Short Communication

OBSERVATIONS ON THE DECOMPOSITION OF COCONUT FIBRES

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Coconut fibres are currently used in the Netherlands on a large scale as a wrapper around plastic drain pipes. However, after functioning for 1 or 2 years, the filter capacity may be reduced due to decay of the coir. Sometimes the wrapper was found to be wholly disintegrated. In order to find the cause of the decay and the way in which it proceeds, cross and longitudinal sections of the fibres embedded in the polyester resin Synolith 544 were made according to JONGERIUS and HEINTZ-BERGER (3) and MIEDEMA *et al.* (4). Sections of about 20 μm thickness were observed under a microscope for the presence of microorganisms. Three samples of coir were derived from laboratory experiments that imitated field conditions (1). These fibres had been exposed to soil for 6 months under anaerobic conditions followed by an aerobic period of 27 months. Another sample of coir had been kept for 3 years under field conditions. The fibres of the outer layer of the fruits of cocos consist of bundles of lignified sclerenchyma cells with central vascular tissue. Decomposition of the fibres starts with attack of the central vascular cells.

Observations of the cross sections, made of the fibres derived from laboratory experiments and field conditions, with polarized light demonstrate that about 40% of the fibres were partly decomposed. Fibres kept without soil contact showed about 20% of partly decomposed cross sections. With normal light the affected and unaffected parts of the cross sections are not easily distinguishable, but between crossed polaroids the partly decomposed section, mostly around the centre of the fibre, becomes dark by the loss of birefringence (Figs. 1–6). The loss of birefringence seems to indicate that cellulose has been degraded. This observation is in agreement with the decrease of cellulose content in partly decayed coir reported earlier by the author. Fungi are thought to play an important role in the decomposition of coir. Isolates belonging to several genera of fungi were obtained already from thoroughly washed coconut fibres (1). The cross sections shown in Fig. 7, derived from fibres kept under field conditions, and in Fig. 8 from fibres of

laboratory experiments demonstrate the penetration of fungal hyphae probably from outside directly into the centre of the fibre. Once a hypha has arrived in the centre, it can easily penetrate in longitudinal direction following the tracheal elements.

Observations of longitudinal sections on the coconut fibres showed thick, often dark brown, hyphae in the centre (Figs. 9–10). The expanding decay, starting at the centre of the fibre, is caused by lateral branches of the hyphae that penetrate the wall of adjoining cells. The extremely thin penetrating hyphae apparently form a

Figs. 1-6. Cross section of different stages of affected fibres derived from laboratory experiments, photographed with normal light (a) and between crossed polaroids (b).

bore-hole at right angles to the longitudinal axis of the cell wall as described by CORBET and LEVY (2) concerning the penetration of *Chaetomium globosum* in wood of *Pinus sylvestris* L. Once having penetrated the cell wall, the hypha resumes its original form and branches vertically following the cell lumen parallel to the longitudinal axis. In the same manner this hypha produces lateral branches which penetrate another adjoining cell (arrows) and the decay extends from the centre of

Fig. 7.

Fig. 8.

Figs. 7 and 8. Fungal hyphae penetrating the fibres probably from outside directly into the centre, photographed with normal light. Cross section of a fibre derived from field conditions (Fig. 7) and derived from a laboratory experiment (Fig. 8).

Fig. 9.

Fig. 10.

Figs. 9 and 10. Thick, dark brown hyphae in the centre of the fibre produce lateral branches of which the extremely thin tops penetrate adjoining cells. After growth in longitudinal direction is resumed, the penetration of lateral branches into other adjoining cells is repeated (arrows). The bars indicate 100 μ m in all figures.

the fibre to the edge. The expanding decay mostly causes a big hole in the centre of the fibre but in other cases the decomposition extends in one direction showing a degrading sector of the cross section. Although the possibility of coir decomposition by fungi/bacteria associations must be kept in mind, in this study neither actinomycetes nor other bacteria were observed inside the fibres.

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