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Abstract.

*Over the past decade, cacao (*Theobroma cacao*) has been introduced to the agroforestry systems in some upland provinces of southern Vietnam to improve the income of local farmers. However termite attack on cacao seedlings is the main constraint to the development of this crop in these systems. Chemical application is the only current method available for farmers to protect their cacao crop. So far there is no study on non-chemical termite control method. An experiment on natural termite control using vetiver grass was established by the Nong Lam University (NLU) team in Nghia Trung (site 1) and Nghia Binh (site 2) communes of Bu Dang district, Binh Phuoc province to test the hypothesis that the natural oil compounds and some of its constituents in composted vetiver grass biomass can repel termites and its organic matter can enhance the growth of cacao seedlings. The initial findings suggest that vetiver grass can be used not only in its traditional role as a tool for soil erosion control, but its biomass can be used as a compost for termite control also, instead of chemicals, in cacao development in agroforestry systems.*

Keywords. termite, biocontrol, vetiver, cacao

INTRODUCTION

Over the past decade, cacao (*Theobroma cacao*) has been introduced to the agroforestry systems in some upland provinces of southern Vietnam, especially in cashew plantations to improve the income of local farmers. However termite attack on cacao seedlings is the main constraint to the development of this crop in these systems. Presently, control of termites depends mainly on the incorporation of synthetic chemical treatments with a long persistence into the soil and it is the only method available for farmers to protect their cacao crop. There is an interest in using natural products in pest control because of their low mammalian toxicity and desirable environmental safety (Duke, 1990).

Vetiver grass, *Vetiver zizanoides (L.)* Nash is native to India and now commonly used for soil and water conservation where soil erosion in prolematic (Chomchalow, 2001). Besides its very high biomass production, vetiver grass can produce many natural compounds that are insect repellent (Duke, 1990). Chemical components of vetiver roots are also very important because they possess fungicidal, herbicidal and insecticidal properties. Vetiver oil and some of its constituents are repellent and toxic to termites (Hendersen et al., 2005b; Ibrahim et al., 2004; Zhu et al., 2001a, 2001b). With 25% vetiver root mulch, such a treatment proved to decrease tunneling activity and

wood consumption, and to increase termite mortality (Nix et al., 2006). Trees surrounded by vetiver do no require traditional anti-termite treatment with lime.

For this reason, termite biocontrol on cacao seedlings by vetiver grass application was studied to test the hypothesis that the natural chemical compounds and some of its constituents in composted vetiver grass biomass can repel termites and its organic matter can enhance the growth of this crop.

TRIAL METHODOLOGY

Time and location.

Two field trials were established with cacao planting under cashew plantation, at Nghia Trung (site 1) and Nghia Binh (site 2) communes of Bu Dang district, Binh Phuoc Province, from August to December, 2007.

Trial design.

In each site, a total of 72 cacao seedlings were planted at the distance of 4mx4m. The trial was carried out with 6 month-old cacao seedlings in a randomized complete block (RCB) design with 4 treatments and three replications. The four treatments were: T1 (control treatment, using 10 kg/tree of cow manure only, no chemical, and no vetiver compost), T2 (farmer practice, 10 kg/tree cow manure, and using chemical termiticide - NoKap 20EC), T3 (mixture of 10 kg of cow manure and 0.5 kg of lime per tree), and T4 (mixture of 5 kg of cow manure and 5 kg of vetiver grass compost per tree, and planting six vetiver clumps surrounding each cacao seedling). Manure, lime and vetiver compost were spread in the holes one week before planting.

RESULTS AND DISCUSION

Effects on vetiver grass on repellence to termites.

Cacao seedlings were often damaged by termites during the rainy season in the first year of planting, according to farmers' experiences. The effects of vetiver grass on cacao seeding damage is presented in table 1 (site 1) and table 2 (site 2).

Table 1. Percentage of cacao seedlings damaged two months after planting at site 1.

Treatment	Total damaged (%)	damaged by termite (%)
T1	66 [a]	44 [a]
T2	22 [b]	11 [b]
T3	39 [b]	23 [ab]
T4	17 [b]	0 [b]
Prob.	0.004	0.014

Two months after planting, the total cacao seedlings damaged was high in all treatments, especially in T1 (66%) and T3 (39%). The seedlings that died in T1 was significant higher in number than in the other treatments. When mortality due to termites was analsysed, T4 (vetiver grass) treatment was free of damage: no seedlings died through termite attack. The seedlings in this treatment that were damaged were largely infected by the disease *Phytophthora palminova*. In T1 (control) T2 (chemical) and T3 (lime used to control termites) treatments, the seedling damagedue to termites was high - 44%, 11% and 23%, respectively.

Picture 1. Cacao seedling death by termite attack Picture 2. Vetiver with cacao seedling

The results shown that vetiver grass used as a compost and planted surrounding cacao seedlings can markedly reduced the attack of termite on this crop; its effectiveness was better than that of the chemical treatment. This was possibly due to the natural chemical compounds in the whole vetiver grass (including leaves and roots); these compounds possibly released during the decomposing of compost repel termites.

Table 2. Percentage of cacao seedlings damaged two months after planting at site 2.

Treatment	Total damaged (%)	damaged by termite (%)
T1	72[a]	72 [a]
T2	61[ab]	61 [ab]
T3	61 [ab]	61 [ab]
T4	27[b]	27 [b]
Prob.	0.037	

Although the cacao seedling mortality was high, and seedlings in all treatments were damaged by termites at this site, the seedlings damaged in T4 was lowest (27%), and significant lower than that of the control treatment (72%).

Compare to that in site 1, seedlings death due to attack of termites was higher at site 2; this is possibly due to the effect of poorer establishment of live vetiver planting surrounding cacao seedlings. Effects of vetiver grass on the growth characteristics of cacao seedlings, four months after planting in site 1 are presented in Table 3.

Table 3. Some characteristics of cacao growth, four month after planting.

Treatment	Plant heigth (cm)	Stem basal iameter (mm)	Primary branch (no.)
T1	61[ab]	12[ab]	3.0 [ns]
T2	51 [b]	10[b]	2.7 [ns]
T3	58 [ab]	14 [ab]	3.3 [ns]
T4	80[a]	17 [a]	3.7 [ns]
Prob.	0.007	0.046	0.34

The plant heigth and basal stem diameter of cacao seedlings in T4 were greater than those of the other treatments, and significantly so copared to treatemtn 2. This is possibly due to the role of organic matter that can improve soil water holding capacity and nutrients and chemical compounds, released from the decomposition of the compost (Mao et al., 2006).

Conclusions

The findings suggest that vetiver grass can be used not only as a tool for soil erosion control, but its biomass in a compost form combined with the close presence of actively growing vetiver plantsrepels termites, in place of chemical control, and enhancs the growth of the cacao crop, a useful development for agroforestry systems.

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