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Insecticidal activity of the medicinal plant, *Alstonia boonei* De Wild, against *Sesamia calamistis* Hampson*

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Abstract: The bioactivity of the aqueous extracts of the leaf and stem bark of the medicinal plant, *Alstonia boonei* De Wild (Apocyanaceae), against the pink stalk borer, *Sesamia calamistis* Hampson (Lepidoptera: Noctuidae) was studied in a laboratory bioassay. The extracts were incorporated into artificial diet at a rate of 0.0% (control), 1.0%, 2.5%, 5.0%, and 10.0% (w/w). Both extracts significantly (P<0.01) reduced larval survival and weight in a dose dependent manner. The concentrations that killed 50% of the larvae (LC_{50}) for the stem bark extract were 2.8% and 2.1% at 10 and 20 DAI (days after introduction), respectively, while those for the leaves extract were 5.6% and 3.5%. The weights of the larvae also varied significantly (P<0.05) between the treatments in a dose dependent manner. We conclude that both leaf and stem bark extracts of *A. boonei* are toxic, used as growth inhibitors to *S. calamistis* larvae, and hold good promise for use as alternative crop protectants against *S. calamistis*.

Key words: *Alstonia boonei*, Extract, *Sesamia calamistis*, Toxicity, Growth inhibitors
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INTRODUCTION

Alstonia boonei De Wild (Apocyanaceae) is a medicinal plant used extensively in West and Central Africa for the treatment of malaria, fever, intestinal helminthes, rheumatism, hypertension, etc. (Terashima, 2003; Betti, 2004; Abel and Busia, 2005). The major phytochemicals in the stem bark are saponins, alkaloids, tannins and cardiac glycosides (Fasola and Egunyomi, 2005). Despite its popularity as an aromatic plant, the insecticidal potential of *A. boonei* has not been investigated as has been done for other medicinal plants like neem, *Azadirachta indica* A. Juss (Maala *et al*., 2000; James *et al*., 2003; Bruce *et al*., 2004). The objective of the present study was to examine the insecticidal properties of the aqueous extracts of the leaf and stem bark of *A. boonei* against the pink borer, *Sesamia calamistis* Hampson (Lepidoptera: Noctuidae), a major pest of maize and some other cereals in West and Central Africa (Bosque-Perez and Mareck, 1990; Kfir *et al*., 2002).

MATERIALS AND METHODS

Fresh leaves and stem bark were collected once from *A. boonei* trees (about 15~20 m tall) along the Akure-Ifon Road, Ondo State, Nigeria, between October and December, 2005. This is the beginning of the dry season when the plant flowers and produces seeds. It is expected to have high concentration of secondary metabolites during this period. The leaves and stem bark were sun dried and ground to powder with an electric blender (SuperMaster®, Model SMB 2977, Japan). About 250 g each of the powders were extracted in the cold with about 300 ml of water in 1 L Schott Duran bottles for 72 h. The extracts were filtered through Whatman No. 1 filter paper and the extraction was repeated twice for maximum yield.

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The extracts were evaporated to dryness in a Gallenkamp Hotbox oven at 40 °C and kept in sealed glass vials until needed. The bioassay was done in the Insect Rearing Unit of the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. The dry extracts were incorporated into artificial diet for *S. calamistis*, made from cowpea and wheat germ flours (Jackai and Raulston, 1988), at a rate of 0.0% (control), 1.0%, 2.5%, 5.0%, and 10.0% (w/w). The treatments were dispensed into wells of a plastic tray (Bioserv®) and allowed to cool down and solidify under a microflow workstation. *S. calamistis* larvae were obtained from the colony in the Insect Rearing Unit at the IITA, Ibadan, Nigeria. They were maintained on the artificial diet for two generations. Two larvae (<12 h old) were introduced into each well of the assay tray containing the treated diet. Each plastic had twenty four wells and represented a treatment. The plastic tray was sealed with a perforated nylon sheet to allow for ventilation. There were three replicates. The treatments were arranged randomly in trays in the laboratory maintained at a temperature of (26±2) °C, (80±5)% relative humidity and 14 h:10 h (light:dark) illumination. Larval survival and weight were recorded at 10 and 20 d after introduction (DAI) from twelve wells per treatment. The fresh weight of the larvae was taken immediately after removal from the diet while the dry weight was taken after drying in the oven for 7 d at 40 °C. The concentration that killed 50% of the larvae (LC_{50}) was calculated at 10 and 20 DAI using probit analysis while data on survival and weight were analyzed using the analysis of variance (ANOVA) (SAS System for Windows, Version 8.2). Means were separated with the Student-Newman-Keuls' test.

RESULTS

The percentage survival of *S. calamistis* larvae reared on the treatments is shown in Table 1. The stem bark was more toxic than the leaf extract against the *S. calamistis* larvae. The LC_{50} of the stem bark extract was 2.8% while that of the leaf extract was 5.6% at 10 DAI. Table 2 shows the fresh weight of the larvae reared on the different treatments. There was a significant reduction in the weight of the larvae in a dose dependent manner by both extracts.

DISCUSSION

The results of our study show that the aqueous extracts of the stem bark and leaf of *A. boonei* adversely affected survival and growth of *S. calamistis* larvae. Growth inhibition may result from toxicity or

Table 1 Mean survival (%) of *S. calamistis* larvae reared on artificial diet incorporated with extracts of *A. boonei*

Concentration (%)	Larval survival (%)			
	Stem bark extract		Leaf extract	
	10 DAI	20 DAI	10 DAI	20 DAI
10.0	0.00e	0.00d	16.67d	6.25d
5.0	29.17d	16.67c	64.58c	50.00c
2.5	62.50c	50.00b	83.33b	66.67b
1.0	83.33b	75.00a	95.83ab	79.17ab
0.0 (control)	100.00a	87.50a	100.00a	87.50a
LC_{50} (%)	2.8	2.1	5.6	3.5
95% *CL*	2.3~3.4	1.7~2.5	4.7~6.8	2.7~4.4

DAI: Days after introduction; Means followed by the same letters in the same column are not significantly different (P<0.05; Student-Newman-Keuls' test). *CL*: Confidence limits

Table 2 Mean fresh weight of *S. calamistis* larvae reared on artificial diet incorporated with extracts of *A. boonei*

Concentration (%)	Mean larval weight (mg)			
	Stem bark extract		Leaf extract	
	10 DAI	20 DAI	10 DAI	20 DAI
10.0	–	–	0.00d (8)	0.00e (3)
5.0	1.43d (14)*	2.40d (8)	1.29cd (31)	10.30d (24)
2.5	2.60c (30)	29.50c (24)	3.73c (40)	30.70c (32)
1.0	5.73b (40)	94.50b (36)	7.23b (46)	87.40b (38)
0.0 (control)	25.46a (48)	214.80a (42)	25.46a (48)	214.80a (42)

Means followed by the same letters in the same column are not significantly different (P<0.05; Student-Newman-Keuls' test); DAI: Days after introduction; *Figures in parenthesis indicate the number of larvae weighed

feeding deterrent properties of the extracts (El-Lakwah *et al*., 1996; Akhtar and Isman, 2004; Erturk, 2006). Since larvae reared on the 10.0% stem bark extract suffered 100% mortality and other doses of this extract caused lower larval survival than the leaf extract, *A. boonei* stem bark likely contains more potent compounds than the leaves. These substances may be antibiotic or antifeedant in nature (Verkerk and Wright, 1993; Kabaru and Gichia, 2001; Sadek, 2003). The insecticidal activity of *A. boonei* extract against *Maruca vitrata* Fabricius was reported by Oigiangbe *et al*.(2007), while McLaughlin *et al*. (1980), Raju *et al*.(1990), El-Lakwah *et al*.(1996) and Jeong *et al*.(2001) observed the bioactivity of other species of the Family Apocyanaceae against different insect species. Some chemical compounds of the indole alkaloid group (alstonine, porphine and astonidine) and triterpenoids have been identified from the bark of *A. boonei* (Phillipson *et al*., 1987; Anonymous, 1992; 2001). The insecticidal potential of these compounds has not been investigated or reported in literature. A bioassay-guided fractionation of these extracts will help to identify the compounds responsible for the activity observed in this study.

We conclude that the stem bark and leaves of the medicinal plant, *A. boonei*, contain insecticidal substances that have potential for use as alternative crop protectants against *S. calamistis* and most likely other pest species.

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