Epicuticular Waxes of Arecanut Leaf

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Abstract

The epicuticular waxes of arecanut (Areca catechu L.) leaf contains mainly hydrocarbons, β-diketones, esters and fatty acids in that order. The first two compounds are known to offer crystalline properties to the wax and water repellent behaviour to the leaf surface. The influence of leaf waxes on foliar uptake of nutrients and chemicals would be discussed in relation to the induction of nitrate reductase activity in arecanut leaf.

Introduction

Waxy components of the leaf cuticle form a highly effective barrier to water loss from plants. In addition to the influence on cuticular transpiration, wax structure and chemical composition are known to affect the wetting and retention characteristics of foliar sprays(Holloway, 1971). Consequent penetration of these applied substances is likewise a function of wax structure, composition and quantity, all of which are highly variable among species and even on the different portions or growth stages of a single leaf(Leece, 1976; Baker et al., 1979).

Hence, to maximise the efficiency of foliar applied chemicals, an understanding of the nature of leaf surface is essential. Little information exists on the leaf surface morphology and chemical composition of epicuticular waxes in plantation crops. The present study reports the chemical composition of the arecanut leaf surface wax and its relationship to foliar penetration of nutrients.

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Materials and Methods

Fully mature leaves from arecanut palms grown in the experimental plots at Vittal were used for analysing chemical composition. The epicuticular waxes were removed by dipping the leaves for 10 sec in 4 successive 50 ml portions of chloroform. All the chloroform was pooled, filtered and evaporated under room temperature. The wax was dissolved in 2 ml chloroform and was chromatographed on silica gel G plates (250 μm thickness, activated and pre-run) in chloroform : methanol (99 : 1). Durum wheat wax was coplated for comparison. Constituents were localized with 40% H_2SO_4 (V : V) and charring at 180° C (Tulloch and Hoffman, 1971).

Nitrate ion uptake by arecanut leaf was assayed by measuring the inducible nitrate reductase activity by *in vivo* method which was essentially as described by Jaworski (1971) and modified by Subbaiah and Shivasankar (unpublished). Both young and fully expanded leaves were used for comparative purposes.

The effect of wax removal on nitrate uptake was tested by assaying NR activity after, (a) gently brushing the leaf surface by a camel hair brush 10 times in one direction or (b) by quickly wiping the leaf with 80% acetone and immediately dropping it in water.

Results and Discussion

Hydrocarbons and β-diketones were the major constituents of arecanut leaf surface wax. These are known to offer water repellent properties to the leaf surface (Freeman et al., 1979). The above components have also been shown to be responsible for the crystalline behaviour of wax and thus regulate the leaf wettability (Hunt et al., 1976). Thus the hydrophobic surface of arecanut leaf can be attributed to the nature of its epicuticular wax.

This was tested by assaying the uptake of nitrate ions by arecanut leaf through its cuticle. Nitrate uptake was measured in terms of inducible *in vivo* nitrate reductase activity. This method depends on the entry of nitrate ions into leaf cells and their reduction to nitrate (Leece and Kentworthy, 1972). As shown in Table 1, the enzyme activity was found to be more in the immature leaf than in the fully expanded leaf. This was unexpected, as the young, non-green leaf was yet to develop the full complementation of the metabolic machinery and a low level of nitrate reductase activity is usually expected at this stage of leaf ontogeny. But as the uptake of nitrate was promoted by the absence of any cuticular wax barrier in the young leaf its enzyme activity was higher than that of mature leaf. In a long term experiment where the leaves were incubated for 4 h in nitrate solution, the nitrate contents were similar both in the young and mature leaves. But NR activity was higher in the fully expanded leaves (Table 2), showing that uptake of nitrate was limiting the enzyme activity in the mature leaves in the short term experiment. Long term incubation might have resulted in the entry of nitrate through the stomata or gradually through the cuticle itself. Thus the waxy layer of the cuticle has acted as a barrier for the nitrate ions to enter the leaf. This was further confirmed by the increase in enzyme activity as a result of wax removal by acetone treatment. Brushing might have resulted in mechanical injury to the leaf which explains the lowered NR activity (Table-3).

Table 1. Effect of leaf ontogenetic status on inducible nitrate reductase activity of arecanut leaf

	NR activity (μ moles NO_2^-/g dwt/h)
Young leaf	4.73 ± 0.4
Mature leaf	1.74 ± 9.1

Table 2. Effect of leaf ontogenetic status on nitrate uptake through cuticle and inducible NR activity. Leaves were incubated for 4 h in 0.1M KNO_3 and then taken for analysis

	NR activity (μ moles NO_2^-/ g. dwt/h)	NO_3^- uptake (μ moles/g dwt/h)
Young	2.46	74.7
Mature	4.00	81.7

Table 3. Effect of wax removal on NR activity of mature arecanut leaves

	NR activity (μ moles/ NO_2^-/ g dwt/h)
Control	4.55
Wax removal by	
a) brushing	3.78
b) acetone	5.95

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Discussions

M Anandaraj:

Is there any difference in the wax content of the surfaces of leaf and fruit?

Subbaiah:

Such a comparative study has not been done.

M Mohan Rao:

Is the wax content high enough for commercial exploitation?

Subbaiah:

The quantity of wax in arecanut leaf is very low and hence not worthwhile for consideration of commercial exploitation.