1 January 1988

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BIOCHEMICAL CHARACTERIZATION OF ROOT REGION SOILS FROM ARECA-BASED CROPPING SYSTEMS

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MIXED cropping of banana (*Musa sapientum* L.), cacao (*Theobroma cacao* L.) and pepper (*Piper nigrum* L.) with areca (*Areca catechu* L.) is in practice. Root exudates from these plants may influence soil composition as the exudates have been shown to contain amino acids, sugars and organic acids[1]. Studies on root exudates from areca, banana, cacao and pepper growing under different areca-based cropping systems have revealed a significant reduction in exudation of amino acids by roots of areca from mixed and high density multispecies (HDMS) cropping systems compared to the exudation by roots of areca grown in a mono-cropping system[1]. Hence studies were undertaken to characterize soils from root regions of areca, banana and cacao from areca-based cropping systems.

Soils from 0 to 25 cm depth (six samples) from each plot) were collected during the pre-monsoon season (February to May). The samples were collected around the roots of areca, banana and cacao growing under mono-, mixed and HDMS cropping systems. The spacing of these crops has been described earlier[2]. All these crops received normal recommended doses of fertilizer and were irrigated in summer.

An ethanol extract of the soil sample was fractionated into amino acids, sugars and organic acids by ion exchange chromatography using Dowex 50 (H^+) and Dowex 1 (formate form) resins. Total sugars[3], amino acids[4] and phenols[5] were estimated. Individual amino acids, sugars, organic acids and phenols were separated by descending paper chromatography using different solvent systems[6]. Amino acids were detected by spraying the chromatogram with 0.3% ninhydrin. Sugars were detected using different spray reagents[7-9]. Organic acids were visualized by dipping the chromatogram in 0.04% bromophenolblue in 95% ethanol. The organic acid fraction was extracted with an equal volume of ethyl acetate and the organic phase was used for chromatography of phenols. Phenols were detected by dipping the chromatogram in ferric chloride–potassium ferricyanide reagent[10].

The results of the analysis are shown in table 1. A significant reduction was noticed in the phenol content of soils from root regions of areca, banana and cacao growing under HDMS cropping system compared to that of soils from mono-cropping systems. Sugar content of soils from areca, banana and cacao under HDMS cropping system was higher than that of soils from the respective mono-cropping systems. Amino acid content of soils from cacao under HDMS and under areca–cacao mixed plot systems was significantly lower than that of soil from cacao under the mono-cropping system.

The present studies revealed the presence of the sugars fructose, glucose, sucrose, maltose, lactose, raffinose; and the amino acids lysine, serine/glycine, glutamic acid, alanine, tyrosine, trypto-

Table 1 *Biochemical composition of soils from different areca-based cropping systems*

Crop	Cropping system[a]	Total sugars[b]	Amino acids[c]	Phenols[b]
Areca	A	5.03	20.1	0.63
	B	5.46	22.0	0.52
	C	4.73	36.1	0.67
	D	11.89	35.1	0.11
CD 5%		2.59	NS	0.22
Banana	A	3.47	32.1	0.75
	B	5.66	15.7	0.84
	D	8.06	24.0	0.061
CD 5%		1.79	8.97	0.224
Cacao	A	2.83	25.9	0.87
	C	4.61	15.3	0.13
	D	6.87	15.2	0.057
CD 5%		1.79	6.0	0.092

[a] A, mono crop; B, areca + banana mixed plot; C, areca + cacao mixed plot; D, areca + banana + cacao + pepper + coffee + clove + pineapple HDMS.
[b] Expressed as mg/100 g dried soil.
[c] Expressed as μg amino nitrogen/100 g dried soil.
Each value is the mean of estimations from six soil samples.

phan, valine and isoleucine; the organic acid succinic acid; and the phenols caffeic acid, gallic acid and catechin in the root region soils of areca, banana and cacao growing under mono-, mixed and HDMS cropping systems.

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MEIOTIC BEHAVIOUR AND MORPHOLOGY OF A PENTAPLOID *MUSA ACUMINATA* (COLLA.) ($2n = 22$) × *M. RUBRA* (WALL.) ($2n = 22$) HYBRID

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THE formation of restitution nuclei in meiosis is of common occurrence in many plants[1] and has played a major role in the evolution of polyploidy[2,3]. The present triploid bananas (AAB and ABB) seem to have originated through this process of sexual polyploidization[4]. However, double-restitution gamete formation is of rare occurrence in the plant kingdom. During hybridization experiments in *Musa*, a case of double restitution in female gamete formation was observed and resulted in the production of a pentaploid hybrid ($2n = 55$) from a *Musa acuminata* ($2n = 22$) × *M. rubra* ($2n = 22$) cross. The present communication describes meiotic behaviour in this hybrid.

M. acuminata is a wild diploid ($2n = 22$) species belonging to the subgenus *Eumusa*. It has small, seedless fruits with very little pulp. *M. rubra* is an ornamental diploid ($2n = 22$) species, belonging to the subgenus *Rhodochlamys*. Both the species have normal meiosis and high pollen fertility, though the quantity of pollen produced in *M. acuminata* is very small[5,6]. Of 43 hybrids resulting from pollination of *M. acuminata* with *M. rubra* pollen, 42 were triploids ($2n = 33$) (AAR) and only one was pentaploid ($2n = 55$). The pentaploid plants were taller and had narrower, brittle leaves. Compared to the parents in most of the vegetative and floral charac-

Table 1 *Vegetative and floral characters of Musa acuminata and M. rubra, and their pentaploid hybrid*

Characters	*M. acuminata* $2n$	*M. rubra* $2n$	Hybrid $5n$
Plant height (m)	1.86	0.9	2.02
Leaf length/width ratio	2.26	2.56	4.7
No. of stomata per mm^2	283	283	79
Length of stomatal aperture (μm)	22.5	22.5	40
Width of stomatal aperture (μm)	12.5	13.75	15
Orientation of female inflorescence axis	Pendulous	Vertically up	Horizontal
Length of female flower (cm)	9.6	6.0	8.4
Length of male flower (cm)	4.7	3.6	7.2
Pollen fertility (%)	72.13	98.6	84.9
Pollen diameter (μm)	130	100	140