

Agricultural Research Station, Pilicode show that this is a heritable character and that progenies of *spicata* mothers segregate into *spicata* and *typica* in about equal numbers. Narayana and John (1949) and Davis (1959) have reported that 50 per cent of the progenies of *spicata* palms breed true to type, though they have not given any explanation for this. Haldane (1958) suggested that the available evidence is compatible with the view that *spicata* is dominant over the normal, though this has not so far been verified from experimental evidence which, in a perennial crop like coconut with a pre-bearing period of 7-10 years, will clearly take not less than a decade. Nevertheless, it should be assumed that *spicata* mothers giving 1:1 segregation of progenies into *spicata* and *typica* might be heterozygotes, say, Ss, where S represents *spicata* and s normal. Such heterozygotes when crossed with homozygous recessives (normal tall or dwarfs) would give a 1:1 segregation of progenies into the parental inflorescence types and this is apparently what is encountered in nature in the *spicata* palms so far studied. Such a possibility seems all the more strong as the *spicata* palms are obligate out-crossers. Also, the chances of crosses between *spicata* palms as well as occasional selfing however, cannot be completely ruled out. Considering the consequences of such events in a heterozygous *spicata* of the constitution Ss, it will be seen that selfing or intercrossing between heterozygotes would produce identical results, i.e. segregation of progenies into *spicata* and normal in a 3:1 ratio. Progenies of homozygous dominants would, however, all breed true to type under selfing, intercrossing or crossing with normals. Available evidences and previous reports on progeny behaviour of *spicata* mothers, however, indicate that a 1:1 segregation takes place in nature, thereby suggesting that such progenies are the result of *spicata* (Ss) x normal crosses, taking place in nature. It would, however, be essential to obtain data on controlled *spicata* x normal crosses as well as selfing of *spicata* before a definite opinion can be expressed. Since we are dealing only with inflorescence characters, it is quite sufficient to perform *spicata* x dwarf crosses instead of *spicata* x tall which would have the additional advantage of early flowering in the progeny (due to inclusion of dwarf elements) and thus facilitate quicker assessment of results. Data on selfing of *spicata* palms are very important for confirmation of results of *spicata* x normal crosses. The selfing process, however involves more delay due to the reduced vigour and consequent late flowering of most of the selfed plants and the larger number of progenies that will have to be tested for verification of the expected 3:1 ratio. The results of selfing would also show whether the *spicata* character is actually due to dominants or it is only a consequence of structural chromosome changes (referred to elsewhere in this paper), since it is known that interchange heterozygotes give the same 1:1 ratio under selfing, sibbing or crosses with normals (Burnham, 1956).

If it is assumed that the *spicata* is inherited as a simple Mendelian dominant, as available information would suggest, it should be expected that there should be cent per cent true breeding individuals in nature and it

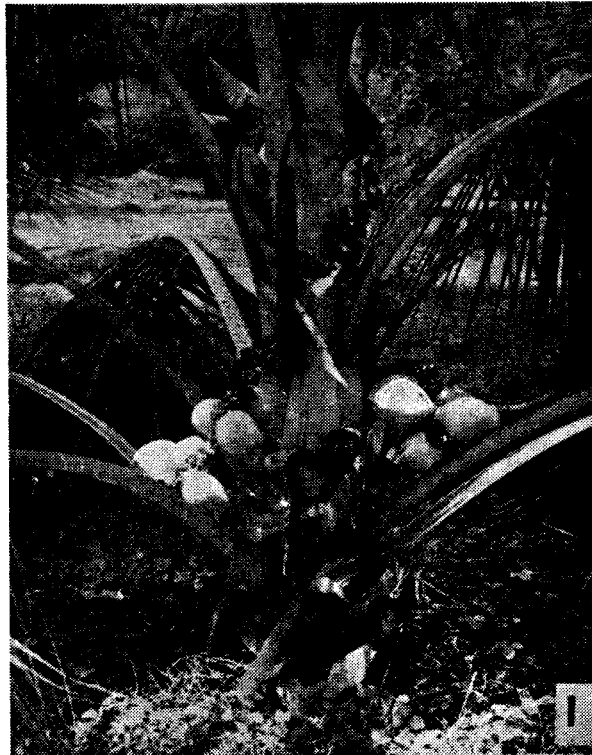


Fig. 1 A six-year old progeny of a *spicata* palm. Note the unbranched inflorescence and bunches bearing nuts.

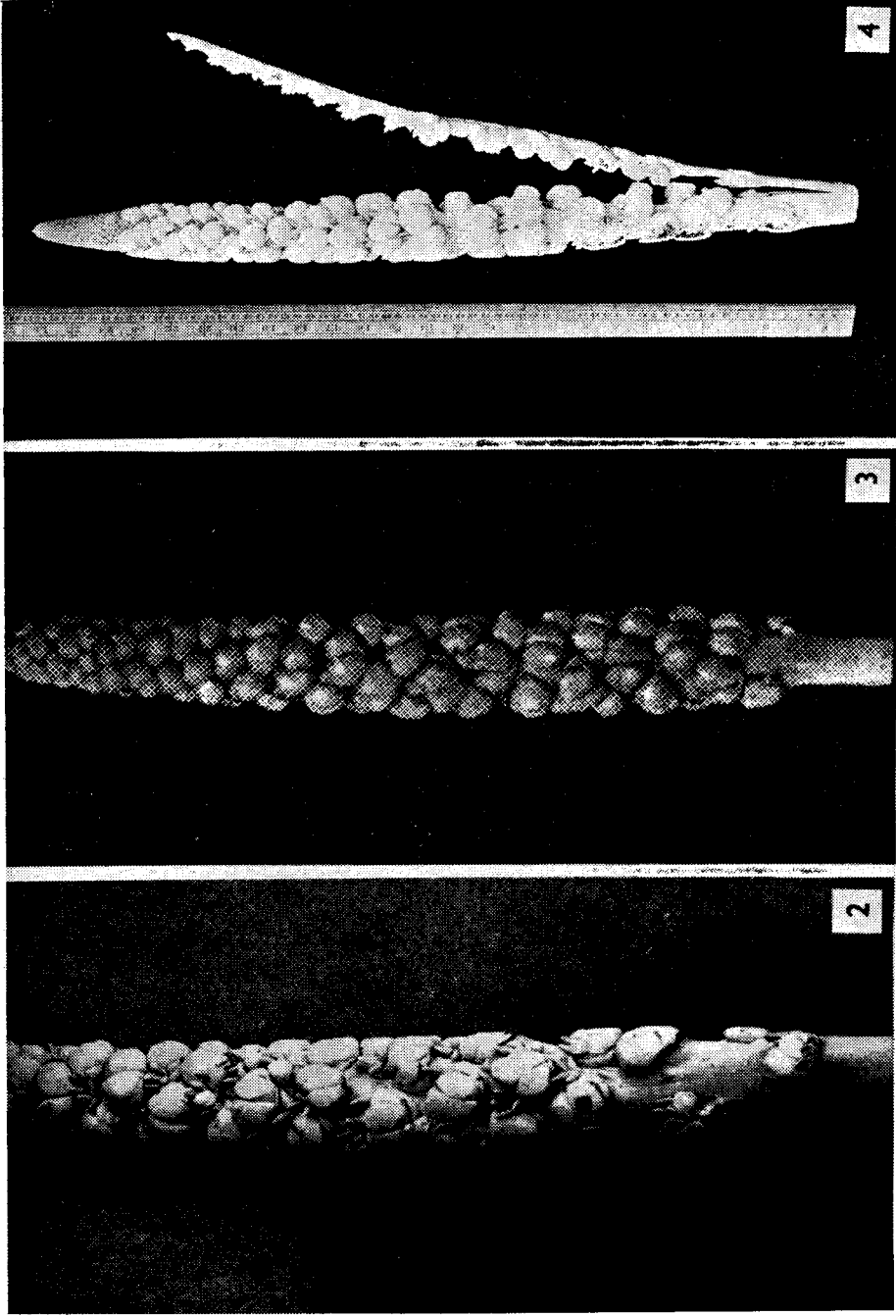


Fig. 2. Portion of a *spicata* inflorescence showing the male flowers amidst the closely arranged female flowers.
Fig. 3. A *spicata* inflorescence without an exclusively male flower bearing portion at the tip.
Fig. 4. A *spicata* inflorescence with a side branch bearing both male and female flowers. Note the upper portion of the peduncle bearing exclusively male flowers.

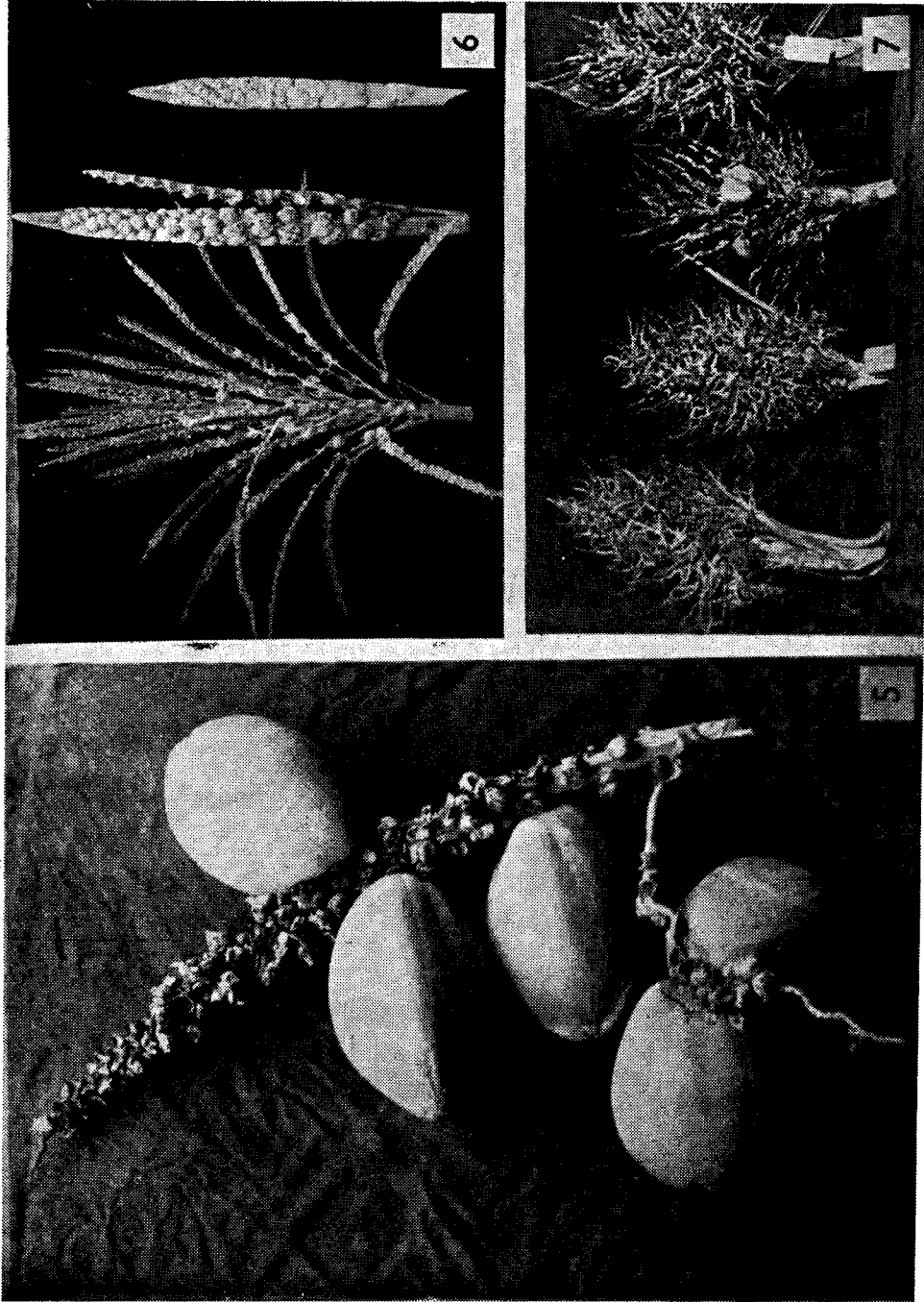


Fig. 5. A *spicata* bunch bearing nuts on the side branch of the inflorescence.
Fig. 6. A normal and two *spicata* inflorescences.
Fig. 7. Inflorescences of a male tree. Note the highly branched nature of the spadix.

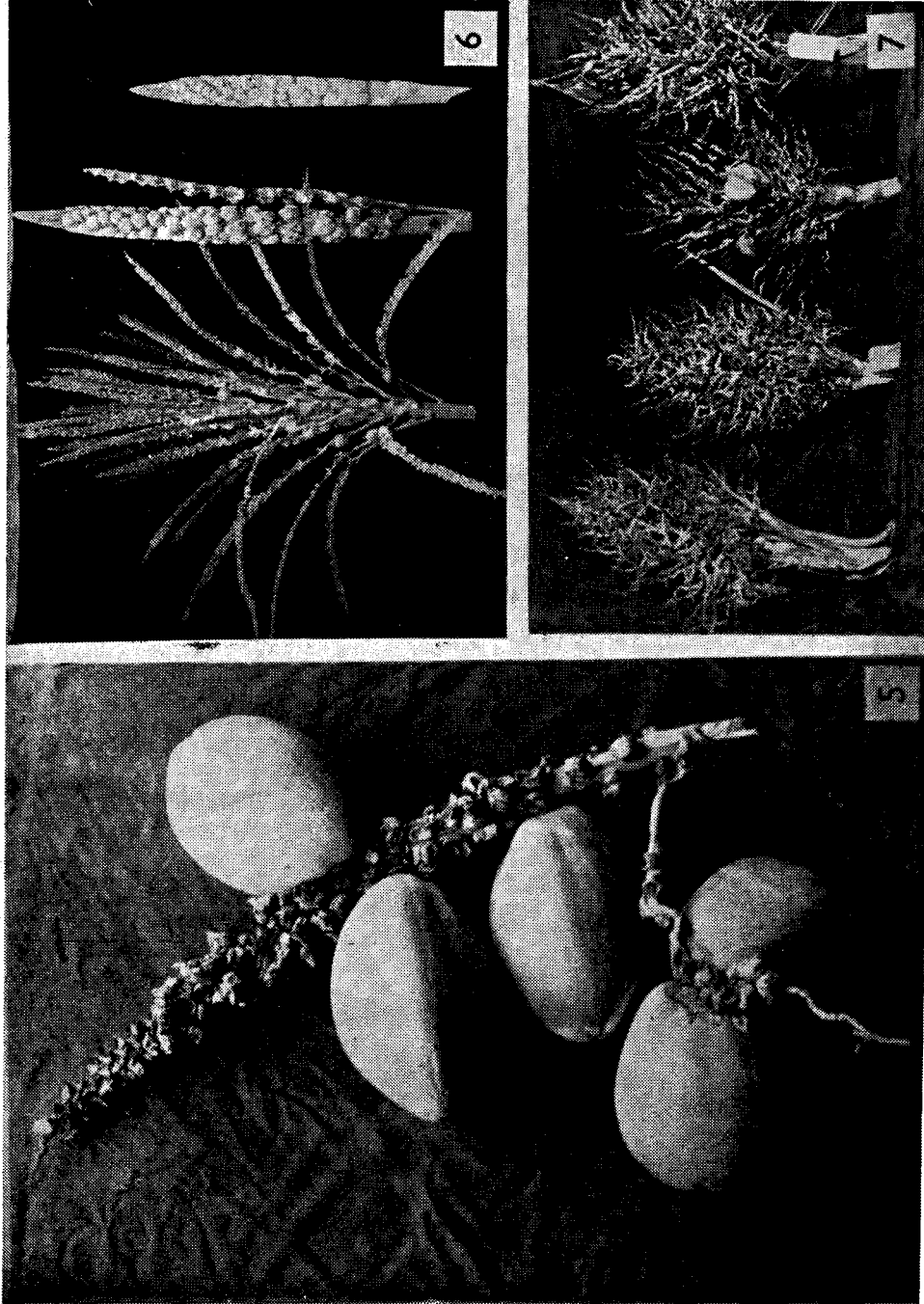


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should also be possible to produce them artificially. So far there is no record on such palms, but it is extremely important to find out whether they exist, or all *spicata* palms are only heterozygotes giving segregation of progenies to *spicata* and *typica*.

CYTOLOGY OF SPICATA PALMS

With a view to study whether the *spicata* palms show any cytological peculiarities, detailed investigations on meiosis in a few *spicata* trees were carried out. While the cytological details will be published elsewhere (Ninan *et al.* 1962), observations that might possibly have a bearing in the present context only will be presented here. The chromosome number in this variety is $n = 16$ (Ninan *et al.* 1960) as in the ordinary tall and dwarfs (Abraham *et al.* 1960, Nambiar and Swaminathan, 1960, Sharma and Sarkar, 1956). While meiosis in the tall variety is quite regular (Abraham *et al.* 1962, Swaminathan and Nambiar, 1961), the *spicata* palms showed evidences of structural chromosome changes like cross-shaped and T-shaped configurations indicating translocations, duplications of chromosome segments and inversion loops (with differential segments again within some of the rings) at pachytene. Quadrivalents at diakinesis and "groups" of varying numbers of chromosomes suggestive of interchange multiple associations as well as those resulting from considerable stickiness of chromosomes have been observed at metaphase and anaphase I. Other meiotic irregularities like lagging bivalents at metaphase, formation of monads, diads, triads, pentads, polyads, micronuclei etc. have also been met with. Pollen sterility was found to be about 12 per cent in the *spicata* palms.

Possible origin of *spicata* palms:

It is not known whether *spicata* or *typica* represents the ancestral condition, and it can only be a matter of speculation until detailed information on the cytogenetics of this character is known. It would, however, be interesting in the light of cytological and genetical evidences already available to speculate as to whether *spicata* or *typica* represents the ancestral condition. Davis (1959) has observed that "the *spicata* palm with its highly reduced number of male flowers is showing an expression towards unisexuality (female). Since dioecious condition in plants is considered to be more towards evolution, the *spicata* palm may be regarded as more evolved than the ordinary coconut palm". Liyanage (1958) considers it to be a case of "sex-suppression". This and evidences of altered sex expression like "male" palms, bulbil bearing palms, etc. might suggest that these are only variants from the ordinary tall variety, which should then be regarded as representing the ancestral situation. Available evidences from breeding behaviour indicate that the *spicata* palms so far studied are heterozygotes, and in the absence of cent per cent true breeding individuals (homozygous dominants) or any known mechanism resulting in the elimination of homozygotes (SS), it cannot be decided whether the heterozygotes are derivatives (mutants) from normals or products of

spicata is tall coconut. Evidences from cytology indicate that the *spicata* palms are complex structural hybrids with heterozygosity for several chromosome rearrangements and that meiosis in them is aberrant compared to that in the tall. Since more stable meiosis is met with in wild types, this may perhaps suggest that *spicata* represents a derived condition from normal tall. It is now known that meiosis in the dwarf coconuts which are believed to be products of progressive inbreeding in tall, is also aberrant compared to the tall (Swaminathan and Nambiar, 1961). The presence of structural chromosome alterations in *spicata* palms further suggests the probability that the *spicata* character itself might be a consequence of this, though further evidence would be necessary to confirm this view. If so, the *spicata* would represent a derivative from the tall variety. Such a possibility is further indicated by the fact that there are several variations from the typical inflorescence (Fig. 6 & 7) like *spicata*, 'bulbil' bearing bunches of different types (Davis, 1948, 1954; Thomas, 1961) branched inflorescences of male trees, terminal inflorescences in seedlings that flower in the nursery, etc. (Menon and Pandalai, 1958) and it appears likely that the loci controlling the inflorescence characters are highly mutable and that mutations at the gene or chromosomal level might be responsible for the wide spectrum of abnormalities of the inflorescence and flower characters in coconuts (Ninan and Ratnam, 1961).

Another observation that is of interest in this connection is that *spicata* palms have not so far been reported in the dwarf variety which it is believed has originated from the tall variety (Menon and Pandalai, 1958; Swaminathan and Nambiar, 1961). If the *spicata* represents the ancestral condition, it is only reasonable to expect *spicata* palms among the dwarfs also. It is also of interest in this connection, that the vast majority of abnormalities on record in coconuts have been encountered in the tall. The absence of *spicata* character in the dwarfs which are predominant selfers might further show that it is only a variant of the tall variety - possibly related to heterozygosity for chromosomal rearrangements or due to heterozygous dominants.

It would thus be seen that the weight of evidence points to a secondary origin of *spicata* palms from normal tall palms, though further studies would be necessary to confirm this. There is thus increased need for detailed studies on the cytogenetics of this interesting character, though it requires a minimum of one decade to gather information from genetic experiments.

Taxonomic position of *spicata* palms.

Whether the *spicata* palms should be considered as constituting a distinct botanic variety, or it is only an abnormality which does not deserve taxonomic recognition is another problem that deserves consideration in this connection. In earlier literature it has been considered only as a freak or monstrosity. Jacob (1941) was the first to consider this as a distinct botanic variety which he described as *Cocos nucifera* var. *spicata*. K. C. Jacob, Natarajan and John (1948) consider this to be a distinct variety like *spicata* or

nana. Davis (1959) describes this under 'freaks of nature' series. Liyanage (1958) has pointed out that varietal recognition based purely on sex expression like *spicata* and *androgena* (male tree) is rather doubtful since the genetical behaviour of such characters have not been studied. It would appear that in the present state of knowledge, there is no justification for considering *spicata* as a distinct botanic variety on the same taxonomic status as *typica* or *nana*. Considered only as a case of "sex suppression" in the tall variety and as a variant of this, varietal recognition may not be necessary, especially as it is not true breeding in the strict sense. It can better be considered as a form of variety *typica* following Reitz (cf. Valentine and Love, 1958) who prefers the term *forma* for sporadic and occasional variants. If on the contrary, it is found that *spicata* represents the ancestral situation and that there are cent per cent true breeding individuals, varietal recognition may be justified.

Utility of *spicata* palms in coconut breeding:

Though there is not much difference in yield of nuts of *spicata* compared to the *typica* segregates from *spicata* mothers it is observed that the latter show increased copra content per nut and in this respect it is found to be better than the ordinary West Coast tall palms as shown in the Table below:

Comparison of copra characters of *spicata* and *typica* progenies

Variety	Mean thickness of kernel	Mean weight of copra per nut (gms.)
<i>Spicata</i>	1.2	140
<i>Typica</i> (Segregants)	1.35	222
W. C. Tall	1.25	158

Narayana and John (1949) have also observed that *typica* progenies of *spicata* are very vigorous. It is also reported that progenies of *typica* and *spicata* crosses conducted in the Agricultural Research Station, Nileshwar, showed hybrid vigour (Pieris, 1960). It would, however, appear that before it would be possible to utilise this vigour in coconut breeding, a study on *spicata* segregates in *typica* x *spicata* crosses would be necessary, since the *spicata* progenies are not economic types. Also, unless it would be possible to distinguish between *spicata* and *typica* seedlings in the nursery, this vigour cannot be exploited economically, since the frequency of *typica* progenies from *spicata* mothers is only 50 per cent in nature.

SUMMARY

In the light of evidences obtained from cytological study and data on progeny behaviour of *spicata* palms, some considerations regarding their possible origin, taxonomic status and utility in coconut breeding are discussed. It is seen that the weight of evidence is in favour of the view that *spicata* might be a derivative of the tall variety. The need for further study on *spicata*, particularly of selfed progenies, for clarification of the genetics of this character is also stressed.

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