DIKIRI-POL: FALLACIES, FACTS AND THE FUTURE

By

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ABSTRACT

The occurrenee of a *dikiri* type endospenn the porapol and kamandala forms of the vatiety (Typica), has led to the advancement of the hypothesis that dikiri is not a form of coconut with in the Typica vadety, but merely a kernel type, which can occur in any tall form of coconut. The argumentis also made that from an evolutionary point of view, the daid kernel is the manifestation for an undesirable allele, which has been made use of by man for his advantage. A review of the literature examines the mechanism of occurrenee of the dikiri charader and the explanation offered on the aberrant condition of the dikiri kernel.

INTRODUTION

Dikiri pol is a form of coconut, producing a jelly like endosperm, of ten used in the confectionery industry by certain communities of people particularly in the southern part of Sri Lanka. Liyanage (1958) has classified dikiri pol as a form of coconut, belonging to the variety Typica. A coconut cultivar producing an enclospenn similar to dikiri pol, termed Makapuno (meaning 'filled coconut') has been reported from the Philippines. Similar kernel 'peculiarities' have also been reported from Indonesia (kelapa kopjor) and India (Thairu Thengai). It has been described that the makapuno character or the dikiri of the endosperm was controlled by a single Mendelian recessive gene and the 'dikiri' bearing tree, which only occasionally bears dikiri, is heterozygous for the character (Torres, 1937). Ohler (1984) has suggested that it is a genetic character which may appear in any tall variety.

The pollination behavior of the coconut palm was used as the major criterion for the classification of indigenous varieties of coconut by Liyanage (1958). Using this criterion, as dikiripol is outbreeding or cross-pollinating it is classified as a form within the variety Typica (tall), which also includes eight other forms of coconut. Unlike the ordinary tall coconut form, the dikiri nut has thicker arid softer meat and less liquid endosperm, if any, which is more than that of normal nuts. It is generally known that the dikiri endosperm has not yet been observed nor artificially induced in genetically pure normal coconut trees (Cedo et al., 1984).

The kernel character in makapuno has been attributed to faulty carbohydrate metabolism. Balasubramanian et al (1976) have reported the presence of large amounts, of galactomannans in the normal endosperm. Makapuno has five times the galactomarman content as in normal coconut, which accounts for the characteristic, soft, fluffy endosperm arid viscous liquid of the makapuno (Mendoza, et al., 1985). It has been suggested that the enzyme product of the gene responsible for the makapuno (dikiri) character is involved in the metabolic conversion of galactomannans; to free galactose and mannose. Because of the deficiency of @ D-galactosidase in makapuno, an abnormally high level of water-soluble galactomannans result (Mendoza et al., 1984). In turn, the altered galactomannan metabolism leads to the expression of other aberrant cellular behavior and properties of makapuno.

In relation to makapuno, Torres (1937) and Zuniga (1953) strongly suggest that the endosperm character is possibly controlled by a single gene (m). Based on Torres' assumption, if the

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megasporogenesis of coconut is the typical form (as in maize) in which the egg and the polar nuclei in the embryo sae are alike in genetic constitution, the nuts from a self-pollinated tree produces some makapuno (dikiri) nuts will be of three genotypes; one MM, nuts with normal endosperm (MMM), two Mm, nuts with apparently normal endosperm (1Mm and 2MMm) and when planted will produce dikiri-bearing trees; and one mm, non viable nuts with makapuno endosperm (mmm). According to this argument if ail the normal nuts of a self-pollinated dikiri tree are used for planting, the ratio of dikiri-bearing to normal trees in a plantation should be 2:1; if all the trees in an isolated plantation are dikiri-bearing, the ratio of the harvested nuts should be 3 normal to l dikiri.

De Guzman and Rosario (1964) and de Guzman and Manuel (1975) germinated makapuno in-vitro, and obtained palms, that were in every respect similar to the tall variety. Of the first 58 nuts harvested 84% yielded makapuno, favouring the hypothesis of de Guzman et al. (1976 that the makapuno embryo is capable of completing the life cycle, provided the initial problem of non-germination is overcome and that the palms raised from the makapuno nut is potentially pure makapuno bearing.

The endosperm tissue is mainly triploid. One complement of the chromosomes (n= 16) is inherited from the pollen parent and other (2n=32) being the fused polar nuclei from the female parent. Kovoor 1981 has suggested that the dikiri endosperm may be a case of cell dedifferentiation occurring on the plant itself and this may be related to the triple set of genes it carries. Cedo et al., (1984) suggest that the makapuno character of the endosperm may be a direct manifestation of the influence of the pollen parent on the development of the endosperm, known as the Xenia effect. Rognon and de Nuce de Lamothe (1976) have shown evidence of Xenia in relation to copra weight involving different crosses which supports the above phenomenon.

Recent evidence

The embryo culture technology for raising dikiri seedlings became available in Sri Lanka only in the late eighties (Karunaratne, 1986). However, prior to this, the existence of dikiri was known, and attempts to propagate this by normal means proved futile.

Recent discussions with farmers of the southern region of Sri Lanka have led to the following information. The occurrence of dikiri nuts on random trees in their population was, known to them. In a dikiri bearing tree only one or two nuts per bunch contain the dikiri kernel and others usually carry a normal solid endosperm. From experience farmers claim to know how to distinguish between a dikiri nut and non-dikiri nut, although later observation indicated that their accuracy ranged from 49 % to 83 %. However, when the nut is ripe and husked, the dikiri nut can be easily distinguished from a normal one by tapping or shaking. The dikiri nut gives a low dull thud, whereas the normal one gives a clear solid sound. However, in the collection missions undertaken, the success achieved so far with respect to this has ranged from 89% to 100% (Peries and Fernando, 1993).

Due to the premium price the dikiri nut fetched in the market, the farmers were keen to propagate and build up a population. Since the dikiri nut could not be germinated in the normal manner, they used the other option available, which was. to plant the non-dikiri nuts from the dikiri bearing trees. The germinated seedlings were planted in the vicinity of the already dikiri bearing trees. In this way farmers claim to have improved the occurrence of dikiri in their plantations. According to the explanation on the genetic constitution of makapuno (dikiri) offered by Torres, (1937) and Zuniga (1953), this procedure was perhaps the only one available to the farmers to increase the occurrence of dikiri within their populations. This appears to have been achieved by the farmers through their own initiative and ingenuity in the absence of access to any technology. This shows the validity in the saying that 'farmers have been plant breeders ever since agriculture began, but plant breeders have been scientists for only about 200 years' (Velleve, 1993).

DISCUSSION

In recent germplasm collection missions, it was found that the occurrence of the dikiri endosperm was not confined to any particular form of coconut. Samples of pora-pol, kamandala and typica forms collected, occasionally carried the dikiri endosperm. This supports the view of Ohler (1984) that makapuno (or dikiri) is not a variety or form in itself but is a genetic character of the endosperm which may occur in any tall variety. Under normal circurnstances, the dikiri-nut does not germinate. From an evolutionary point of view, the dikiri type endosperm is the result of an undesirable allele. If it were to germinate and produce true to type, the resulting nuts would not be of any value from a commercial stand point (i.e. in terms of oil and copra). (Farmer experience shows that the oil in dikiri cannot be extracted using the traditional domestic process because the dikiri kernel disintegrated when subjected to high temperature). Recent investigations have revealed that the dikiri endosperm develops a very high oil content with maturity (Nandadasa, pers. comm).Mendoza et al. (1982) have shown that the fat content increases, 5 and 12 fold in both normal and makapuno endosperms, respectively. These fats mainly consist of volatile fatty acids, which apparently have an injurious effect on germination of the embryo when in contact. Local studies (Peries, 1992) show that unless the embryo is separated from the husked dikiri nut within a maximum of 48 hours after harvest, the germination in-vitro could be also be seriously affected. It is yet to be verified, if this is due to biochemical changes associated with germination occurring within the nut or due to physical contarnination of the embyro from the endosperm substances. Dikiri -is, therefore, a clear case of man using a genetically undesirable trait, for his advantage. Because the dikiri kernel has a pleasant taste and is an acceptable additive in the confectionery industry, it has received the acceptance of man as a desirable trait, However, if this phenomenon gave rise to a kernel with a foul smell and a bad taste, one would not want these palms breeding true to type and producing similar nuts in a plantation.

This would now lead us to think of the other aberrant kernel forms of coconut usually occurring in coconut plantations, for which no satisfactory explanations have yet been offered. Itis not unlikely that the 'empties' (i.e. nuts without both liquid and solid endosperm) are also a result of a similar mechanism. Their occurrence is known' to be more frequent in 'dry' weather and is commonly attributed to poor palm nutrition. Lack of commercial interest in this aberrant kernel form may have led to it being conveniently ignored.

Evidence suggests that dikiri kernel is also a clear example of Xenia, where the influence of the pollen is directly manifested in the development of the endosperm. According to the normal mode of inheritance, the embryo would carry the homozygous gene combination but it will be phenotypically manifested only in the next generation. If this was the case, and the nut produced a normal endosperm, such nuts would have germinated under normal circumstances and produced palms which in turn would have produced 80-100% true dikiri (or whichever desirable or undesirable kernel character). The Xenia effect in this instance has facilitated natural selection and therefore could be considered as an adaptation to avoid the undesirable alleles becoming widespread in populations.

CONCLUSION

It may be said that dikiri-pol is not a separate type or form of coconut, but is merely an endosperm type that can occur in any tall variety of coconut. From an evolutionary point of view, dikiri kernel is the result of an undesirable allele in its homozygous form, which man has made use of for his own advantage. There is potential for commercial exploitation of dikiri in the confectionery industry and therefore embryo culture of dikiri is a worthy commercial proposition. However, expansion of dikiri cultivation would have to he done with caution, since large plantations of dikiri in the vicinity of commercial estates can lead to the occurrence of more and more dikiri, in already non dikiri producing tall plantations. The occurrence of dikiri in copra and oil producing plantations would be undesirable as this would lead to a decrease in the out-turn. The occurrence of other aberrant kernel forms of coconut in plantations may be the result of similar phenomena and therefore is worthy of further investigation.

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