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FUNGAL INFECTION OF STORED ARECANUTS*

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ABSTRACT

The betel nuts (*Areca catechu* L.) are infected by various fungi and bacteria during drying and storage. Most of the fungi gain access to the nuts through soil contact. The nuts are predisposed to infection by fungi when rainfall, high humidity, and favourable temperature are prevalent during drying and storage. The infection can be prevented or minimised by eliminating soil contact at the time of harvest and drying, by quick drying of nuts using mechanical driers or cement floors, and storing nuts in polythene-lined gunny bags or air tight store rooms.

INTRODUCTION

The arecanuts or betel nuts, the product of commerce obtained from the areca palm (*Areca catechu* L.) are generally sun-dried after harvest on drying yards for about 40 days. Normally, farm yards of well compacted or rammed grounds as such, or after plastering them with cow dung slurry, are used as drying floors. The dried nuts are stored as such or after dehusking in gunny bags, or wooden barns, or store rooms till they are sold. The betel nuts are attacked by various fungi during the course of processing and in storage, thus rendering them inferior or unsuitable as a masticatory for which purpose it is mainly used. The infection affects the quality of nuts and lowers their market value. Recently, Koti Reddy, Saraswathy, and Chandramohan (1978) reviewed the various diseases affecting arecanut crop. However, this review did not include the spoilage of arecanuts during drying and storage. The present attempt is to fill in this gap.

SYMPTOMS

Both the husk and kernel are involved in the fungal attack. However, the infection of the latter is of prime importance, as this is the portion used as the masticatory. The invading fungi first attack the embryo (Jaleel and Govindarajan, 1969; Nambiar, Edison, and Nair, 1972). Later, they spread to the central white core of the endosperm. Once this tissue is completely disintegrated, the fungi pass on to the adjacent lamella of the rumination. In advanced stages of infection, the kernel will present a hollow cavity due to complete disintegration of the tissues. The affected nuts, when cut open, show discoloured tissues of the white core, the colour being dependent on the fungi involved in the attack (Jaleel and Govindarajan, 1969; Nambiar and Nair, 1970; Rawther and Nambiar, 1970; Nambiar et al., 1972).

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EXTENT OF DAMAGE

The damage due to fungi and other biological agents aiding deterioration depends on the nature of drying yard, season of drying, ambient temperature, and humidity. Poor maintenance of the drying yard or lack of it, improper spreading and turning of nuts, and exposure to unexpected rains during drying results in prolongation of the drying period and consequent invasion by the pathogens. The infection of the kernel will be either mild, moderate, or severe according to the duration of exposure to infection and fungi involved. Nambiar et al. (1972) found that the percentage of fungal infection was the highest in nuts dried in October (62%) and the lowest in February (21%). The high fungal infection in October may be due to the prevalence of low temperature during the period coupled with the receipt of rains (157 mm) and consequent high relative humidity (up to 91%), which are all congenial for the growth of fungi. These factors also do not permit quick drying of nuts. On the other hand, in February there was no rain, the temperature was comparatively higher and relative humidity low and hence the percentage of infection was also low.

SOURCES OF INFECTION AND ETIOLOGY

The fungi gain entry into arecanuts during different stages of their development on the areca palm, during harvest, processing, transit, storage, and in the market.

(i) **Infection on the host plant.** Recently, Koti Reddy et al. (1978) reviewed in detail the nature and extent of loss caused to nuts by the different fungi on the host. Nuts which are affected by nut-splitting disease are easily attacked by secondary organisms like *Aspergillus* sp., *Penicillium* sp., etc. resulting in the deterioration of the kernel.

(ii) Infection during harvest and processing. The conventional method of harvesting nuts is by cutting the bunches with knives or separating the bunches from the mother palm by pulling them down. The bunches are dropped on to the ground and this causes abrasions on the nuts. These serve as points of entry for the fungi or other organisms in the soil into the kernel (Nambiar and Nair, 1970). Nuts harvested by this method and dried on the drying yard recorded 54.7% fungal infection. Such nuts recorded fungi like *Aspergillus niger*, *A. flavus*, *Botryodiplodia theobromae*, and *Rhizopus* sp.

Studies on the extent of infection during different stages of drying showed that majority of infection in nuts occurred during the initial days of drying itself. It is also observed that loss of moisture in drying nuts was maximum during the first 5-10 days, presumably from husk.

Moisture loss from endosperm occurs rather slowly as it is seated inside. The slow drying of endosperm coupled with its richness in nutrients encourage the fungi to penetrate inside and attack the kernel (Nambiar et al. 1972).

Usually, the microflora associated with the husk and kernel are *Aspergillus* sp., *Diplodia*, sp., *Fusarium* sp., *Mucor* sp., *Penicillium* sp., *Thielaviopsis* sp. and certain aerobic bacteria (Anonymous, 1961, 1962b), *Cladosporium* sp., and *Fusarium* sp. (Rawther and Nambiar, 1970), *Phomopsis heteronema* (Butler and Bisby, 1931), and *Colletotrichum gloeosporioides* (Saraswathy, Reddy, and Nair 1977). Nambiar and Nair (1970) and Nambiar et al. (1972) reported the following fungi from processed nuts: *Aspergillus niger*, *A. flavus*, *A. fumigatus*, *A. chevalieri*, *B. theobromae*, *Mucor* sp., *Penicillium* sp, *Rhizopus* sp., and *T. paradoxa*. Nambiar et al. (1972) also found that maximum kernel infection was caused by *B. theobromae* (19.3%) followed by *Aspergillus* spp. (6.4%).

Among the different cultivars, fungal infection was the highest in "sweet areca" (Nambiar and Edison, 1971). This may be due to the fact that the endosperm occupies a larger area of the kernel in this cultivar and this serves as a good substratum for the fungus to thrive on.

(iii) Infection during transit and storage. Nuts used for seed purposes are often damaged by various organisms during transit. To reduce this, seednuts and the baskets used for packing the seeds may be treated with 0.5% coppesan.

Usually, the nuts are stored during the rainy season till September. The fungal infection of nuts is bound to increase in storage if the storing facilities are not good. Nambiar and Edison (1971) found that fungal infection in nuts stored for one year increased from an initial level of 33.7% to 60.7%. The fungal infection in nuts stored in jute bags increased from 16.0% to 32.3% from May to September with an increase in moisture content from 9.5% to 15.6%. The extent of infection was 17.7% in nuts stored in airtight tins with fused $CaCl_2$ kept at the bottom as dehydrating agent, 22.0% in polythene-lined gunny bags, and 30.0% in store houses of cultivators (Nambiar and Nair, 1970; Nambiar and Edison, 1971; Nambiar et al., 1972).

The fungi found in stored arecanuts are *A. niger arecae* (Lal and Chandra, 1953), *Subramanella arecae* (Srivasthava, Banu, and Govindarajan, 1962), and *A. chevalieri* (Syn. *Eurotium chevalieri*) (Nambiar and Nair, 1971).

CONTROL

Since soil contact with nuts at the time of harvest and after aids in hastening the fungal infection at the drying yard, eliminating soil contact should be beneficial in reducing nut infection. Incidentally, in some parts of Karnataka, harvesting of arecanut is done by lowering the bunches with a rope. It has been reported that nuts treated with blitox showed less infection (Anonymous, 1962c). Steeping the nuts in Bordeaux mixture followed by drying them on drying yard reduced the percentage of infection significantly in nuts as compared to drying nuts on yard drenched with the chemical (Nambiar and Edison, 1971). When the nuts were harvested without soil contact and dried in hot air ovens at 65°C for 63 hr, there was no infection at all (Nambiar et al., 1972). At the same time, nuts harvested by the conventional type, and dried in mechanical drier (Namboodiri, Govindarajan, and Subramanyan, 1963) at 62°C for 72 hr contracted 3.6% infection (Nambiar et al., 1972). Nuts dried on cement floor showed only 5.0% fungal infection (Nambiar and Nair, 1970). The number of days required for adequate drying was also reduced if nuts were dried on cement floors. The splitting of kernel observed when nuts are dried on cement floor could be lessened by turning the nuts twice a day after 10 days of drying (Nambiar and Nair, 1972).

In storage, high humidity and long period of storage favour infection, and hence such conditions may be avoided (Nambiar and Edison, 1971). Polythene-lined gunny bags can be used with advantage over plain gunny bags for storing nuts (Nambiar et al., 1972).

Thus avoiding soil contact at the time of harvest and quick drying using mechanical driers or cement floors, storing nuts in polythene-lined gunny bags or in airtight barns or store rooms would help reduce fungal infection of nuts. Fumigating the store rooms with ethylene dibromide or burning sulphur in godowns would not only control some of the storage pests (Anonymous, 1962a) but also would help in reducing the spread of fungal infection through these agents.

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