SUMMARY

BACKGROUND INFORMATION: The pollen grains being the male partner in the reproductive biology of the flowering plants, it has a vital role to play in the production of fruits and seeds for sustaining the food needs of man. The importance of pollen in plant improvement has been understood by man as early as 700 B.C., as evident from the stone carvings of Assyrian period showing winged human beings pollinating the date palm. Scientific knowledge building on pollen biology began with the discovery of the compound microscope by Robert Hooke in 1756 and since then botanical pursuits covered in pollen studies to result in the understanding of the relevance of pollen in plant biology. A very definite scientific beginning to the study of pollen structure was made with the publication of the book “Pollen grains” by Wodehouse (1935), followed by another publication “Pollen Morphology of Angiosperms” by Erdtman (1952).

During the last 50 years, fast progress has been made in the knowledge of pollen architecture aided by the advances made in optical technologies, particularly the TEM and SEM. It is now clearly established that pollen morphology is of application in plant taxonomy and evolution at various taxa levels down to natural varieties and even cultivars.
The structural features are attributed to the exine and the dual characteristic of protection and diagnosis is unique to pollen units. Genetical changes due to various factors are reflected in pollen morphology, which has given a new dimension of application of morphology in the biology of plants. This is particularly important in view of the fact that pollen morphology serves to resolve the breeding system of crop plants and its wild allies giving new directions for plant improvement practices. It is in this background that the study of pollen morphology of coconut cultivars has been taken up for the present investigation.

**MATERIALS AND METHOD:** The pollen materials consisting of male flowers has been procured from the CPCRI, Kasargode, Kerala, India, where a sizable germplasm collection of the crop from various parts of the world is maintained. In the present study, 44 cultivars representing South America, Africa, Pacific Islands and South East Asia covered by India, Sri Lanka, Malaysia, Indonesia and Vietnam are considered.

Pollen preparations have been made by the acetolysis method of Erdtman (1952) modified by Nair (1970). Data generation of pollen morphology has been made from Light Microscope (LM) and Scanning Electron Microscope (SEM) studies and morphological analysis based on proposals by Erdtman (1952) and Nair (1970), associated also by new terms and expressions has been necessitated by the present investigation.
OBSERVATIONS: In order to characterise pollen morphology of each variety, the general procedure has been to resolve all the characters into five groups namely Aperture, Exine Ornamentation, Exine Strata, Pollen Size and Shape, in the order of the importance in comparative morphology.

A special feature in coconut pollen is the occurrence of dimorphism with monocolpate-elongate and monoporate-spheroidal pollen types, the percentage of each of which vary with the varieties warranting also been taken into consideration. For reasons of comparative analysis of the pollen morphology, the monocolpate pollen has been considered as the standard form for descriptions. In the monocolpate form, the aperture position is distal and into form and structure varies in the varieties. In order to explain the exine ornamentation, the grain in lateral view has been taken and such a grain has been resolved into (i) Distal point (colpus end) (ii) Proximal point (diametrically opposite to colpus end) (iii) the lateral extremities of colpus (iv) lateral surface (area between the distal face and proximal face). In recording pollen size, the longest diameter of colpate grain in lateral view is considered; and in the case of spheroidal grains the diameter is provided.

COMPARATIVE MORPHOLOGY: The aperture is dominantly monocolpate, with the difference that in some varieties, the megaporate–spheroidal types are present very rarely or in larger
percentages. In the monocolpate form, the aperture is furrow-like, with the furrow being wide or narrow, and the colpus margin is fortified by thickenings and very rarely without it. While the edge of the colpus margin is generally even, some varieties have novel characteristics, being sometimes frilled; (var. Borneo) or even segmented (Var. Sri Lankan Yellow dwarf). Among the varieties studied Guam II alone is characterized by the presence of an operculum.

The exine ornamentation as presented by SEM is the most unique feature of coconut pollen. The proximal end of the grain is bestowed with a cap-like structure, formed of dense or lax aggregation or agglutination of powdery granules (described as polar cap). In some varieties, the polar cap is missing, but replaced by other unique characteristics, like the hump (eg. Zanzibar) or thick-segmented ridges (Blanchesuseuse). The nature and extent of the polar cap varies with the varieties and in general, the polar cap formation extends to the lateral ends and to the margin of the colpus as a continuous formation.

The lateral surface is variously ornamented being psilate, echinulate, echinate and striate, the striae being in a variety of forms varying with varieties, in the nature of the muri, the width between adjacent ridges, the fusion and orientation of the ridges leading to a twined, or matted pattern, reflective of the various varieties.
The exine strata is not of any comparative value and so also
the pollen size and shape, although the pollen size can be of subsidiary
value in varietal characterization.

**Pollen Morphology and Cultivar Evaluation:** The
apertural and exine ornamentation characteristics may be considered
to be of considerable value in cultivar evaluation. In such an event
single or combination of characters has been noticed to be relevant
even at the micro taxa levels, (eg. Colpus edge), as evident from the
following instances.

Colpus faintly developed : Malayan Yellow Dwarf

Colpus narrow : Federated Malay States

Colpus narrow and disrupted : Philippines Ordinary
(by diffuse fusion of edges)

Colpus operculate and polar cap arched : Guam II

Colpus edge profusely toothed : Cameroon Red Dwarf
(echinulate)

Colpus edges scarcely toothed : Kappadam
Colpus edge distantly toothed : Malayan Tall

Colpus edge frilled : Laccadive Micro

Colpus edge segmented : Sri Lankan Yellow Dwarf

Exine lateral surface formed into massive ridges : Borneo Tall

Exine lateral surface formed into rounded hillock structures : Niu Leka Dwarf

Among other typical characteristics of value in cultivar authentication, the following informations may be provided.

Polar cap absent : Laccadive Ordinary

Polar region humped : Cochin China

Polar region cleft : Sri lankan Yellow Dwarf

Polar region dissected, striate : Blanchesseuse

Polar cap lax : Laksha Ganga
Polar cap zonate : Seychelles Tall

Lateral surface rugulate- (striate rugulate; rugulae straight) : Benaulim

Lateral surface echinulate : San Ramon Tall

Lateral surface reticulate : Kulasekhara Yellow Dwarf

Whole grain granulate : Cochin China

Surface striato – reticulate : Zanzibar Tall

**EVOLUTIONARY AND ECOLOGICAL CONSIDERATIONS:** The polar cap and pattern of lateral surface could possibly be considered in designing the status of morphological evolution in coconut pollen. The varieties with polar cap are the most common but there are a few varieties without the cap, but with other structural features. This gives the direction that there are two lines of diversification one with cap and another without cap. While it is very complex to make a generalization on morphological evolution of all the varieties taken together; it could be possible to develop some standards for coconut
diversification on the basis of pollen morphology, considering that the psilate form could be more primitive and that matted form is the most advanced. Considering the various geographical zones, the diversity is perceptible with the varieties within any one geographical zone and very special features such as segmentation of the colpus edge, the formation of operculum, or else the variations in exine topography could be the result of local ecological impacts. On the basis of comparative characterization, and commonalities of characteristics the varieties studied could be considered to have been dispersed along two possible lines of movement of the coconut fruits from its original home in South America, namely Africa–West of India route and the Pacific islands South Asia route including east of India. In certain varieties locational specificity, as an evidence of ecological adaptation, is of significance.

The pollen data provide ample evidence to substantiate cultivar characterization made on the basis of nut characteristics. The pollen data have provided a new parameter in defining the route of migration and changes that occurred during the course of naturalization of the crop, along a wide expanse of the coastal belt covering South America, Africa, Pacific Islands, and South East Asia. Therefore, the information from pollen morphology could be beneficially utilized in gaining new knowledge on coconut biodiversity and dispersal.