Research article

Pre-Planting Treatments of Stem Cutting with Vermicompost Tea Affecting Rooting and Growth Yields of Different Cassava Varieties

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Abstract This study investigated the effects of the pre-planting treatment of stem cutting with different vermicompost tea concentrations on the rooting, budding, and root biomass of cassava. The completely randomized design (CRD) was used with three replications. The stem cutting of three cassava varieties (Rayong 7, Rayong 9 and Kasetsart 50) were soaked into the different solutions consisting of un-treated (control), 0% VM tea (distilled water), 50% VM tea, and 100% VM tea. Root and bud number and root dry weight were monitored at 7, 14 and 21 days after planting. Results showed that the numbers of cassava root pre-treated with vermicompost tea treatments were significantly increased compared to control. The number of cassava root grown in soil amended with 50% and 100% of the original vermicompost tea concentration were increased by 41.69% and 36.56%, respectively and the buds were increased by 44.09% and 44.18%, respectively compared to the control. The dry weights of root were also increased significantly average 213% and 292%. Therefore, this study indicated that pre-treating cassava stem cutting of three varieties with vermicompost tea before planting had a positive effect on initial root development, bud and root growth. Because of vermicompost tea had organic substances: humic acids, fuvic acids and plant- growths regulators hormone and plant nutrients on cassava growth.

Keywords budding and rooting of cassava, pre-planting treatment, root growth, vermicompost tea

INTRODUCTION

Cassava is an important economic crop of Thailand, which this crop occupies the largest planting area in northeastern part accounting for approximately 54.7% of those of the whole amount of the country (Ministry of Agriculture and Cooperatives, 2008). Productivity and commercialization targets of this crop contribute to concentrate uses of many kinds of chemicals, e.g., pesticides, herbicides, and plant growth promoting compounds. These chemicals may accumulate in cassava stem. Additionally, they may lead to negative effects on the environment and also physical, chemical, and biological properties of soil (Warburton and Pillai-McGarry, 2002).

Vermicompost (VM) tea is known to have positive effects on plant growth as it contains plant essential elements (including both macro- and micronutrients) and growth regulators (e.g., indole acetic acid, gibberellins, and cytokinins) (Arancon et al., 2005). A number of soil scientists found that there were abundance of microorganisms which promoted plant growth and yield. Additionally, humic acid contained in VM tea can improve soil properties (Atiyeh, 2001).

OBJECTIVES

Objectives of this study were to evaluate effects of pre-plating treatments of cassava cutting with different VM tea concentrations on their rooting, budding, and root growth.

METHODOLOGY

Vermicompost tea preparation: The VM tea was prepared from soil:cattle manure:cassava pulp mixture (2:1:7 ratio). Total amount of the mixture was equal to 1000 kg. One hundred individuals of earthworm (*Eudrillus eugeniae*) were fed in a 1 m^2 cement tank. After 30 days of the composting, liquid solution, extracted from the vermicompost, was collected as VM tea, and was pH (8.11), EC (0.69%), OM (0.08 %), Total N (0.0045%), Total P (0.0058%), Total K (0.14 %) and C/N (10.71 %) in VM tea.

Experimental design: A pot experiment was conducted under greenhouse conditions. A factorial treatments structure was used with three cassava varieties (Rayong 7 (RY7), Rayong 9 (RY9), and Kasetsart 50 (KU50)) and four pre-planting treatment media (un-treated (control), 0% VM tea (distilled water), 50% VM tea, and 100% VM tea). The 12 treatment combinations were arranged in a completely randomized design (CRD) with three replications for a total of 36 experimental units.

Statistical analysis: All data were analyzed by two-way analysis of variance using Statistix 8 program (Analytical Software, 2003). The treatment means were compared using Fisher's least significant difference (LSD) for the main effects of cassava varieties, pre-plating treatment media, and their interactions. The significant difference was accepted at $P \leq 0.05$.

RESULTS AND DISCUSSION

Influences of vermicompost tea on cassava budding

There was significant difference of cassava bud number between all pre-planting treatments (i.e., 0%, 50%, and 100% VM tea) and control ($P \leq 0.005$) since 7 days after cassava planting (DAP) (Table 1). At 7 DAP, bud numbers of all cassava varieties which were treated with 50% VM tea (7, 5, and 4 buds for RY7, RY9, and KU50, respectively), were significantly higher than the controls (1, 0, and 0 bud for RY7, RY9, and KU50, respectively). VM tea contained plant available nutrients, organic acids, and plant growth regulators (Edwards et al., 2006) as well as humic and fulvic acids (Arancon et al., 2005), which these compounds might accelerate budding and increase bud number of these cassavas. During 14 – 21 DAP, no significantly different bud number among the varieties, which were treated with all pre-planting treatments, were observed. Because, the stem cutting lengths (25 cm length) and nod numbers (4-7 nods) of all studied varieties were equivalent so that the maximum bud number per each stem cutting of these cassavas were already obtained at 14 DAP. However, these treatments were still significantly higher than the controls.

Influence of vermicompost tea on cassava rooting

No significant difference of cassava root number among all treatments were found at 7 DAP (Table 2). However, the root numbers of the three cassava varieties treated with 50% and 100% VM teas significantly higher than 0% VM tea and the control were observed at 14 DAP and 21 DAP. At these growth stages (14 DAP and 21 DAP), root numbers of RY7, RY9, and KU50 were significantly higher than their controls. These can be explained that the germination of cassava root generally appears at approximately 2 - 3 weeks after cassava planting (Montaldo, 1972). Increases in cassava root number when treated with VM tea is confirmed by Edwards et al., (2006) who found that VM tea had positive effects on plant growth (including root) at the early stage. However, the rooting period depends substantially upon cassava stem cutting quality and varieties (Department of Agriculture, 2002).

Table 1 Bud number of cassava with different varieties

(Rayong 7 (RY7), Rayong 9 (RY9), and Kasetsart 50 (KU50)) treated with four pre-planting treatment media (un-treated (control), 0% VM tea (distilled water), 50% VM tea, and 100% VM tea) at 7, 14, and 21 days after planting

Pre-planting treatment	Bud number								
	RY7			RY9			KU50		
	7 DAP	14 DAP	21 DAP	7 DAP	14 DAP	21 DAP	7 DAP	14 DAP	21 DAP
Control	1 e	2 d	2 d	0 e	2 d	2 d	0 e	1 d	1 d
0 % VM tea	4 cd	4 c	4 c	3 d	4 c	4 c	3 cd	4 c	4 c
50 % VM tea	7 a	7 a	7 a	5 bc	6 ab	6 ab	4 b-d	5 bc	5 bc
100 % VM tea	6 ab	6 ab	6 ab	3 d	5 bc	5 bc	4 b-d	5 bc	5 bc
F- test (cassava variety; a)					*				
F- test (pre-planting treatment; b)					*				
F- test (a × b)					ns				
CV (%)					23.94				

**significantly different at P ≤ 0.05; and ns: not significantly different (P > 0.05)*
DAP = day after cassava planting

Table 2 Root number of cassava with different varieties

(Rayong 7 (RY7), Rayong 9 (RY9), and Kasetsart 50 (KU50)) treated with four pre-planting treatment media (un-treated (control), 0% VM tea (distilled water), 50% VM tea, and 100% VM tea) at 7, 14, and 21 days after planting

Pre-planting treatment	Root number								
	RY7			RY9			RY7		
	7 DAP	14 DAP	21 DAP	7 DAP	14 DAP	21 DAP	7 DAP	14 DAP	21 DAP
Control	2 a-c	23 ab	23 c-e	2 a-c	12 f	15 f	1 c	10 f	12 f
0 % VM tea	2 a-c	17 c-e	17 e	2 ab	15 de	18 de	1 bc	17 c-e	20 de
50 % VM tea	3 a	28 a	34 a	2 ab	17 c-e	20 de	2 a-c	21 b-d	28 a-c
100 % VM tea	3 a	23 a-c	30 ab	2 ab	15 e	25 b-d	2 a-c	15 de	25 b-d
F- test (cassava variety; a)					**				
F- test (pre-planting treatment; b)					**				
F- test (a × b)					**				
CV (%)					22.72				

***significantly different at P ≤ 0.01; *significantly different at P ≤ 0.05;*
DAP = day after cassava planting

Table 3 Root fresh- and dry biomasses of cassava with different varieties

(Rayong 7 (RY7), Rayong 9 (RY9), and Kasetsart 50 (KU50)) treated with four pre-planting treatment media (un-treated (control), 0% VM tea (distilled water), 50% VM tea, and 100% VM tea) at the harvest day (21 days after planting)

Pre-planting treatment	Root fresh biomass (g pot^{-1})			Root dry biomass (g pot^{-1})		
	RY7	RY9	KU50	RY7	RY9	KU50
Control	2.29 b-c	1.55 d	1.09 d	0.15	0.12	0.09
0 % VM tea	1.17 d	1.11 d	1.53 cd	0.09	0.09	0.23
50 % VM tea	2.77 b-c	3.13 bc	5.99 a	0.44	0.37	0.47
100 % VM tea	5.96 a	3.91 b	2.47 b-d	0.57	0.59	0.44
F- test (cassava variety; a)		ns			ns	
F- test (pre-planting treatment; b)		*			*	
F- test (a × b)		*			ns	
CV (%)		41.89			59.47	

**significantly different at P ≤ 0.05; and ns: not significantly different (P > 0.05)*

Influences of vermicompost tea on root biomass

No significant difference of root dry biomass among treatments was found. Nevertheless, root fresh biomasses of RY7 treated with 0% (1.17 g pot^{-1}) and 100% (5.96 g pot^{-1}) VM teas were significantly higher than the control (2.29 g pot^{-1}) (Table 3). Meanwhile, root fresh biomass of RY9

treated with 50% (3.13 g pot^{-1}) and 100% (3.91 g pot^{-1}) VM teas significantly increased relative to the control (1.55 g pot^{-1}). In KU50, only 50% VM tea (5.99 g pot^{-1}) was significantly higher than the control (1.09 g pot^{-1}). Significant decrease in root dry biomass in KU50 treated with 100% VM tea suggests that this VM tea might has plant diseases and toxic compounds which exerted the negative effects on root growth. Frederickson (2002) found that VM tea decreased seed germination and plant growth. Therefore, dilution of VM tea for pre-planting treatment of cassava stem cutting should be critically considered. However, this practice may decrease plant nutrients, and hence cassava root biomass.

CONCLUSION

Pre-treatment of cassava stem cutting with VM tea before planting could accelerate rooting and budding of all three cassava varieties (RY7, RY9, and KU50). This was due to VM tea containing plant essential elements and growth regulators which promoted cassava rooting within 7 DAP.

We recommend that 50% VM tea is the optimum concentration for pre-planting treatment of the cutting as this concentration contributed to the highest cassava root and bud numbers compared to others. Therefore, use of VM tea is an alternative choice for stem cutting pre-treatment, which can substitute chemical uses, and also accelerate rooting and budding of cassava.

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