Tropentag 2017, Bonn, Germany
September 20-22, 2017
Conference on International Research on Food Security, Natural Resource Management and Rural Development
organised by the University of Bonn, Bonn, Germany

Impact of termite infestation on cocoa yield under different cocoa cultivation systems in Cameroon

Djuideu[1] T.C.L., Ambele[2] C.F. and Bisseleua[3] D.H.B.

[1]University of Yaoundé 1, Cameroon, Animal Biology and Physiology (djuideuchristian@gmail.com)
[2]Icipe, African Insect Science for Food and Health, Kenya (felicitasfavour@yahoo.fr)
[3]World Agroforestry Centre (ICRAF), Kenya (H.bisseleua@cgiar.org)

Introduction

Cocoa (*Theobroma cacao* L.) is a crop of the humid tropical lowlands, which is mostly grown by smallholders. In some countries of Africa like Cameroon and Ghana, cocoa is traditionally grown under a multilayer forest canopy (Norgrove *et al.* 2009; Bisseleua *et al.* 2013) where upper-canopy shade trees provide several ecosystem functions (Beer *et al.* 1997; Tschantke *et al.* 2011). In Cameroon, cocoa is increasingly grown in less-shaded plantations or in full sun (Bisseleua *et al.* 2013) (Fig. 1), leading recurrent outbreaks and emerging pests such as termites (Ives *et al.* 2000, Hooper *et al.* 2005). Termites are important pests of cocoa which can cause huge damages to several parts the plant especially the root system (Tra Bi, 2013; Djuideu, 2017) (Fig. 2). We hypothesize that cocoa intensification can lead to termite pest outbreaks in Cameroon resulting on important yield loss in cocoa farms highly infested and important death of cocoa trees due to subterranean attacks. This paper seeks to investigate farmers' perception of termites in their farms and their effect on cocoa yield obtained according to cocoa cultivation system along a shade gradient from heavily shaded to unshaded systems.

Fig 1: Intensification strategies in West Africa

Fig 2: Typical damages of termites on cacao trees

Material and Methods

The study involved a cross–sectional survey from April to May 2016 in five localities in southern Cameroon according to the cocoa cultivation system ranged from heavy shaded system to full sun system.

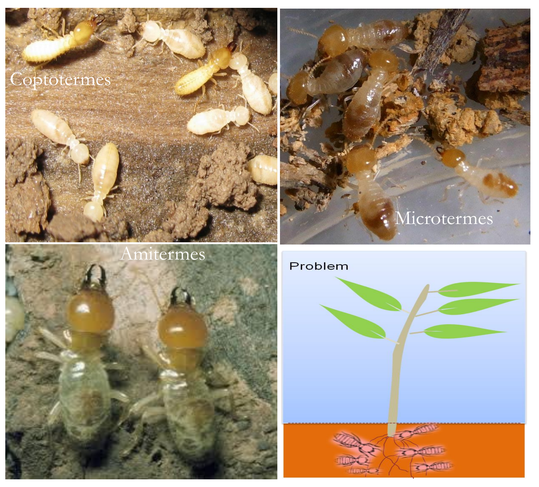

Fig 3: Termites species pest of cocoa

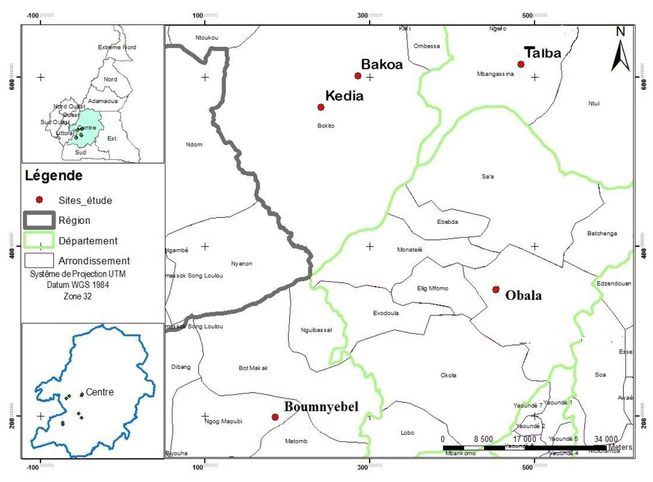

Fig 4: Study area

We carried out informal surveys with 104 farmers to investigate the importance of termite as constraint to cocoa cultivation and their impact on cocoa yield. We also investigated the cocoa farmers experience, the shade management activities and the cost of agrochemicals inputs (1USD= 500 CFAF). During the survey, cocoa farms were divided into two groups in each locality according to the level of damages caused by termite species in their cocoa farms: highly infested farms and poorly infested farms. To evaluate the effect of termites on cocoa yield we calculated yield loss in each locality by assessing the percentage of yield loss in term of fresh beans between highly infested farms and poorly infested farms using equation (1).

$$Yl = (Yi - Yj) / Yi) \times 100 \quad (1)$$

With Yl = yield loss
Yi = average yield in poorly infested farms
Yj = average yield in highly infested farms

Results and discussion

Plant parts	Boumnyebel	Obala	Talba	Bakoa	Kedia	p-value	Mean
Stems	92.9 ± 7.1a	92.3 ± 7.7a	20.0 ± 6.8b	94.4 ± 5.5a	6.7 ± 6.7c	0.006	51.5 ± 5.1
Roots	35.7 ± 13.2	38.5 ± 14.0	48.6 ± 8.3	58.8 ± 12.3	66.7 ± 12.5	NS	50.5 ± 5.1
Stems + roots	64.3 ± 10.2ab	65.4 ± 10.9ab	34.3 ± 7.5b	76.6 ± 8.9a	36.7 ± 9.6b	0.001	51.0 ± 5.1
Chupons	35.7 ± 13.3ab	69.2 ± 13.3ab	2.7 ± 2.6c	38.9 ± 11.8ab	26.7 ± 11.8a	<0.0001	26.8 ± 4.5
Branches	0.0 ± 0.0b	0.0 ± 0.0b	21.6 ± 6.8a	33.3 ± 11.4a	13.3 ± 9.1a	<0.0001	16.5 ± 1.4
Pods	35.7 ± 13.2a	46.1 ± 14.4a	0.0 ± 0.0b	5.6 ± 5.6b	6.7 ± 6.7b	<0.0001	13.4 ± 3.5

'P' is the significance level of Kruskal-Wallis (NS = no significance, P > 0.05). Same letters in a same row show no significant differences between regions based on Mann-Whitney test.

Table 1: Farmers' assessment of plant parts damaged by termite in southern Cameroon

Farmers reported termite damages to be more serious in nurseries and very old plantations (94% of respondents) as observed by Tra Bi (2013) in Cocoa farms of Côte d'Ivoire. In shaded systems (Boumyebel and Obala), stem is the most preferred plant parts by termites while roots are the most preferred plant parts in low shaded systems (Bakoa and Kedia) (Table 1). According to Jones *et al.* (2003) and Tra Bi (2013), termite pest species may respond positively to ecosystem disturbance (shade trees removal) and too much shade is favorable to cocoa attacks on stems. Intermediate shading system (Talba) showed a low infestation of both stems and roots of cocoa trees.

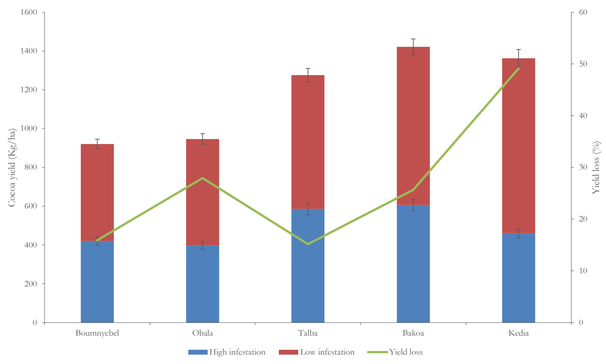

Fig. 3: Yield loss due to termite infestation in cocoa agroforestry systems

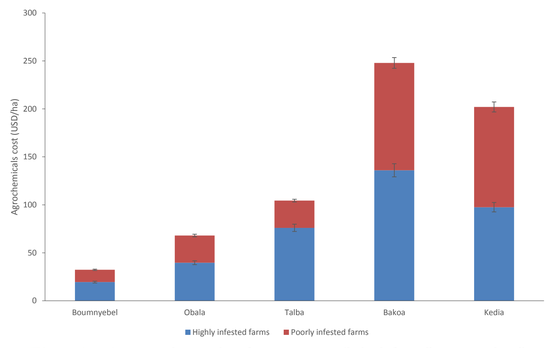

Fig. 4: Agrochemicals costs (highly farms infested compared poorly infested farms) in each agrosystem

The yield loss was very low in heavily shaded systems like Boumnyebel with 15% of loss, compared to unshaded shaded systems like Kedia with 50% of loss (Fig. 3). This support the hypothesis that density of functionally monophagous herbivores will be reduced with increased vegetation complexity (Van Bael *et al.*, 2008).

The shade removal to reach unshaded systems lead to increase of agrochemical inputs with a cost of average 19 USD/ha in Boumnyebel until 102 USD/ha in Kedia (Fig. 4). We also noted that the cost of agrochemicals was positively correlated with yield loss showing that increasing use of agrochemicals in unshaded systems does not limit termite negative effect on the yield of cocoa.

Conclusion and outlook

This survey shows that high infestation of termite in cocoa farms can strongly affect cocoa yield and yield loss is more significant in low shaded than heavily shaded systems. Termite damage was important on roots of cocoa trees in lowly shaded systems and the shade trees removal can lead to termite pest outbreaks responsible of death of cocoa in such systems. This study also showed that Talba's agroforestry system (intermediate shading system) combining a sustainable cocoa production and some important ecological and economical services especially pest biocontrol, needs to be promoted at large scale.

References

Bisseleua, H.B.D., Fotio, D., Yede, Missoup, A.D. and Vidal, S. (2013). Shade Tree Diversity, Cocoa Pest Damage, Yield Compensating Inputs and Farmers' Net Returns in West Africa. *PLoS ONE*, 8(3): 1-9.

Tscharntke, T., Clough, Y., Bhagwat, S. A., Buchori, D., Faust, H., Hertel, D., Hölscher, D., Juhrbandt, J., Kessler, M., Perfecto, I., Scherber, C., Schroth, G., Velkamp, E. and Wanger, T. C. (2011). Multifunctional shade-tree management in tropical agroforestry landscapes–a review. *Journal of Applied Ecology*, 48 (3): 619-629.

September 2017