of bearing to 8th year of bearing. Hirehalli local being a local variety of maidan region and has been popular with farmers, has produced promising yield. Though adaptation and establishment of Mohitnagar seedlings were poor, it has produced moderate yield. Mohitnagar was introduced from northern region of Bengal, where the crop is grown with abundant rain and high humidity.

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