BIOLOGICAL CONTROL OF COCOA BLACK POD DISEASE BY FUNGI AGENTS: ARBUSCULAR MYCORRHIZAL FUNGI AND *TRICHODERMA ASPERELLUM*

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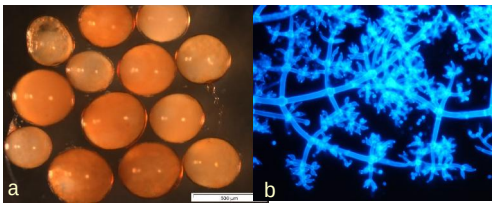
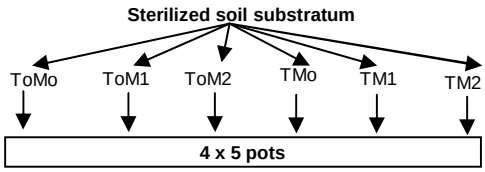
INTRODUCTION

Cocoa black pod rot, caused by *Phytophthora megakarya*, causes substantial yield losses worldwide, particularly in Africa. In optimum conditions, Losses can reach 80 % . Chemical control mostly used is expensive and environmental harmful. An alternative is the use of biological control agent such as Arbuscular mycorrhizal Fungi (AMF) and *Trichoderma* (Ngonkeu et Nwaga, 1998; Tondjé et *al.*, 2007). Both microorganisms are know to improve protection against plant telluric pathogens and reduce inorganic fertilizer input up to 70 % (Ngonkeu, 2009). The goal of this work is to assess dual inoculation of Arbuscular mycorrhizal Fungi (AMF) and *Trichoderma asperellum* on the growth and the biological control of cocoa black pod diseases due to *P. megakarya.* In the present work, we are focusing on biochemical compound in plant fungi interactions. Specifically the role of phenolic compound and amino acids in AMF and *Trichoderma* associations is discussed.

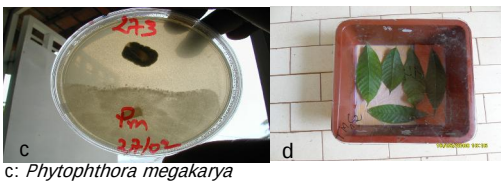
MATERIAL AND METHODS



a: *Gigaspora margarita* b*: Trichoderma asperellum*



EXPERIMENTAL DESIGN



c: *Phytophthora megakarya*
d: Leafs inoculated and incubation method

Means parameters evaluated, 18 weeks after seedling

- **Agronomical**: Height, leafs number, fresh root, dry matter, root colonisation and symptom scoring
- **Physiological**: Chlorophyll rate and P Content
- **Biochemistry**: Acids phosphatases, soluble amino acids and phenolic compound

RESULTS AND DISCUSSION

Table 1. Effect of AMF and *T. asperellum* on some agronomical and physiological parameters of cocoa tree, 18 weeks after seedling

Treatments	Root colonization (%)	Height (cm)	Leafs number	Fresh root (g.plant^{-1})	Dry matter (g.plant^{-1})	Chlorophyll rate (%)
T_0M_0	0.0c	24.6c	9.8c	2.9b	2.6c	37.2b
T_0M_1	50.7a	37.0b	22.8a	7.13a	4.0bc	46.5a
T_0M_2	51.7a	37.0b	17.3b	7.1a	7.1a	50.0a
TM_0	0.0c	41.6a	16.5b	8.9a	4.0bc	46.4a
TM_1	26.7b	44.0a	16.7b	7.6a	3.8bc	46.5a
TM_2	20.0b	44.6a	22.9a	8.0a	6.0bc	48.4a

AMF and *Trichoderma asperellum* increased significantly (P=0.01) plant height (1,5 to 1.8 fold), fresh root (2.4 to 3 fold), dry matter (1.5 to 2.3 fold) and chlorophyll rate (1.25 to 1.3 fold). Interaction AMF-*T. asperellum* is not significant at P=0.01.

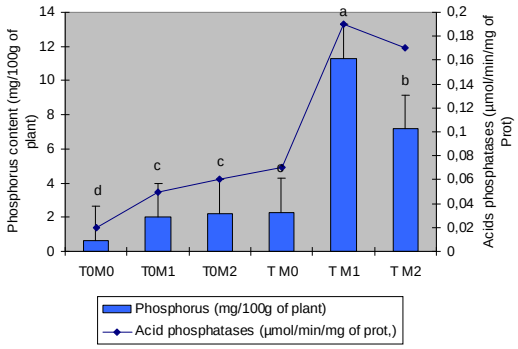


Fig 1. Effect of AMF and *T. asperellum* on P and acids phosphatases cocoa tree, 18 weeks after seedling

P uptake increase significantly (P=0.001) after inoculation with AMF and *Trichoderma* (2 to 3.5 fold). The interaction AMF-*T. asperellum* is positive and significant (P=0.001). These results can be related to acids phosphatases stimulation in plant root; responsible to P-organic matter hydrolyzation (Tchameni et *al.*, 2009).

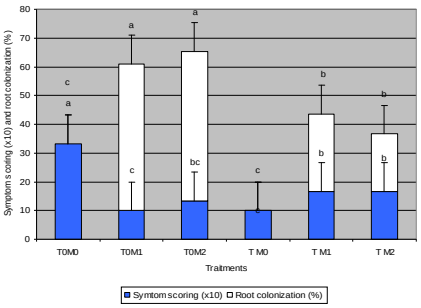


Fig 2. Effect of AMF and *T. asperellum* on symptom scoring of cocoa black pod disease, 18 weeks after seedling

AMF and *T. asperellum* reduce significantly (P = 0.001) *P. megakarya* symptoms in cocoa leaf. Interaction between AMF -*Trichoderma* is negative and significant (P = 0.01)

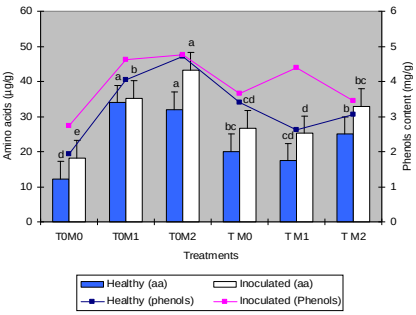


Fig 3. Effect of AMF and *T. asperellum* on healthy and inoculated leaf on soluble amino acids and phenols of cocoa tree pod disease, 18 weeks after seedling

AMF and *T. asperellum* increase significantly (P=0.001) leaf amino acids content (1.6 to 2.7 fold). There is positive correlation between root colonization and amino acids content (P = 0.0002 ; r^2 = 0,812); and negative correlation between symptom scoring and amino acids (P= 0.015; r^2=-0.61).

Leaf Phenolic compound increase (1.7 to 2.5 fold) after inoculation by AMF and *T. asperellum*. Positive correlation have been observed between root colonization and phenolic content (P<0.001 ; r^2 = 0.866) and negative correlation between symptom scoring and amino acids (P = 0.002 ; r^2 =-0.716).

Amino acids and phenolic compound synthesis combined to P nutrition are potential mechanisms used by these biological control agents for plant protection.

CONCLUSION

AMF and *Trichoderma sp.* can be used as an alternative to*:*

- Øreduce chemical pesticides for cocoa tree protection and nutrition against *P. megakarya*;
- Øproduce safety and healthy plants in nursery;
- Øimprove cocoa pot nutritional quality (high amino acid content)

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