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CURRENT COCONUT YIELD IMPROVEMENT PROGRAMMES IN INDIA

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SUMMARY

This paper reviews the various aspects of the recent coconut yield improvement programmes being pursued in India. In the varietal selection, cultivars such as Philippine ordinary, S.S. Green, Fiji, San Ramon, Kappadam, Lakshadweep ordinary, Lakshadweep micro and Andaman ordinary which have proved to be superior to the native West Coast Tall are under multiplication. Efforts in progress to improve the genetic base of West Coast Tall have been outlined. Extensive trials laid out for locating hybrid vigour in different parental combinations and programmes under way for the large scale production of proven hybrids such as Dwarf orange x Tall, Tall x Gangabondam and Lakshadweep ordinary x Gangabondam and identification of hybrids using different characters including biochemical markers are described. Programmes being initiated on the production physiology of coconut have been discussed.

INTRODUCTION

India which occupies third position among the coconut producing countries of the world has 10,98,400 ha under coconut and produces annually 5,954 million nuts. During the last sixty years of coconut research in this country crop improvement programmes had as usual centred round varietal selection and hybrid vigour exploitation. These have been reviewed by Satyabalan and Nambiar (1969). However, the average yield of the crop in the country has been more or less static, ranging between 31 and 34 nuts per palm per year over the last 10 years. Since 1970, when the research on this crop was reorganized, there has been considerable change in the various approaches to crop improvement programmes. These include not only new lines of work but also expansion of items in progress for producing quick impact on coconut production in the country. These are reviewed in this paper.

Varietal selection

The country has a germplasm holding of 32 indigenous and 99 exotic cultivars. Satyabalan (1973) and Nampoethiri and Pillai (1972) have discussed the relative merits of these cultivars. The main performance of the promising cultivars is given in Table 1.

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Table 1. Performance of promising exotic and indigenous coconut cultivars (Mean of 4 years)

Cultivar	Yield of nuts per tree per year (%)	Copra per nut (gms)	Copra yield per tree per year (kg)
1. S.S. Green	91.6	271.9	20.3
2. Kappadam	80.5	265.2	21.4
3. Philippines	89.0	233.1	20.7
4. Fiji	82.5	195.2	15.9
5. Lakshadweep ordinary	120.8	139.9	19.5
6. Andaman	110.8	165.7	18.4
7. San Razon	61.9	339.7	21.0
8. West Coast Tall	62.6	156.9	9.8
9. Lakshadweep micro	214.2	113.5	24.2

Compared to the extensively cultivated native West Coast Tall, Philippine ordinary, S.S. Green, Fiji, San Razon, Kappadam, Lakshadweep ordinary, Lakshadweep micro and Andaman ordinary are far superior. Seed production plots of 0.28 ha in extent has now been laid out for these varieties. Under an All India Co-ordinated Coconut and Arecanut Improvement Programme six of these cultivars are being evaluated in six multiplication trials in different agroclimatic regions of the country for assessing their performance under these conditions. In view of the out crossed nature of these cultivars, for maintaining varietal purity only inter-crossed seed material has been used in these trials. These trials have been laid out on statistical designs for enabling not only their critical evaluation but also for the application of biometrical techniques like D^2 statistic (Mahalanobis, 1936). In the absence of additional genetic materials future coconut improvement programmes will be highly handicapped. A survey and collection of the germplasm from the important coconut growing countries of the world as attempted by Whitehead (1966) will be highly rewarding. In view of the urgent need to locate resistance to the root (wil) disease of coconut this programme should receive the topmost priority.

Genetic improvement of the local WDT and dwarfs

Efforts made so far in the study of the genetics of different characters as well as improvement of the genetic base of this cultivar have been limited to a few characters like leaf production, number of bunches, number of female flowers, distribution of female flowers, number of spikes, nut setting and yield of nuts (Lakshmanachar, 1959; Nambiar and Nambiar, 1970; Nambiar, Jacob Mathew and Basalakaran, 1970; Nambiar, Jacob Mathew and Sumanigala Eddy, 1970). This is far from adequate. Open pollinated progenies numbering 5,700 belonging to 190 families of West Coast tall have been planted on randomized block design and are being studied for vegetative, productive and biochemical characters for

working out their phenotypic and genotypic correlations with yield, heritability and selection indices.

Bavappa, Subraman and Jacob Mathew (1973) observed that both Dwarf green and West Coast Tall are heterozygous for dwarfness. Selfing them for a few generations is bound to enhance their value in breeding for exploiting hybrid vigour. This has been taken up in West Coast Tall for two generations and in Dwarf orange for one generation.

Exploitation of hybrid vigour

Subsequent to the report of hybrid vigour in West Coast Tall x Dwarf green by Patel (1957), the superiority of tall x dwarf hybrids has been confirmed by many workers as listed by Satyabalan, Ratnam and Ranjan (1970). The superiority of other hybrids involving tall parents such as Lakshadweep ordinary and dwarfs like Gangabondam has been reported. Satyabalan (1956) and Ninan and Satyabalan (1964) reported that the natural crosses of the Chowhat dwarf orange to be prolific bearers with superior quality of copra. Existence of hybrid vigour in the hybrids of different tall forms from Andamans and Lakshadweep islands has been recorded (Anji, 1972). The performance of the different hybrids evaluated in the country is given in Table 2.

Table 2. Performance of promising hybrids and their parents (Mean of five years)

Hybrid/Parent	Time taken for flowering (in years)	Annual yield of nuts per palm (Nos.)	Weight of copra per nut (g)	Annual yield of copra per palm (kg)
West Coast Tall	6.74	71.90	176.60	12.69
Lakshadweep ordinary	4.81	120.8	159.9	19.3
Dwarf orange	3.97	74.17	158.60	10.72
Gangabondam	4.00	73.00	181.85	13.27
Tall x Dwarf orange	5.17	101.79	177.86	18.76
Dwarf orange x Tall	5.04	130.17	209.76	26.98
Tall x Gangabondam	5.52	89.50	193.46	17.76
Lakshadweep ordinary x Gangabondam*	-	109.00	167.3	18.24

*Data from Central Coconut Research Station, Nilleshwar, Kerala, India

Dwarf orange x Tall, Tall x Dwarf orange and Tall x Gangabondam have yielded respectively 11%, 50% and 40% more copra than the West Coast Tall.

Of the above hybrids, D x T and T x D have been observed to be tolerant to the deadly root (wilt) disease. The data are given in Table 3.

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Table 3. Field tolerance of some of the varieties and hybrids to the coconut root (wilt) disease and their yield performance

Variety/Hybrid	Number of palms observed	Incidence of disease (%)	Average number of nuts per palm per year	
			Healthy	Diseased
West Coast Tall	2088	37.5	40.7	25.1
Tall x Dwarf	2125	11.4	48.3	39.5
Dwarf x Tall	1019	9.3	69.6	71.3
Dwarf orange	867	22.9	74.7	51.1
Dwarf green	250	10.4	72.4	50.6

It will also be seen from the table that even under diseased conditions these two hybrids give more yield than the West Coast Tall.

In order to assess the hybrid vigour in other parental combinations, crosses involving 14 tall cultivars, viz. West Coast Tall, Andaman giant, S.S. Green, S.S. Apricot, Spicata, Lakshadweep micro, Lakshadweep ordinary, San Ramon, Fiji, Jamaica, Java, New Guinea, Cochin China and Philippines and four dwarfs viz. Dwarf orange, Dwarf green, Gangabondam and Andaman dwarf have been made and are being evaluated under statistically laid out yield trials. In the absence of information on the genetic distance of the cultivars, geographic isolation has been taken as a criterion along with others in deciding the parental combinations.

Studies in progress to find out the response of these hybrids to different management practices have shown that T x D responds better to irrigation than WC^T, the increase being 64 nuts and 43 nuts respectively. The indications from a manurial experiment are that the hybrids are better converters of the applied nutrients and thus may not require a nutritional input in proportion to their high yields.

For the large scale production of hybrids three seed gardens in the two states of Kerala and Karnataka are being established over an area of about 800 ha. Though Dwarf orange x Tall hybrids will be produced to a greater extent, sizable areas are also being planted with other parents for producing West Coast Tall x Gangabondam and Lakshadweep ordinary x Gangabondam hybrids with a view to ensure that more than one hybrid is distributed to the farmer and to that extent the genetic base of the planting materials is kept diverse. High yielding selected tall have been planted with dwarfs in alternate rows either in double hedge or square systems. Dwarfs will be emasculated to obtain Dwarf x Tall hybrids. The nuts from the tall will also be made use of as planting material. In view of the high combining ability of high yielders and stability of yield (Nambiar and Nambiar, 1970) these Tall x Tall will be better than open pollinated material.

It has been shown that there is segregation in the F₁ populations of Tall x Dwarf hybrids (Bavappa, Sukumaran and Jacob Mathew, 1973). Efficient exploitation of hybrid vigour will, therefore, depend upon the

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accuracy with which these hybrids are identified. They are now selected on the basis of their general vigour and colour wherever available. On a bulk scale about 70% of the F_1 population alone are realised as hybrids. In addition to the growth characters and colour, possibility of using biochemical markers such as net assimilation rate, chlorophyll content etc. for the identification of hybrids are being investigated.

Better understanding of the production physiology of coconut

The physiology of commencement of flowering is under investigation at the Institute with the objective of reducing the pre-bearing age of the coconut palm. The study has revealed that the W.C.T. variety which commences bearing only after the 42th leaf stage of growth or 6-7 years of age under normal conditions, is capable of producing inflorescence primordia from the 10th leaf axil onwards, or in one year after planting (Pillai *et al.*, 1973). This indicates that there is considerable possibility of reducing the pre-bearing age in coconut.

The early commencement of flowering in the Tall variety is however found to depend on a rapid rate of leaf production followed by a build up of high carbohydrate reserve in the stem which functions as the main source of sink. In hybrids which commence flowering very early before the stem formation, the leaf itself is found to be the main source of sink for carbohydrates. In adult bearing palms, the rate of apparent photosynthesis is significantly correlated with annual yield of nuts.

In one year old seedlings of W.C.T. variety, the Net Assimilation Rate (NAR) is found to be significantly correlated with the chlorophyll content, number of leaves and girth at collar. The canopy size and shape of coconut have been observed to show wide variation. There are at least five distinct types which seem to intercept light to varying extents. The different characteristics that govern the canopy size, their relation with yield etc. are being studied with a view to fixing an ideal plant type for coconut.

In conclusion it may be stated that the maximum utilisation of the existing genetic diversity in this crop has been made and any further programme in this direction is only possible with fresh addition to the germplasm. For India, strengthening of germplasm is particularly important in view of the resistance that is required for combating the deadly root (wilt) disease of coconut. A comprehensive view of the coconut research and development has been taken and various projects to achieve quick gains have been commenced.

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