Occurrence of bizarre/freakish inflorescence in coconut palm

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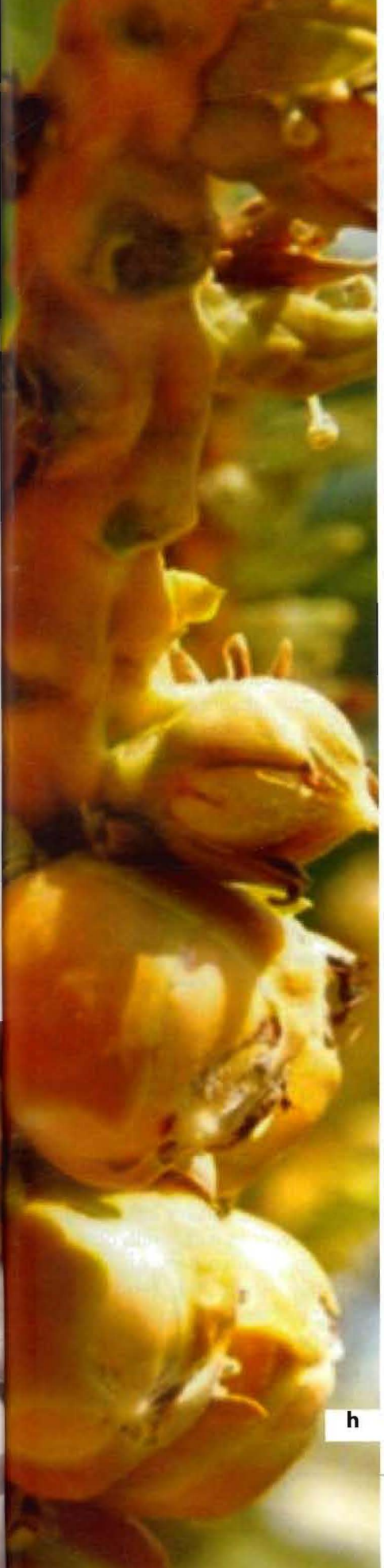
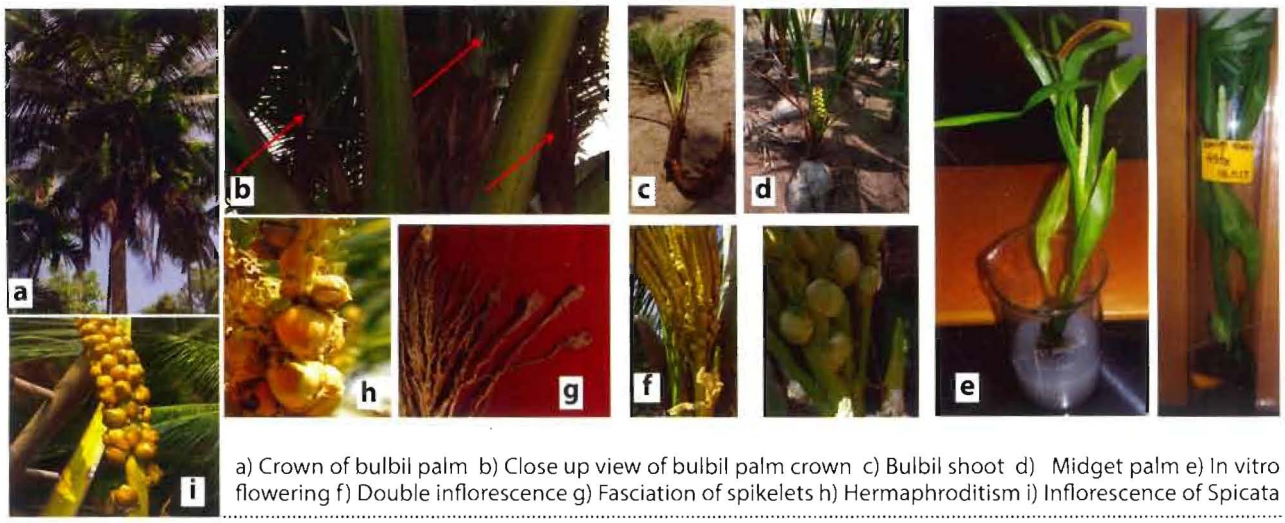


The coconut, *Cocos nucifera L.* is one of the most useful plants to the humans and every part of the palm was being useful from very ancient times. The palm is monoecious with distinct male and female flowers borne on the same inflorescence. The coconut inflorescence is known as a 'spadix' which is borne singly in the axil of each leaf. The male flowers are borne on the top portion of spikelets and female flowers are situated at the base of the spikelets.

The production of inflorescence commences as a vegetative meristem that later gets converted into floral primordia. The transition of vegetative meristem to the flowering state has been considered to be controlled by genetic factors combined with environmental factors like temperature, daylight and the developmental state of the plant. In most flowering plants, there is a clear differentiation of vegetative and reproductive growth phases, whereas in palms like coconut, these phases are continued even after the first flowering, throughout its life time, wherein a single terminal bud continues to produce leaves whereas the axillary buds regularly get converted into inflorescence, which subsequently produce flowers and fruits.

In coconut, the inflorescence primordium is reported to develop in the leaf axils about 32 months before the opening of the inflorescence. The primordia of the branches of inflorescence develop in about 16 months and male and female flowers in about 11 and 12 months, respectively before the opening of the inflorescence. The ovary normally differentiates 6-7 months before the opening of the inflorescence. Various environmental factors including nutrition during the 32 months period before the opening of inflorescence affects the yield of coconut. In coconut, the spathe (inflorescence) opens at the 32nd month and fertilization takes



a) Crown of bulbil palm b) Close up view of bulbil palm crown c) Bulbil shoot d) Midget palm e) In vitro flowering f) Double inflorescence g) Fasciation of spikelets h) Hermaphroditism i) Inflorescence of Spicata

place during the 33rd month after initiation of the floral primordium. The nut development process takes 10-12 months after female flower fertilization depending upon the season. In exceptional cases, the inflorescences of coconut show some abnormalities in the development creating curiosity. Such variations could be due to genetic/epigenetic/ physiological reasons. Some of the abnormal/rare traits observed in inflorescences are reported in this article.

1. Bulbils

Usually the leaf axil of a normal bearing coconut palm subtends to an inflorescence. In bulbil forming palms, these spadices, spikes, female flowers and male flowers gets transformed into vegetative shoots either in part or fully due to genetic and environmental factors. These are known as bulbil-shoots on account of their similarity to bulbils seen in certain members of Agavaceae and Liliaceae families. The term 'bulbil' denotes small, young plant that is reproduced vegetatively from axillary buds on the parent plant's stem or in place of a flower on an inflorescence. The palm resembles normal coconut palms in its morphological appearance, except that they produce only bulbil shoots in place of normal inflorescence and hence do not produce nuts. At the time of emergence from the leaf axil, the shoot like structure just resembles a normal inflorescence with a green spathe covering the growth. In the bulbil shoots, the emerging spathe was observed to split vertically to expose spathes with leaf sheath and the top as leaflets. The transformation of reproductive structures into vegetative shoots may be due to certain genetic and environmental factors. The phenomenon is also known as pseudo vivipary as it is akin to development of seedlings still attached to the mother palm. In bulbiferous palms, the terminal bud continues to produce leaves and the axillary buds grew into spathe like inflorescence and then get converted into bulbil shoots making the palms completely vegetative. However, the root formation of such bulbil shoots was not observed in these palms.

2. 'Midget' coconut palm

In coconut nursery, rarely certain coconut seedlings flower at the early infant stage and are referred as "midget" palms. The inflorescence produced is terminal and they soon die after producing the first inflorescence. Such inflorescence is conspicuous for the absence of the spathe. They bear only female flowers and these ranged upto eleven in an inflorescence. These palms are normal in their habit with adventitious root system. The inflorescence appeared at the terminal portion of the short regular stem. Presence of unsplit leaflets in midget palm is a remarkable feature and the leaves of this palm have narrow stipular sheaths. Decrease in size of leaves was noticed and the last two leaves appeared at the base of the inflorescence resembles bracts which enclose the young spadix. This decreasing size of leaves and terminal inflorescence are rare occurrence among coconut palms which bear axillary inflorescence. However this is generally observed in some members of monocot family where the terminal bud transformed into an inflorescence or flower.

In midget palms the inflorescence is a simple spadix without a regular spathe but

the two bracts found just below this terminal inflorescence serves the function of spathes. Midget palm dies or wither after flowering and this palm is monocarpic according to Morris (1892) instead of polycarpic normal palms. Hence this phenomenon of early flowering in seedling stage has no significant utility to the farmers since the palm dies before producing any nut. Immature or infant flowering in midget palm may be due to some photoperiodic induction occurred in the unsplit immature leaves of the palm because these partially matured leaves are highly sensitive and capable of initiating flowering through photoperiodic response. The midget palms are usually noticed in progenies of dwarf palms.

3. In vitro flowering

A case of in vitro flowering was noticed at ICAR-CPCRI Regional Station, Kayamkulam in tissue culture plantlets of West Coast Tall (WCT) cultivar. Immature inflorescence was used as the explants. The transition of vegetative shoot to reproductive state was accompanied by some morphological changes in the in vitro raised plantlets which include rapid emergence of long and thin leaves before the appearance of pearly white inflorescence. As in midgets, the emergence of inflorescence was terminal and the inflorescence was devoid of spathe. Usually the conversion from vegetative to reproductive growth in vitro is regulated by various external and internal factors, which include plant growth regulators, nutrients, pH of the medium and light conditions. Prolonged sub-culture in the same media might have resulted in changes in pH and reduction in organic and inorganic constituents of the media and the resulting chemical stress might have induced in vitro flowering.

4. Double inflorescence

A rare occurrence of double inflorescence in one leaf axil of Chowghat Green Dwarf variety of coconut was noticed. Each of the two spadices was independent with fully developed spathe with normal spikelets bearing male and female flowers. However, the size of one of the spadices was smaller with only seven spikelets and five female flowers. Outer spathe was common to both spadices and therefore external appearance before the opening of inflorescence was normal. The double inflorescence was observed in only one inflorescence of the palm indicating that this may not be due to genetic factors

5. Fasciation of spikelets

In fasciated spikelets, the proximal end of some of the spikelets is flattened. The spikelets bear normal male female flowers. The fasciation is not observed in all the spikes of the same palms and hence it is not genetic. It may be due to the insect attack or similar injury to the spikelet happened during the meristermatic stage. This injury induces a rapid growth in the meristem and thus enhancing the surface area.

6. Hermaphroditism

Coconut is normally monoecious, bearing male and female flowers separately in the same inflorescence. The male flowers are arranged at the distal end of the spikelet and female flowers at the basal portion. Occasionally some palms which bear hermaphrodite flowers along with male and female flowers. The hermaphrodite flowers are located in between female and male flowers. These flowers are bigger than male flowers and smaller than female flowers. Sectioning of hermaphrodite flowers revealed well developed anthers and ovary. It is reported that some of the hermaphrodite flowers develop into nuts and these nuts are smaller in size than the normal ones.

7. Spicata

Palms with unbranched inflorescences, is referred to as spicata and have rarely been reported from all coconut growing regions. Spicata type is believed to have arisen from Tall coconut types and is associated with meiotic abnormalities. They are tall palms with unbranched inflorescence or inflorescence with one or two small spikes, unlike the normal inflorescences that are branched with 30-35 spikelets. The inflorescences of the spicata palms bear a large number of female flowers (125-130) with very few male flowers (50), in stark contrast to the normal inflorescences, with innumerable male flowers and few female flowers at the base of each spikelet. One of the characteristic features of the unbranched type of spicata is that female flowers are attached throughout the main rachis of the inflorescence, resulting in closely set fruits compared to normal inflorescence. Based on color, three types of spicata have been identified i.e. green, brown and yellow. However, a complete documentation on the morphology, taxonomy and genetic control of the spicata character in coconut is lacking which in turn limits the potential of exploiting this character in the breeding programme. ■