SPORAD FORMATION AND POLLEN FERTILITY OF NINE LOCAL COCONUT CULTIVARS

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ABSTRACT

Sporad formation and pollen fertility were studied in nine local coconut cultivars. Varying frequencies of abnormal sporads such as dyads, triads, pentads, hexads and heptads were observed. Normal sporads (tetrads) occurred highest in Lingkuranay (99%) and lowest in Coconiño (58%). Pollen fertility ranged from 66% (Coconiño) to 96% (Baybay Tall). Significant positive correla tion ($r = 0.75$) was seen between tetrad frequency and pollen fertility percentage.

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KEY WORDS: Coconut. Sporad formation. Pollen fertility.

INTRODUCTION

Aberrant sporads were among the commonly reported meiotic irregularities in coconut. Abnormalities like lagging chromosomes, multipolar spindle formation, dicentric bridge and its associated acentric fragment formation occur in coconut and usually lead to polyspory while disjunction of chromosomes possibly causes the development of sporads with less than four spores. Abnormal sporads, specifically those with micronuclei, would very likely produce sterile pollen.

A few studies on coconut cytology reported varying degrees pollen sterility. Tan (1969) observed 11, 30 and 40% pollen sterility in Philippine coconut cultivars Laguna, Coconiño and Tambolilid, respectively. Likewise, Swaminathan and Nambiar (1961) reported 15-35% pollen sterility in their study on several foreign semi- tall and dwarf varieties. In both cases, regular meiosis occurred in cultivars with high pollen fertility whereas cultivars with relatively higher pollen sterility have more meiotic abnormalities.

Pollen fertility of the breeding materials at the Regional Coconut Research Center at ViSCA has neither been assessed nor the presence of meiotic irregularities and their association with pollen sterility been determined. These information are necessary to determine the causes of the observed low pollen viability during pollination and to formulate means of improving pollen germinability and fruit setting. This study therefore assessed the degree of occurrence of aberrant sporads in nine local coconut cultivars, and determined its association with pollen sterility. Pollen fertility of each cultivar was also noted.

MATERIALS AND METHODS

Determination of Meiotically Active Stages of the Coconut Inflorescence

Five representative sample palms were randomly chosen from each bearing dwarf coconut cultivar namely, Albuera Dwarf (ALBA), Camotes (CAM), Catigan (CAT), Coconiño (CCN), Lingkuranay (LKY), Orange Dwarf (OD), Tacunan (TAC), Yellow Dwarf (YD) and the indigenous Baybay Tall (BAY) population. A few male florets were collected from each unopened spathe of trees with newly opened inflorescences at different times of the day to identify the spathe number and peak period of meiotic activity of each cultivar. Collected samples were immediately fixed in freshly prepared Farmer's solution (three parts 95% ethyl alcohol + one part glacial acetic acid + traces of ferric chloride) and kept at room temperature for 24 hours. They were transferred to 70% alcohol and refrigerated until used for microscopic examination following the simple acetocarmine squash method. During the latter half of the study, samples were kept in chloroform instead of transferring them to 70% ethyl alcohol. This procedure removed most of the oil droplets from the meiotic cells.

Subsequent samplings from the meiotically active spathes whose numbers varied according to the cultivar were done during the identified peak period of meiotic activity.

One hundred sporads per cultivar were randomly observed. The different sporad types were noted and their frequencies were recorded.

Pollen Fertility Test

Five consecutive spathes per sample tree were used for pollen fertility study. Unopened mature florets from newly opened spathes were gathered. Pollen from five florets per sample spathe were mixed in a slide and stained with I_2KI. Fertile pollen frequency was determined from 20,000 pollen grains per sample tree (4,000 per sample spathe). Well rounded, full and well stained pollen grains were considered fertile whereas those which were shrivelled, empty or with partly stained cytoplasm were considered sterile.

RESULTS AND DISCUSSION

Meiotically Active Stages of the Coconut Inflorescence

Meiotically active cells of ALBA, CAM, CAT, CCN, LKY and OD were obtained from inflorescence number 3 (the newly opened spathe was considered as inflorescence number 1). In BAY, YD and TAC however, inflorescence number 4 showed meiotic activity. This deviates from the report of Ninan et al. (1960) that meiotic stages were observed in the third inflorescence in all *Cocos nucifera* varieties they studied. This is probably due to the relatively narrower genetic variability in their *C. nucifera* materials. Meiotic activity in the fourth inflorescence was seen in *Cocos australis,* another species with lesser chromosome number (2n = 30). No difference was noted among trees in a population.

The peak of meiosis was between 9:00 and 10:00 a.m.

Sporad Formation

Sporad formation in ALBA, BAY, CAM, LKY and TAC appeared to be almost normal. Aberrant sporads in these cultivars were less than 10% (Table 1) with LKY having the least (1%). On the other hand, the frequency of abnormal sporads in CAT, CCN, OD and YD ranged from 18-42%, with the highest value recorded in CCN. CCN had four aberrant sporad types whereas LKY had only one. These observations are quite interesting since LKY and CCN were previously considered the same cultivar because of morphological similarities. The observed difference in their sporad formation is a strong evidence that these cultivars are distinct from each other.

Aside from the normal tetrad type; dyads, triads, pentads, hexads and heptads were noted (Fig. 1). BAY, CCN and OD exhibited the widest range of aberrant sporads.

Abnormalities in the first and second meiotic divisions could have resulted to irregularities in sporad formation. The observed occurrence of laggards, bridges (without the usually associated acentric fragments), multiplate formation, unequal chromosome distribution and unsynchronized chromosome movement in the second meiotic division might have led to micronuclei formation, polyspory or development of

Table 1. Type and frequency of sporads formed in nine local coconut cultivars.

Cultivar	Frequency (%)					
	Dyad	Triad	Tetrad	Pentad	Hexad	Heptad
Albuera Dwarf	1	2	96	1	0	0
Baybay Tall	4	1	93	1	1	0
Camotes	0	5	92	3	0	0
Catigan	0	16	77	5	2	0
Coconiño	0	9	58	30	8	5
Lingkuranay	1	0	99	0	0	0
Orange Dwarf	2	9	78	9	2	0
Tacunan	0	0	97	3	0	0
Yellow Dwarf	0	10	82	3	5	0

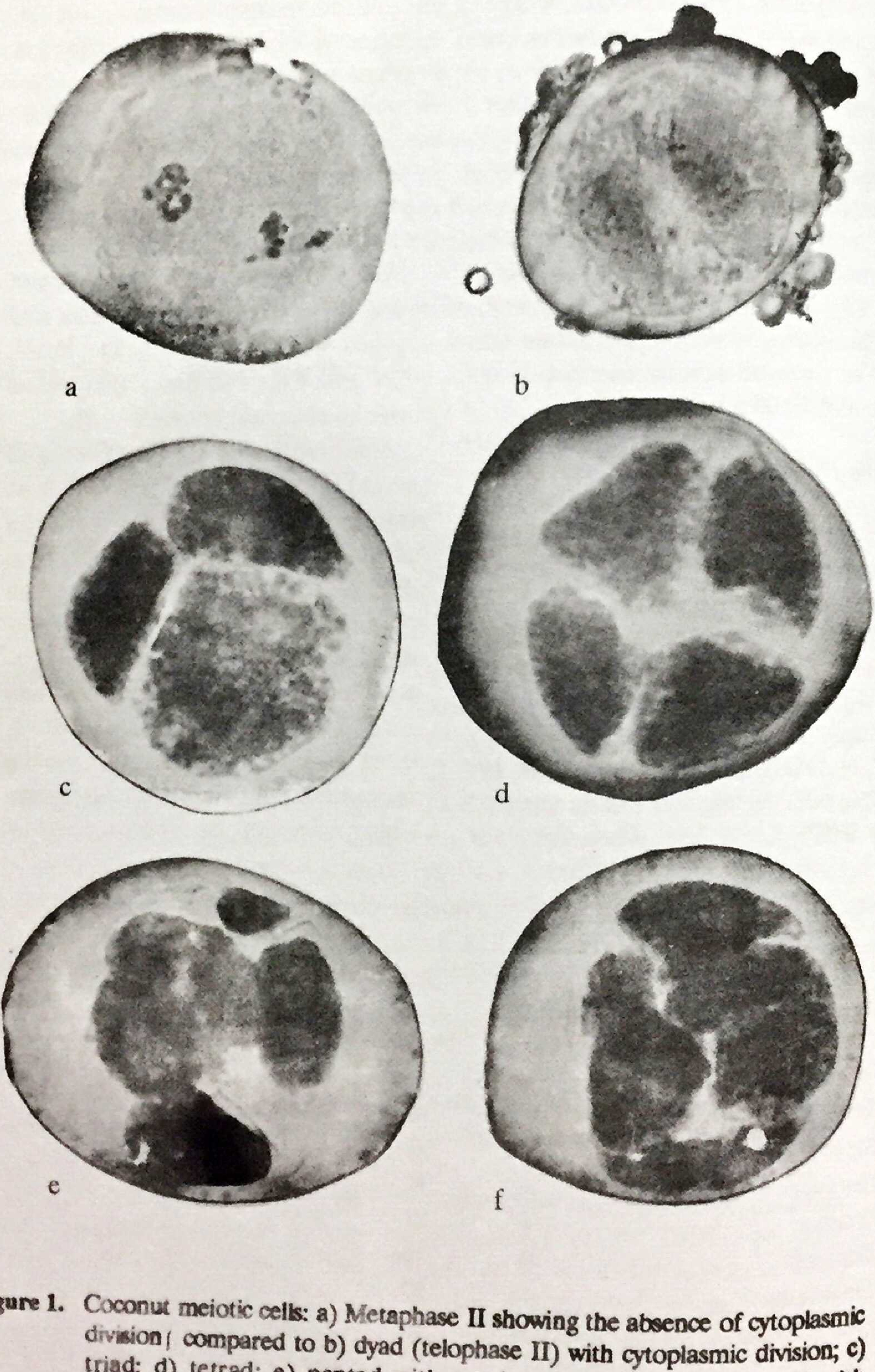

Figure 1. Coconut meiotic cells: a) Metaphase II showing the absence of cytoplasmic division, compared to b) dyad (telophase II) with cytoplasmic division; c) triad; d) tetrad; e) pentad with a micronucleus; and f) heptad with micronuclei.

Figure 2. Different spore orientations in sporads.

sporads with less than four spores. Varying numbers and sizes of micronuclei were also noted.

Differences in spore orientation in the sporads were observed (Fig. 2). These might be due to the differences in spindle fiber orientation at metaphase II which influenced chromosome movement at anaphase II. However, spore orientation has no effect on pollen fertility.

Pollen Fertility

Except for CCN with a mean of 66% pollen fertility, the local coconut cultivars studied generally showed high pollen fertility based on their stainability (Table 2). Aside from relatively low pollen fertility, the data gathered from CCN were also quite variable. On the other hand, Baybay Tall with a fairly high percentage of normally looking sporads had the highest percentage of fertile pollen and the narrowest range in values.

Slight differences in size were also noted among the stainable (fertile) pollen grains of each cultivar and among the sterile pollen. Some of the stainable pollen might have come from the sub-haploids which lack at least one chromosome thus appearing smaller than the normal ones. Since the micronuclei varied in size; the empty, shrivelled and unstainable pollen that could have developed

Table 2. Pollen fertility of nine local coconut cultivars.

Cultivar	Pollen Fertility (%)		
	Range	Mean	C.V. (%)
Albuera Dwarf	83 -95	89	4.6
Baybay Tall	91 - 98	96	1.9
Camotes	85 - 95	92	2.3
Catigan	75 - 96	89	5.3
Coconino	31 - 89	66	18.4
Lingkuranay	66 - 92	83	6.0
Orange Dwarf	63 - 94	83	7.5
Tacunan	48 - 97	91	11.0
Yellow Dwarf	48 - 92	79	10.7

from them are also expected to differ in size.

Except for CCN, TAC and YD; the fertility of pollen grains from different sample trees per cultivar and even the pollen fertility data from five spathes per sample tree which were collected within a span of at least 5 months differed very slightly. This implies that individual tree selection is not necessary during pollen collection and that pollen fertility does not vary much with changes in season except perhaps for the aforementioned cultivars.

Considering further the high pollen fertility of most cultivars studied, the low viability during pollination is apparently due to poor storage and handling of pollen. Hence, the present handling procedures must be reexamined to devise ways of improving germinability of the processed pollen.

In the case of low pollen fertility in CCN, increasing the amount of pollen for pollination may increase fruit setting percentage.

Correlation Between Normal Sporads and Pollen Fertility

Statistical analysis showed significant positive correlation ($r = 0.75$) between the frequency of tetrads (normal sporads) and pollen fertility of the sample palms. This can indicate the major role played by meiotic aberrations in the development of sterile pollen in the cultivars studied.

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