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INTRODUCTION

THE role of plant introduction in crop improvement work is well recognised by plant breeders everywhere. Work on exploration, introduction and evaluation of different cultivated varieties of crop plants as well as study of their wild relatives have already yielded results of practical value in many crop plant species. However, it is only the more important and easy among the wide array of economic flora that have received adequate attention in this line.

Though coconut is one of the most important perennial tropical crops, this aspect of work has lagged far behind in comparison with other favourable crop plant species, for obvious reasons. Like all other improvement work in this crop, introduction and evaluation of cultivated varieties present unique problems and the results are of a very long term nature. However, it has received attention from early Indian workers on this crop and thanks to their pioneering efforts, several foreign breeds of coconuts have been introduced in the Agricultural Research Station, Pilicode, and their progenies and a few other foreign breeds planted at Kasaragod.

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Since the advent of the Indian Central Coconut Committee, introduction of coconuts from foreign sources has been given greater emphasis and attempts to build up a representative collection of all available foreign breeds are under way. At present there is a fine collection of over 60 different foreign breeds in the Central Coconut Research Station, Kasaragod and several fresh consignments of seednuts are also being received. The recent introductions are either in seedling stage or have just started bearing and it will clearly take 10-15 years for assessment of their performance under Indian conditions. In the present paper, a comparison of the performance of some foreign breeds of coconuts introduced in earlier years at Pilicode and their progenies, a few other foreign breeds, indigenous types and hybrids planted at Kasaragod is made, making use of data collected and recorded in these two Stations.

Performance of foreign breeds at Pilicode

Details regarding the various foreign breeds at Pilicode, number of palms studied in each case, number of years for which data on female flower production, yield and nut-setting have been considered and estimated annual out-turn of copra are given in Table 1. Similar observations on local tall palms (West Coast Talls) planted along with the foreign breeds are also given for purposes of comparison.

A perusal of the table shows that the average annual yield for the local tall variety at Pilicode is 50 nuts and out-turn of copra 7.8 kg. While most of the other breeds show a lower production of copra, *Java*, *Laccadive ordinary*, *Ceylon*, *Philippines* and *Siam* show more copra out-turn. Of these, the yield in terms of number of nuts is considerably high in *Laccadive ordinary* (72 per year) which also combines high production of female flowers (332 per year). Though female flower production (418) and yield of nuts (100) are highest in *Laccadive small*, due to the small size of nuts, copra out-turn is much less than that in *Laccadive ordinary*, but comparable to the local tall variety. *Laccadive ordinary* thus combines high female flower production, yield of nuts as well as out-turn (11.8 kg.) and is second only to *Java* in copra out-turn (12.9 kg.). In *Java*, however, the number of nuts (47) is much less than that in *Laccadive ordinary*.

Performance of foreign breeds, first generation progenies of straight introductions, indigenous types and hybrids at Kasaragod

A few other foreign breeds, first generation hybrids and selfed lines of straight introductions at Pilicode, indigenous types and hybrids (between) local tall and dwarf varieties) planted in the Central Coconut Research Station, Kasaragod were also studied. Details of their performance are given in Table 2. A comparison of Tables 1 and 2 reveals that the palms at Kasaragod are on the whole better yielders than those at Pilicode. While random bred West Coast tall palms at Pilicode show an annual production of 50 nuts and 7.8 kg. of copra, the corresponding figures for the same variety at Kasarago are 81 nuts and 14.2 kg. of copra. There can be no doubt that the differences in soil types as well as management practices may account largely for this. Judged on the basis of the performance of the local tall variety at Kasaragod, open-pollinated progenies of *Laccadive ordinary*, *Philippines*, *Andaman ordinary*, *Laccadive dwarf* (Natural hybrid?) and *S. S. Green* and first generation inbreds of *Cochin-China*, *New Guinea*, *Laccadive minor*, etc., are better producers of copra. Indigenous types like *Kappadam* and *Kaithathali* as well as tall x dwarf hybrids and semi-tall progenies of dwarfs also show better performance than W. C. talls.

COMMENTS

The two important aspects of introduction in coconut improvement work are (1) assessment of the performance of different breeds under local conditions for selection and propagation of the best among them and (2) evaluation of the importance of various breeds as genetic stocks for utilisation in breeding work. In doing so, it is essential that statistically designed experiments should be conducted and data on performance of the various introductions gathered from trials done in different tracts in the region of introduction. While such studies are much easier in most other crop plants and their results known within an year or so, in coconuts it will take about 2 decades for the results of such experiments to be known when once they are started. These can be expected to be taken up only by institutions engaged in research work on this crop and even at that level it may not be possible to try all varieties, due to the practical difficulties in obtaining sufficient seed materials in good condition as well as problems of availability of suitable area for growing large progenies. This would also involve enormous expenditure. It would, therefore, be highly necessary and essential to examine all available information on various breeds that have already been introduced, however scanty it might be, for the planning of future improvement work. The present study is only an attempt in this line.

An important point that may be observed from a comparison of Tables 1 and 2 is that though the Kasaragod progenies show better performance in general, in comparison to the straight introductions at Pilicode, there are cases in which breeds that exhibit better performance at Pilicode show very poor progeny performance at Kasaragod and *vice versa*. Thus *Ceylon* which performs excellently at Pilicode shows comparatively much poorer performance at Kasaragod. On the contrary, progenies of breeds like *Laccadive dwarf* and *S. S. Green* (out of two progenies studied one is a very prolific and regular bearer with an annual yield of 132 nuts and copra out-turn of 28.5 kg.) at Kasaragod far out-yield their parental types at Pilicode. As already stated, there are also breeds like *Laccadive ordinary* which show better performance in both the Stations (straight introductions and their progenies). The observations of Prof. Haldane (1958) quoted below appear to be very pertinent in this context, "A number of nuts of foreign breeds have been planted at Kasaragod, and results are awaited. It is perhaps unlikely, though not impossible, that any of the trees derived from them will prove superior to the local variety. It is much more likely that first generation hybrids of these breeds, either with Indian breeds or with one another may prove to be of value. Here again no sure conclusions can be reached unless the paternity of each plant is known. The fact that trees of a given breed do not do particularly well in Kerala does not prove that hybrids derived from them may not do so. If the hybrids are thought desirable it may or may not be found that later generations derived either from back-crossing or from the inter-crossing of hybrids, will be of value". It will thus be seen that due to the varying nature of the first generation progenies of the various introductions, no sure conclusion can be drawn without a knowledge of the paternity of each progeny which unfortunately, is lacking. However, there appears to be no harm in propagating promising varieties like *Laccadive ordinary* that have also given good progeny performance under open-pollination. Crosses of different breeds with known males will have to be taken up to exploit the vigour found in certain first generation hybrids. Trials on 'sib-mating' may also be made to conserve the germplasm of such breeds as are found superior.

A comparison of the behaviour of open-pollinated and selfed progenies of various breeds planted at Kasaragod reveals several interesting aspects. Most of the first generation inbreds show remarkable inbreeding depression in the form of reduced vegetative vigour, diminished nut size, lesser copra content per nut, etc. This is well-marked in variety *Kappadam* in which the selfed plant produces nuts which are much smaller than those in the open-pollinated plants. Though yield of nuts is more in the selfed progeny, copra out-turn is only about half that in the open-pollinated plants. However, in

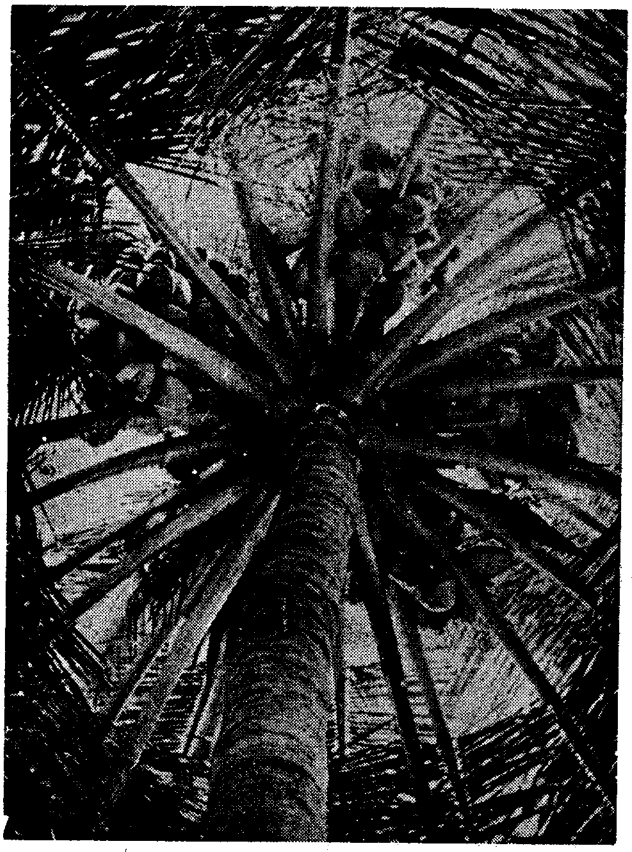

Fig. 1
Laccadive ordinary

Fig. 2
Laccadive small

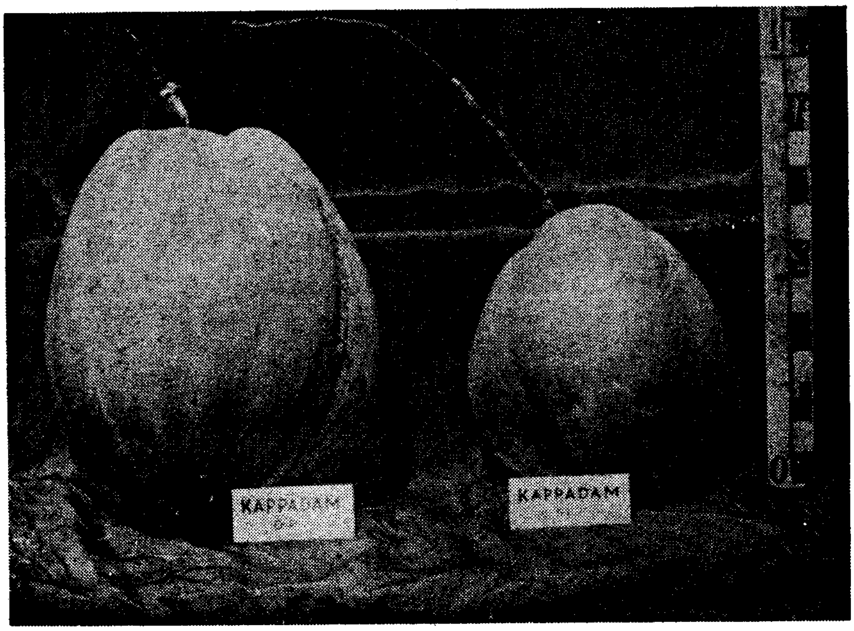

Fig. 3

Kappadam — Mature nuts from OP and S_1 plants
(note the size difference)

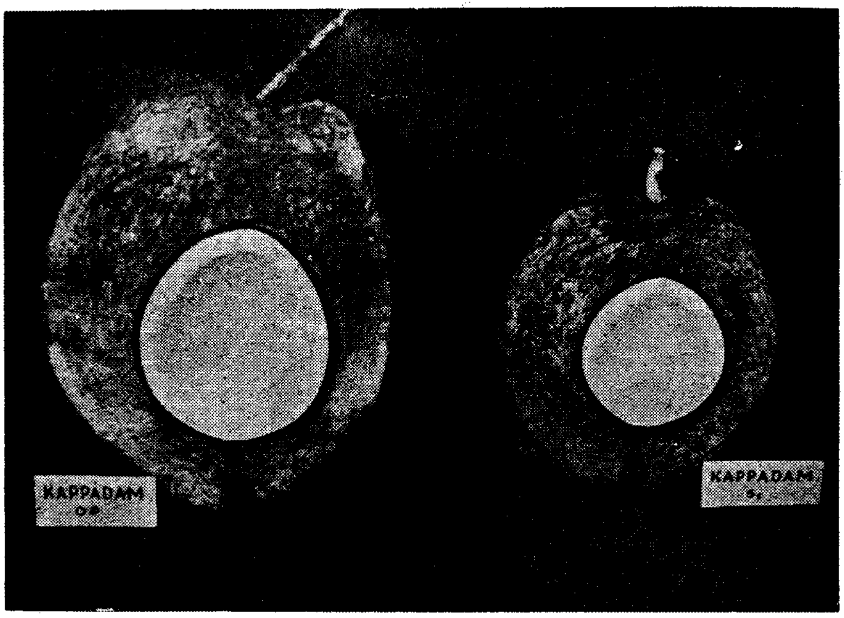

Fig. 4

Kappadam — Nuts of OP and S_1 plants cut open varieties like *New Guinea, Cochin-china,* etc., the inbred plants show considerable increase in number of nuts as well as out-turn of copra over their open-pollinated sister plants. These findings support the observations of Harland (1957) that different varieties may respond to selfing in quite different ways and to varying extents and open up interesting possibilities of self-pollination in coconuts.

The fact that there is marked inbreeding depression in first generation selfs of most varieties makes it highly probable that progenies of first cross between such lines or those derived by two or three generations of inbreeding (Haldane, 1958) may show greater vigour than the parental types. Cyclic crosses between all available lines may be taken up for selecting lines having the highest specific combining ability. Furthermore, the observation that inbred plants of a few varieties retain their productivity or are better than their open-pollinated sister plants indicates that the chances of realising inbred lines of high productivity by further selfing and handling large progenies may not be remote.

Considering the difficulty and time lag involved in evolving selfed lines in coconuts, it would be highly advantageous for coconut breeders throughout the world to exchange inbred materials for experimental purposes. The fact that first generation selfs of several breeds (including many trees of the local tall variety) are available at Kasaragod and Pilicode makes it easy for interested institutions to obtain second generation inbred nuts, thereby saving several years of effort in evolving such lines. This is a fruitful field for international co-operation among coconut breeders.

SUMMARY AND CONCLUSIONS

Data on the performance of fifteen foreign breeds of coconuts in the Agricultural Research Station, Pilicode and their first generation progenies (open-pollinated and selfed), a few other foreign breeds, indigenous types and hybrids in the Central Coconut Research Station, Kasaragod have been compared. It has been found that among the foreign breeds, *Laccadive ordinary* shows consistently better performance of both the straight introductions and first generation progenies in comparison to the other breeds. Though some of the open-pollinated progenies of foreign breeds like *Straits Settlements Green* show very high yield and regular bearing habit, such vigour can be exploited only by a knowledge of the paternity of the progeny concerned. Inter-varietal crosses of such breeds with known males may be taken up to fix the best combinations for continued propagation. 'Sib-mating' of promising breeds may also be tried to maintain varietal authenticity and to avoid vicinism by mongrel types, which

may perhaps be the cause of the poor performance of first generation progenies of a few promising breeds encountered in the present study.

Comparison of open-pollinated and selfed progenies of different breeds has shown that they respond to selfing in quite different ways and to varying extents. While there is marked inbreeding depression in first generation inbred lines of most breeds, a few are much better than their open-pollinated sister plants. Exploitation of hybrid vigour by single cross trials as well as establishment of fairly homozygous high yielding lines would thus appear to be two possibilities of self-pollination from the breeder's point of view.

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TABLE 1.

Performance of world varieties of coconuts at Agricultural Research Station, Nileshwar (Pilicode), Kerala

Sl. No.	Variety	Number of: Palms available for study	Number of: Years for which data taken	Average annual production (per tree): Female flowers	Average annual production (per tree): Nuts	Average annual production (per tree): Copra	Setting percentage
1	2	3	4	5	6	7	8
	Straight introductions						
1.	Andaman Dwarf	4	18	149	30.5	3.9	20.5
2.	Andaman Giant	1	18	274	36.7	6.6	13.4
3.	Andaman ordinary	4	18	217	28.5	4.8	13.1
4.	Ceylon	4	12	164	43.2	11.1	26.3
5.	Cochin China	5	18	200	42.8	6.0	21.4
6.	Fiji	11	16	167	32.5	5.9	19.5
7.	Java	8	18	174	47.0	12.9	27.0
8.	Laccadive Dwarf	1	17	108	40.0	5.2	37.0
9.	Laccadive Ordinary	5	18	332	72.0	11.8	21.7
10.	Laccadive Small	8	18	418	100.0	7.8	23.9
11.	New Guinea	4	18	200	37.1	7.8	18.6
12.	Philippines	10	18	230	50.6	10.3	22.0
13.	Siam	1	18	203	42.2	9.3	20.8
14.	Straits Settlements Apricot	3	18	109	31.5	5.2	28.9
15.	Straits Settlements Green	7	18	204	45.0	7.4	22.1
	Indigenous						
16.	*West Coast Tall*	10	14	216	50.1	7.8	23.2

TABLE 2

Performance of the world varieties of coconuts at Central Coconut Research Station, Kasaragod, Kerala

Sl. No.	Variety	Nature of progeny*	Number of: Palms available for study	Number of: Years for which data taken	Average annual production (per tree): Female flowers	Nuts	Copra (kg.)	Setting percentage
1	2	3	4	5	6	7	8	9
	First generation progenies of Pilicode introductions							
1.	Andaman dwarf	OP	1	10	312	83.4	14.0	26.7
2.	Andaman giant	OP	1	10	132	47.6	8.3	36.1
3.	do	S_1	1	10	221	62.5	10.3	28.3
4.	Andaman ordinary	OP	1	10	364	95.1	15.9	26.1
5.	do	S_1	1	10	429	53.2	7.0	12.4
6.	Ceylon	OP	1	10	186	35.9	8.5	19.3
7.	Cochin-china	OP	1	10	77	16.8	4.8	21.8
8.	do	S_1	1	10	240	61.7	15.3	25.7
9.	Fiji	OP	4	10	224	78.1	14.3	34.8
10.	do	S_1	2	10	245	41.6	7.0	17.0
11.	Java	S_1	1	10	224	43.8	8.2	19.6
12.	Laccadive dwarf	OP	1	10	326	120.6	22.7	37.0
13.	Laccadive minor	S_1	2	10	214	123.0	17.0	57.5
14.	Laccadive ordinary	OP	3	10	313	120.0	19.4	38.3
15.	do	S_1	3	10	353	91.4	13.7	25.9
16.	Laccadive small	OP	1	10	122	42.0	6.8	34.4
17.	do	S_1	1	10	186	50.0	6.9	26.9
18.	New Guinea	OP	1	10	107	50.3	11.4	47.0
19.	do	S_1	1	10	379	96.0	19.0	25.3
20.	Philippines	OP	3	10	482	76.7	15.3	15.9
21.	do	S_1	3	10	330	69.6	11.8	21.1
22.	Straits Settlements Apricot	S_1	1	10	305	67.4	11.6	22.1
23.	Straits Settlements Green	OP	2	10	358	80.1	16.1	22.4
	Indigenous types							
24.	Dwarf green	OP	3	7	259	59.0	3.5	22.8
25.	Dwarf orange	OP	4	6	174	58.7	7.6	33.7
26.	Gangabondam	OP	3	5	401	51.3	11.7	12.8
27.	Kaithathali	OP	1	10	179	81.5	17.0	45.5
28.	Kappadam	OP	2	10	165	69.6	19.6	42.2
29.	do	S_1	1	10	442	75.5	10.6	17.1
30.	Spicata	OP	2	6	1992	96.0	11.9	4.8
31.	*West Coast Tall*	OP	3	10	261	81.4	14.2	31.2
32.	Tall x Dwarf (hybrid)	artificial	3	10	368	98.3	17.3	26.7
33.	Dwarf red (Semi-tall progeny	Natural hybrid	9	10	317	99.7	19.5	31.5
34.	Dwarf green (do)	do	1	1	...	61.0	15.1	...
	Straight introduction							
35.	F.M.S. big	OP	3	10	160	64.8	11.7	40.5
36.	Laccadive micro	OP	1	10	393	182.4	13.2	46.4

* OP — Open-pollinated. S_1 — First generation inbred.