

**RESEARCH NOTE**

## The effect of poultry manure and inorganic fertilizer on the arbuscular mycorrhiza in coconut

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Revised: 13 May 2009; Accepted: 20 July 2009

The arbuscular mycorrhizal fungi (AMF) are known as beneficial soil micro-organisms and they have been widely used as bio-fertilizers to improve seedling vigor in plant nurseries<sup>1,2</sup> as well as in fields to restore the soil fertility and thereby to improve crop growth<sup>3,4</sup>. Coconut (*Cocos nucifera* L.) is an important food and cash crop in most tropical regions of the world. Unfortunately, the coconut industry has recently faced a major problem in yield reduction. It was speculated that the underlying causes for this may be the depletion of soil physico-chemical and biological properties of the plantations<sup>5</sup>. The current study was conducted as a preliminary investigation to estimate and compare natural AMF colonization and soil spore densities in coconut palms located in the low country intermediate zone.

The study was conducted at the Rathmalagara experimental plantation of the Coconut Research Institute (CRI) in a randomized complete block design where three

blocks were treated annually viz., no fertilizer application (NT); inorganic fertilizer mixture comprising 800 g of urea, 1600 g of muriate of potash, 900 g of Eppawala rock phosphate and 1 kg of dolomite per palm per year, the recommended inorganic fertilizer mixture (IFM) for adult coconut palms; and poultry manure (30 kg) with a supplement of muriate of potash (0.25 kg) per palm (PL). One year after fertilization, soil (12 cm depth) and actively growing root samples were taken in triplicate in each block. Actively growing roots were cleaned and stained with 0.1% Trypan blue, then percentage of root colonization, arbuscules and number of vesicles were determined<sup>3</sup>. The spores were separated from soil samples according to the wet sieving method and counted<sup>3</sup>. Soil samples were analyzed for selected physicochemical properties namely, pH, electrical conductivity (EC), organic carbon (OC), NH<sub>4</sub><sup>+</sup>-N, NO<sub>3</sub><sup>-</sup>-N and available phosphorus (P<sub>a</sub>) using standard methods<sup>6</sup>.

**Table 1:** Means with standard errors of root colonization, arbuscules, number of vesicles of arbuscular mycorrhiza, coconut yield in non treated (NT), inorganic fertilizer mixture (IFM) applied and poultry manure (PL) applied coconut palms.

Treatment	Percentage of root colonization	Percentage of arbuscules	Number of vesicles/ 1 cm root length	Total number of spores / 1g Soil	Coconut yield nuts/palm/ month
NT	46.9 <sup>a</sup> ± 1.4	28.5 <sup>a</sup> ± 1.2	1.4 <sup>b</sup> ± 0.1	204.1 <sup>ab</sup> ± 12.8	6.4 <sup>a</sup> ± 0.58
IFM	29.0 <sup>b</sup> ± 3.2	9.5 <sup>b</sup> ± 1.3	2.5 <sup>a</sup> ± 0.4	261.2 <sup>a</sup> ± 29.5	8.0 <sup>b</sup> ± 0.37
PL	42.0 <sup>a</sup> ± 1.2	13.1 <sup>b</sup> ± 0.5	0.9 <sup>b</sup> ± 0.1	151.6 <sup>b</sup> ± 23.1	11.6 <sup>c</sup> ± 0.29
Significance	***	***	***	*	***
LSD (α = 0.05)	7.49	3.69	0.79	79.14	0.75

Means with different letters within columns are significantly different, \* at p ≤ 0.05, \*\*\* at p ≤ 0.001; LSD: least significant difference.

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**Table 2:** Means and standard errors of soil physico-chemical parameters in non treated (NT), inorganic fertilizer mixture (IFM) applied and poultry manure (PL) applied coconut palms.

Treatment	Soil physico-chemical parameters					
	pH	EC ( $\mu\text{mho/cm}$ )	Organic carbon (%)	$\text{NH}_4^+\text{-N}$ (mg/kg)	$\text{NO}_3^-\text{-N}$ (mg/kg)	Available phosphorus (mg/kg)
NT	6.0 <sup>c</sup> ± 0.1	36.5 <sup>b</sup> ± 2.3	0.8 <sup>b</sup> ± 0.03	4.3 <sup>a</sup> ± 0.4	2.2 <sup>a</sup> ± 0.4	146.6 <sup>c</sup> ± 35.4
IFM	6.5 <sup>b</sup> ± 0.1	32.4 <sup>b</sup> ± 1.1	0.7 <sup>b</sup> ± 0.04	2.3 <sup>b</sup> ± 0.6	1.9 <sup>a</sup> ± 0.5	281.0 <sup>b</sup> ± 56.2
PL	7.0 <sup>a</sup> ± 0.1	79.7 <sup>a</sup> ± 9.4	1.4 <sup>a</sup> ± 0.21	4.3 <sup>a</sup> ± 0.6	2.2 <sup>a</sup> ± 0.6	951.5 <sup>a</sup> ± 137.4
Significance	***	***	**	*	ns	***
LSD ( $\alpha = 0.05$ )s	0.24	19.49	0.43	1.80	1.81	228.36

Means with different letters within columns are significantly different, \* at  $p \leq 0.05$ , \*\*\* at  $p \leq 0.001$ ; LSD: least significant difference; ns - no significance.

The AMF present in the coconut roots in all three treatments were identified as *Glomus* spp<sup>7</sup>. Highly significant differences ( $p < 0.001$ ) were observed between treatments for AMF root colonization, arbuscules, number of vesicles and total number of spores in soil (Table 1). PL applied soil showed significantly higher  $\text{NH}_4^+\text{-N}$ ,  $\text{P}_a$  and organic carbon than the IFM treated soil (Table 2). In the current study, soil nutrient status has increased with the application of PL than the application of IFM. Low amount of inorganic nutrients in IFM treated soil could be due to the reason that the added inorganic fertilizers are lost rapidly by several soil processes. However, poultry manure treatment has not increased total AMF root colonization and soil spores when compared with untreated (NT) coconut palms. Application of IFM or inorganic nutrients as a supplement has decreased the AMF colonization in coconut roots. This is probably because of the adverse effects of high concentration of nutrients and salts in inorganic fertilizers<sup>3,8,9</sup>. Also in the PL treatments, both the  $\text{P}_a$  and the AMF colonization were high. This is not in agreement with a previous study<sup>9</sup>, where root colonization of AMF decreased when  $\text{P}_a$  was high in the rhizosphere. However, since the level of organic carbon is highest in the PL treated soil, it can be assumed that the increased colonization could be due to the favourable conditions created by the application of organic manure, which facilitate the growth of roots as in other studies<sup>10,11</sup>. The  $\text{NH}_4^+\text{-N}$  levels of the rhizosphere soil of the palms may have a stimulatory effect over colonization and arbuscule formation of AMF, probably indicating a relationship between AMF colonization, arbuscule formation and soil nitrogen levels as seen in previous studies<sup>12,13</sup>. Therefore, it shows that AMF depend on the soil nutrient levels or the type of fertilizer applied to the coconut palms. Since AMF naturally colonize the coconut roots, AMF combine fertilizer management practice or AMF-friendly fertilizer application will be

more effective for coconut palms to maintain their natural AMF colonization, and thereby to improve the nutrient uptake in eroded coconut lands.

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