



# Improvement of Health and Vigor of Hybrid Cacao (*Theobroma cacao* L.) Seedling through Incorporation of *Trichoderma* spp. in Seed Matriconditioning and Planting Media

Satriyas Ilyas<sup>1</sup>, Baharudin<sup>2</sup>, Agus Purwantara<sup>3</sup>, Mohamad Rahmad Suhartanto<sup>1</sup>

<sup>1</sup>Department of Agronomy and Horticulture, Faculty of Agriculture, Bogor Agricultural University (IPB), Darmaga Campus, Bogor 16680, Indonesia. Email: [satriyas252@gmail.com](mailto:satriyas252@gmail.com). <sup>2</sup>Balai Pengkajian Teknologi Pertanian Sulawesi Tenggara. Jl. Prof. Muh. Yamin no. 89, Kendari 93114, Indonesia. <sup>3</sup>Balai Penelitian Bioteknologi Perkebunan Indonesia. Jl. Taman Kencana no. 1, Bogor 16151, Indonesia.

## INTRODUCTION

- Our study in hybrid cacao seed showed that there were 13 species of fungal pathogens reducing seed vigor and cacao seedling (Baharudin *et al.* 2012).
- Application of seed treatment using matriconditioning plus *Trichoderma harzianum* DT/38 dan *T. pseudokoningii* DT/39 improved viability and vigor of hybrid cacao seed (Baharudin *et al.* 2010). This invigoration treatment using matriconditioning plus biological agents has been defined as biomatriconditioning (Ilyas and Sopian 2013).
- Use of planting media consist of soil:sand:organic matter (2:1:1) plus *Trichoderma* spp. is good for growth of coffee and cacao seedlings (Prawoto 2008).

## OBJECTIVES

The objective of this study was to evaluate the effectiveness of seed biomatriconditioning and planting media using *Trichoderma* spp. in improving vigor of hybrid cacao seedlings.

## MATERIALS AND METHODS

Seeds of hybrid cacao TSH 858 x Sca 6 were extracted from physiological matured fruits harvested at 150 days after anthesis from Seed Orchard of Research Center for Coffea and Cacao, Jember, Indonesia.

Compost was made from waste of cacao endocarp with *Trichoderma harzianum*, *T. pseudokoningii*, *Aspergillus niger*, and *Pholiota* sp. as composting activators. Fertilizers (N:P:K = 2:1:2) were provided at the rate of 1, 2, 3, 4, and 5 g/seedling for 1, 2, 3, 4, and 5 month old-seedlings, respectively.

This experiment was conducted using completely randomized factorial designed with four replications. The first factor was seed treatment (untreated, matriconditioning plus *T. harzianum* DT/38 and *T. pseudokoningii* DT/39), and the second factor was planting media (soil, soil:sand 2:1, soil:compost 2:1, soil:sand:compost 2:1:1, soil:compost 2:1 plus *T. harzianum* DT/38 + *T. pseudokoningii* DT/39, and soil:sand:compost 2:1:1 plus *T. harzianum* DT/38 + *T. pseudokoningii* DT/39). Matriconditioning was done by using ratio of seeds to carrier (burned rice hull 250 µ) to water of 4:2:1 for 5 h in 24 °C room. Cacao seeds (120 g) were wetted with 30 ml water containing *Trichoderma* spp. (10<sup>6</sup> spores/ml), then 60 g of the carrier was added and mixed thoroughly. Biomatriconditioned seeds were then planted directly.

## RESULTS AND DISCUSSIONS

The result showed that biomatriconditioning was effective in increasing stem diameter, leaf area, root dry weight, and P content of leaves as compared to untreated. Planting media treatment of soil, sand and compost mixture (2:1:1) plus biological agents increased stem diameter, leaf area, root dry weight, P-K content of leaves of cacao hybrid seedlings better than other treatments (Table 1 and 2). There was no significant difference between biomatriconditioning and untreated seed if planted on this planting media treatment on seedling height, seedling dry weight, and N content in the leaves of 5 month-old cacao seedlings (Table 1).

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Table 1. Effect of interaction between seed treatment and planting media on seedling height, seedling dry weight, nitrogen and phosphor leaf content of 5 month-old hybrid cacao seedling

Planting Media	Seed Treatment	
	Untreated	Biomatriconditioning
... Seedling height (cm) ...		
S	25.70 Bc	42.05 Aa
SS	32.48 Abc	38.13 Aa
SC	34.85 Ab	37.45 Aa
SSC	34.98 Ab	40.83 Aa
SCB	37.78 Aab	41.45 Aa
SSCB	42.00 Aa	43.02 Aa
... Seedling dry weight (g) ...		
S	10.51 Bc	13.13 Aa
SS	10.21 Bc	14.14 Aa
SC	11.20 Bc	13.51 Aa
SSC	11.74 Bb	14.03 Aa
SCB	13.94 Aa	13.73 Aa
SSCB	13.68 Aa	14.90 Aa
... Nitrogen leaf content (%) ...		
S	2.41 Bbc	2.55 Aa
SS	2.46 Aab	2.54 Aa
SC	2.37 Bc	2.54 Aa
SSC	2.55 Ba	2.44 Ab
SCB	2.52 Aab	2.61 Aa
SSCB	2.56 Aa	2.62 Aa
... Phosphor leaf content (%) ...		
S	0.51 Bb	0.55 Ab
SS	0.49 Bb	0.55 Ab
SC	0.52 Aa	0.57 Ab
SSC	0.48 Bb	0.55 Ab
SCB	0.48 Bb	0.62 Aa
SSCB	0.52 Ba	0.64 Aa

Note: S = soil, SS = soil + sand, SC = soil + compost, SSC = soil + sand + compost, SCB = soil + compost + biological agents, SSCB = soil + sand + compost + biological agents. Mean separation at 5% level (DMRT); capital letters within planting media values, small letters within seed treatment values.

Table 2. Effect of seed treatment and planting media on stem diameter, leaf area, root dry weight, and potassium leaf content

Planting Media	Seed Treatment		Average of Planting Media
	Untreated	Biomatriconditioning	
... Stem diameter (cm) ...			
S	0.26	0.35	0.31 c
SS	0.30	0.34	0.32 c
SC	0.28	0.39	0.33 bc
SSC	0.33	0.39	0.36 bc
SCB	0.34	0.43	0.39 ab
SSCB	0.39	0.44	0.42 a
AST	0.32 b	0.39 a	
... Leaf area (cm <sup>2</sup> ) ...			
S	415.02	499.83	457.42 c
SS	397.02	503.44	450.23 c
SC	421.85	529.55	475.70 bc
SSC	421.92	505.46	463.69 bc
SCB	460.96	545.21	503.08 b
SSCB	506.55	607.50	557.02 a
AST	437.22 b	531.83 a	
... Root dry weight (g) ...			
S	3.34	4.88	4.11 c
SS	3.40	4.65	4.03 c
SC	4.06	4.60	4.33 bc
SSC	3.94	4.70	4.32 bc
SCB	4.35	4.95	4.65 ab
SSCB	4.28	5.48	4.88 a
AST	3.89 b	4.88 a	
... Potassium leaf content (%) ...			
S	4.02	3.52	3.77 b
SS	4.01	3.69	3.85 b
SC	3.97	3.94	3.95 b
SSC	3.85	4.21	4.03 b
SCB	3.90	4.44	4.17 ab
SSCB	4.45	4.67	4.56 a
AST	4.03 a	4.08 a	

Note: Details of planting media as in Table 1. Mean separation at 5% level (DMRT); letters within average of seed treatment (AST), and average of planting media values for each parameters.



Figure 1. Five month-old hybrid cacao seedlings derived from the seed treated with biomatriconditioning (B<sub>1</sub>) and planted in soil (M<sub>1</sub>) or soil + sand + compost + biological agents (M<sub>6</sub>).

## CONCLUSIONS

Matriconditioning plus *T. harzianum* DT/38 and *T. pseudokoningii* DT/39 applied on hybrid cacao seeds could replace the biological agent treatment in the planting media mixture of soil, sand and compost (2:1:1) to improve vigor, and N, P, K leaf content of 5 month-old seedlings.

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