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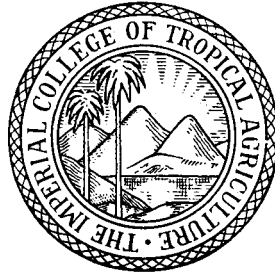
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# TROPICAL AGRICULTURE

THE JOURNAL OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE  
(FACULTY OF AGRICULTURE, UNIVERSITY OF THE WEST INDIES)

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Published on behalf of the Faculty by

**BUTTERWORTHS**

LONDON

1969

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*Studies on the Bearing Tendency  
of the Coconut Palm (Cocos  
nucifera Linn.) II—Factors  
Affecting Variation in Annual Yield  
of Palms*

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IN Part I of this series SATYABALAN *et al.* (1968) discussed the variation in yield among individual coconut palms over a period of years and concluded that the incidence of irregular bearing is high in poor and medium yielders when compared to high yielders. In this paper an attempt has been made to study the factors responsible for this condition.

Considerable variation in the annual yield of coconut palms has often been observed, and earlier workers have investigated the causes. According to PATEL (1938), the yield of nuts depends on the number of spadices opened, the number of female flowers produced and the number of female flowers set and developed into nuts. He believed that inherent characters, management practices and seasonal effects were the factors which affect the yield. MENON and PANDALAI (1958) stated that high yields are the resultant effect of abundant female flowers and high setting percentage.

TAMMES (1937) considered that yield was not controlled by flower production or pollination but exclusively by nutritional factors, especially water supply. JOHNS (1938) reported that colour, shape and size of the nuts are not related to yield.

MATERIALS AND METHODS

Palms (var. *typica*) about 50 years old growing on a red sandy loam soil in fields I, II, O.C. and IX at the Central Coconut Research Station, Kasaragod were used for the study of yield attributes such as leaf, spadix and female flower production. The land on which the palms were growing had not received any fertilizer other than green manure (*Crotolaria*) grown *in situ* and incorporated into the soil at the end of the monsoon. The fields were worked once with a cultivator during the summer months and ploughed twice between September and December.

On the basis of the yield data and other characters for the ten year period 1942 to 1951, the palms were classified into six groups depending on the average yield per year and the coefficient of variation of the yield. On the

Table 1. Mean values of characters related to yield for palms in different groups

| Yield group                 | No. of leaves produced per year            |  |      | No. of spathes produced per year           |  |      | No. of aborted spathes per year            |  |      |
|-----------------------------|--|--|------|--|--|------|--|--|------|
|                             | Bearing group<br>B <sub>1</sub><br>Regular | Bearing group<br>B <sub>2</sub><br>Irregular | Mean | Bearing group<br>B <sub>1</sub><br>Regular | Bearing group<br>B <sub>2</sub><br>Irregular | Mean | Bearing group<br>B <sub>1</sub><br>Regular | Bearing group<br>B <sub>2</sub><br>Irregular | Mean |
| A <sub>1</sub> High         | 12.7                                       | 12.7   | 12.7 | 12.5                                       | 9.8  | 11.2 | 0  | 2.2  | 1.1  |
| A <sub>2</sub> Medium       | 12.8                                       | 12.0   | 12.4 | 12.8                                       | 8.0  | 10.4 | 0.1  | 3.4  | 1.7  |
| A <sub>3</sub> Low          | 11.7                                       | 11.7   | 11.7 | 11.0                                       | 9.0  | 10.0 | 0.2  | 1.9  | 1.1  |
| Mean                        | 12.4                                       | 12.2   | 12.3 | 12.1                                       | 8.9  | 10.5 | 0.1  | 2.5  | 1.3  |
| LSD for marginal means of A | 0.7  |  |      | Not significant                            |  |      | Not significant                            |  |      |
| LSD for marginal means of B | Not significant                            |  |      | 1.0  |  |      | 0.7  |  |      |

| Yield group                 | No. of female flowers per bunch            |  |      | No. of female flowers per year             |  |       | Setting %                                  |  |      |
|-----------------------------|--|--|------|--|--|-------|--|--|------|
|                             | Bearing group<br>B <sub>1</sub><br>Regular | Bearing group<br>B <sub>2</sub><br>Irregular | Mean | Bearing group<br>B <sub>1</sub><br>Regular | Bearing group<br>B <sub>2</sub><br>Irregular | Mean  | Bearing group<br>B <sub>1</sub><br>Regular | Bearing group<br>B <sub>2</sub><br>Irregular | Mean |
| A <sub>1</sub> High         | 24.5                                       | 28.8   | 26.7 | 306.0                                      | 281.0  | 293.5 | 37.3                                       | 36.7   | 37.0 |
| A <sub>2</sub> Medium       | 21.5                                       | 16.8   | 19.1 | 278.2                                      | 126.4  | 202.3 | 26.9                                       | 46.8   | 36.8 |
| A <sub>3</sub> Low          | 16.1                                       | 11.8   | 14.0 | 177.9                                      | 98.7   | 138.3 | 22.3                                       | 32.5   | 27.4 |
| Mean                        | 20.7                                       | 19.1   | 19.9 | 254.0                                      | 168.7  | 211.4 | 28.8                                       | 38.7   | 33.7 |
| LSD for marginal means of A | 7.2  |  |      | 16.7                                       |  |       | 8.5  |  |      |
| LSD for marginal means of B | Not significant                            |  |      | 13.7                                       |  |       | 6.9  |  |      |

basis of average yield the palms were grouped into high yielders ( $A_1$ ) with a mean yield of over 80 nuts per year; medium yielders ( $A_2$ ) with a mean yield of 40 to 80 nuts per year and low yielders ( $A_3$ ) with a mean yield of less than 40 nuts per year. The palms in the above groups were again subdivided into regular bearers ( $B_1$ ) having a C.V. of 30 per cent or less and irregular bearers ( $B_2$ ) having a C.V. of over 30 per cent. From each of the above groups, six palms were selected at random for examination of the yield characters. In order to estimate the amount of variation in yield contributed by female flowers, four palms each from high, medium and low yield groups were taken and their yield and female flower data examined for the period 1942 to 1951.

#### RESULTS AND DISCUSSION

In *Table 1* are presented data regarding the mean annual production of leaves, spadices, number of spadices aborted, total female flower production, female flowers per bunch and setting percentage of the palms in the six groups.

There was no significant difference in leaf production between 'regular' and 'irregular' bearers. Regular bearers produced 3.2 spadices more per year than the irregular bearers, an increase largely accounted for by the higher abortion rate of 2.5 spadices per year in the irregular bearers. Regular bearers rarely suffered spadix abortion. No significant difference was found between the numbers of female flowers per bunch in regular and irregular bearers. These conclusions were generally equally applicable to all three yield groups. Regular bearers produced more female flowers than irregular bearers of all three yield groups, while irregular bearers showed a higher setting percentage than regular and irregular bearers of medium and poor yield groups. In the high yield group there was no significant difference in the setting percentage of regular and irregular bearers.

Irregular bearers show larger variations from year to year in the number of female flowers per bunch as well as in the setting percentage than those shown by regular bearers. It is the variation in the female flower production that chiefly influences the yield because of the high significant correlation ( $r > +0.7$ ) between yield and annual female flower production (*Table 2*). However, this is only true up to a limit, as the relationship does not apply when female flower production is very high.

The variation in annual female flower production appears to be due more to the number of opened spadices than to the number of female flowers per bunch. It has already been noted that abortion of spadices is more frequent in irregular bearers and since all the palms, both regular and irregular, were growing under the same soil and climatic conditions this would suggest that trees become irregular bearers because of their easy susceptibility to drought.

According to PATEL and ANANDAN (1936), the branches of the inflorescence begin to form sixteen months before the opening of the spathe, and severe drought at this period may kill the growing point and cause abortion of the spathe. MARAR and PANDALAI (1957) also considered that abortion of spadices is influenced by the high temperatures of the hot season which

Table 2. Correlation between female flower production and yield

| Tree No. | Mean annual yield (1942-1951) (nut/year) | C.V. of annual yield (%) | Correlation coefficient between yield and female flowers |                     | $100 \times r_b^2$ |
|----------|--|--------------------------|--|---------------------|--------------------|
|          |  |                          | Individual bunches $r_a$                                 | Annual output $r_b$ |                    |
| IX/139   | 28.2                                     | 76.7                     | 0.3805   | 0.8623              | 74.4               |
| I/25     | 29.9                                     | 21.7                     | 0.1347   | 0.7835              | 61.4               |
| I/155    | 33.9                                     | 56.4                     | 0.5256   | 0.8697              | 75.6               |
| I/32     | 35.8                                     | 28.1                     | 0.5718   | 0.7846              | 61.6               |
| I/133    | 50.5                                     | 51.2                     | 0.2193   | 0.7193              | 51.7               |
| I/165    | 63.6                                     | 56.4                     | 0.7514   | 0.9614              | 92.4               |
| I/65     | 65.4                                     | 17.5                     | 0.2195   | 0.7656              | 58.6               |
| I/24     | 70.2                                     | 15.0                     | 0.2496   | 0.5244              | 27.5               |
| I/184    | 84.4                                     | 43.3                     | 0.4742   | 0.9312              | 86.7               |
| I/62*    | 99.2                                     | 57.0                     | 0.2942   | 0.0994              | 0.9                |
| I/41*    | 103.1                                    | 14.6                     | 0.2958   | 0.1874              | 3.5                |
| I/58     | 112.3                                    | 13.3                     | 0.4440   | 0.8315              | 69.1               |

\*Trees producing more than 300 female flowers per year.

cause desiccation of the inflorescences in the primordial stage. The study of regular and irregular bearing trees made by SAMPSON (1923) indicated that regular bearing trees have a larger number of main roots arising from the stem base than the irregular bearers. It is possible, therefore, that irregular bearers are more easily affected by drought because of their poorly developed root system.

Medium and poor bearers normally form a large proportion of the palm population of a garden and it is these that more commonly show irregular bearing. It is because of this factor that the production of coconut gardens shows such wide variations from year to year.

#### SUMMARY

A study of total numbers of leaves, spadices, female flowers, numbers of female flowers per bunch and flowers set was carried out in coconuts. The trees were grouped as high yielders (over 80 nuts per tree per year), medium yielders (40 to 80 nuts per tree per year) and low yielders (less than 40 nuts per tree per year). Each group was subdivided into regular bearers (C.V. 30 per cent or less) and irregular bearers (C.V. over 30 per cent).

The production of spadices was greater in regular bearers than in irregular bearers, and the difference was accounted for by the abortion of spadices in irregular bearers. The abortion of spadices may be linked with the effect of drought on the less well developed root system of irregular bearers and seemed to be the main cause of irregularity in yield of all three yield groups.

There was no significant difference in the number of female flowers per bunch in regular and irregular bearers. A positive correlation was found between yield and female flower production except when female flower production was high. The variation in female flower production appeared to be related more to the number of opened spadices than to the number of female flowers per bunch.

## ACKNOWLEDGEMENTS

The authors are grateful to the Indian Council of Agricultural Research for the provision of facilities for this study and to Mr M. M. Krishna Marar, former Director, Central Coconut Research Station, Kasaragod for his interest and guidance.

(Received February 1969)

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