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Original Research Paper

Evaluation of some botanicals against termites' damage on hot pepper at Bako, Western Ethiopia

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A field study was conducted to evaluate the pesticidal efficacy of eleven botanical plants against termites on hot pepper at Bako, Western Ethiopia during the 2005, 2006, and 2007 cropping seasons. The powder of leaves and seeds of botanical plant species was applied at 50gm per 12.6m2 plot size. Plants with least termite damage were always recorded from plots treated with *Maesa lanceolata, Azadirachta indica* and Diazinon 60EC (2,500 ml/ha).The highest stand count and yield were also obtained from plots treated with the above plant species and Diazinon. Treatment with *Shinus molle* and *Ficus vasta* appeared to have the lowest effects on termite damage protection, consequently, there was low plant population at harvest. The use of *Maesa lanceolata* and *Azadirachta indica* might be promoted as part of an integrated management program of termite on hot pepper.

Key words: Evaluation, botanicals, pepper, termite

INTRODUCTION

Termites have been regarded as serious pests that attack a wide range of agricultural crops, forest trees and buildings in Western Ethiopia (Abdurahaman, 1983; Abraham, 1990; Temesgen, 1996). Most of the termite spp are *Macroterms subhyalinus* (Rambur) and *Microtermes adschaggae* (Sjosted) in this area (Abdurahman, 1990). They are subterranean in nature which is difficult to locate and destroy (Temesgen, 1996).

Termite**s** attack caused up to 62% and 36% reduction in yields of hot pepper and maize, respectively (Abdurahaman, 1983; Abraham, 1990; Devendra et al., 1998). In addition it causes severe soil degradation by reducing vegetation and leaving the soil surface barren and exposed to the elements of erosion (Abraham, 1990; Devendra et al., 1998).

The consequences of termite infestation reduce farm productivity, increased land degradation and vulnerability of resources of poor farmers (Altieri, 1984; Abraham, 1986). As a result, farmers were forced to abandon their farmlands and migrate to their surroundings (Abraham and Adane, 1995).

Use of some cultural control methods such as mounds destruction, removal of the queen, flooding with water, use of hot ash and hot pepper were either partially effective or not effective at all. As a result, control methods heavily depend on synthetic chemicals especially organo-chlorides, which are currently banned from the world market due to their persistent toxicity (Abraham, 1986; Abdurahaman, 1990). Many plants species including *neem* and *Ipomea fistulosa* have been reported to posse's insecticidal and repellant properties to termites (Gold et al., 1991). According to Adetola et al. (1995) and Listinger et al. (1978), incorporating such plants and /or their derivatives into annual cropping system may provide an ecologically sound method in termite control. Hence, the present study reports on the field efficacy of some plant products against subterranean termite.

MATERIALS AND METHODS

Description of study area

The experiments were conducted at Bako Agricultural Research Center, western Ethiopia, for three years (2005, 2006 and 2007). The Center lies at 9° 6`N latitude and 37°09`E longitude, 260 km west of Addis Ababa, at an altitude of 1650 m.a.s.l. The area is characterized by warm and humid climate. The annual average rainfall and relative humidity were 1259 mm and 58.95%, respectively**.** The average minimum and maximum atmospheric temperatures of the area during the study period were 14.10°C and 27.93°C, respectively. Sixty percent of the soil is reddish brown Nitosols with PH range of 5.0-5.31.

Table 1: Effect of different plant species on percent damaged plants, stand count at harvest and dry pod yield (qt/ha) of hot pepper at Bako

No	Botanicals	Percent damaged plants	Plant stand at harvest	Dry pod yield (qt/ha)
1	*Maesa lanceolata*	7.50 ± 2.50 g	54.00 ± 1.24 a	4.29 ± 0.81 a
2	*Chenopodium spp*	25.28 ± 6.90 cd	41.50 ± 2.74 bcd	2.95 ± 0.52 b
3	*Azadrachta indica*	9.44 ± 2.26 g	52.67 ± 0.95 a	4.67 ± 0.85 a
4	*Croton macrostachyus*	17.50 ± 4.27 e	40.50 ± 1.84 cd	3.05 ± 0.59 b
5	*Tagetes minuta*	16.94 ± 4.09 ef	37.67 ± 2.04 d	2.50 ± 0.40 bc
6	*Datura stramonium*	16.94 ± 3.02 ef	45.00 ± 2.45 b	2.25 ± 0.73 bc
7	*Vernonia amygdalina*	17.50 ± 4.72 e	40.33 ± 1.05 cd	2.76 ± 0.49 bc
8	*Phytolaccadodecandra*	23.61 ± 6.75 d	38.50 ± 2.68 d	2.39 ± 0.22 bc
9	*Nicotiana tobaccum*	23.33 ± 4.04 d	32.83 ± 1.81 e	2.29 ± 0.52 bc
10	*Shinus mole*	29.72 ± 8.23 bc	30.83 ± 1.92 e	2.72 ± 0.60 bc
11	*Ficus vasta*	36.94 ± 9.40 a	26.66 ± 2.23 f	2.38 ± 0.38 bc
12	Diazinon 60% EC	11.11 ± 2.67 fg	50.50 ± 0.96 a	4.09 ± 0.81 a
13	Untreated check	34.44 ± 4.90 ab	32.33 ± 1.87 e	2.09 ± 0.19 c
CV%		23.88	8.61	23.85
Mean		20.78	40.22	2.95

Means followed by similar letter within a column are not significantly different from each other at 5% level of probability (DMRT)

Experimental design and development of test plants

The experiment was conducted in two seasons during the year of 2005 and 2006. Eleven different species of botanical were collected from Addis Ababa, Holeta, East and West Wellega and around Bako area. All botanicals were evaluated against termites together with standard check (Diazinon 60 EC) and an untreated check. The experiment was laid out in randomized complete block design with three replications with the plot size of (4.2m × 3m) in 2005 and 2006. Botanicals that showed promising effects against termites were advanced to a third season in 2007 on large plots (9.3 m × 9.1 m) without replication. DAP and urea were applied at 207 kg/ha and 137kg/ha, respectively. Weeding was done three times. Irrigation was done as at when necessary. Leaf powder of *Maesa lanceolata, Chenopodium spp, Croton macrostachyus, Tagetes minuta, Datura stramonium , Vernonia amygadalina, Phytolacca dodecandra,Nicotiana tobaccum,Shinus molle* and *Ficus vasta* were used for treatment application, however, seed powder was used for *A. indica*.

Treatment application

The leaves and seeds of the botanicals were dried under shade and grounded into fine powders. The powders of the plant species were applied at 50g per plot as basal or root application at transplanting and pod setting stages. Likewise the recommended rate of Diazinon 60EC (2,500 ml/ha) was applied at the transplanting and pod setting stags. Untreated check plots were neither treated with the insecticide nor with powders of botanicals.

Collection and analysis of data

Two weeks after application of the first treatment and every two weeks thereafter until physiological maturity, ten plants were randomly selected per plot to asses for termite damage. The mean of termite damaged plants was expressed as percentage of the total sampled plants. Stand count was taken at harvest. The six middle rows were harvested at physiological maturity. Dry pod yield per plot was converted to qt ha^{-1}. The percentages of termite damaged plants and stand count at harvest were square-root transformed to stabilize the variances. One way analysis of variances was used. The data obtained were subjected to analysis of variance using MSTATC computer program and means were separated using Duncan`s multiple range test (DMRT) at the probability level of 5%

RESULTS

The results showed that significantly lower percentages of damaged plants were recorded in Maesa lanceolata, Azadirachta indica and Diazinon treated plots than the other treatments. In contrast, significantly higher percentages of damaged plants were recorded in F. vasta and in the untreated check. Percent damaged plants in *C. macrostachyus, T. minuta, D. stramonium* and *V. amygdalina* ranged from 16.94 - 17.5 and differences among them were not significant (Table 1). Likewise, substantial amount of percent damaged plants were observed in *Chenopodium, P. dodecadra* and *N. tobaccum* treatments.

Significantly higher number of plants at harvest were recorded in *M. lanceolata , A. indica* and Diazinon 60 EC treatments (Table 1). The next higher number of plants at harvest were recoded in *Chenopodium , C. macrostachyus, T. minuta, D. stramonium , V. amygdalina* and *P. dodecandra*, which did not differ significantly from each other. Stand count at harvest in *F. vasta* treated plots was significantly

Table 2.Effect of different botanical plants against termite damage, stand count at harvest and dry pod yield (qt/ha) of hot pepper at Bako, Western Ethiopia in 2005 cropping season.

Treatments	Percent damaged plants	Mean stand count at harvest (No.)	Dry pod yield (qt/ha)
Maesa lanceolata	2. 78 ± 2.00 **f**	56.00 ± 1.15 **a**	6.07 ± 0.39 **a**
Chenopodium spp	10.56 ± 1.47 cde	47.00 ± 0.58 cde	4.03 ± 0.39 b
Azadrachta indica	5.00 ± 1.92 **ef**	54.00 ± 1.53 **ab**	6.54 ± 0.19 **a**
Croton macrostachyus	8.33 ± 0.96 def	41.67 ± 3.28 ef	4.15 ± 0.66 b
Tagetes minuta	8.33 ± 0.96 def	39.33 ± 3.71 f	3.33 ± 0.27 bc
Datura stramonium	10.56 ± 1.47 cde	50.33 ± 1.20 bcd	3.52 ± 1.01 bc
Vernonia amygdalina	9.44 ± 2.94 cde	39.67 ± 2.18 f	3.62 ± 0.64 bc
Phytolacca dodecandra	8.89 ± 2.78 de	43.67 ± 0.67 ef	2.81 ± 0.17 bc
Nicotiana tobaccum	15.00 ± 2.89 bc	29.00 ± 0.57 g	3.13 ± 0.81 bc
Shinus mole	12.78 ± 2.42 bcd	29.67 ± 0.88 g	3.77 ± 0.61 b
Ficus vasta	16.67 ± 2.54 b	28.00 ± 3.5 g	3.13 ± 0.44 bc
Diazinon 60% EC	5.56 ± 2.00 **ef**	52.00 ± 1.00 **abc**	5.89 ± 0.18 **a**
Untreated check	23.89a ± 1.47 a	31.67 ± 3.88 g	2.25 ± 0.26 c
CV	31.67	7.65	21.84
LSD	5.6	5.398	1.46
Mean	9.95	41.69	4.02

the lowest of all treatments, including the untreated check (Table 1).

Significantly ($p<0.05$) higher amount of dry pod yields (qt/ha) were recorded from *M. lanceolata, A. indica* and Diazinon 60 EC treated plots than that of all other treatments. Dry pods yield qt/ha ranged from 2.25-2.76 for *Qomonyo (Om.), T.* minuta, *D. stramonium, V. amygdalina, P. dodecadra, N. tobaccum, S. molle* and *F. vasta* and no differences were observed among them (Table 1).

The effects of the different botanicals on the percent damaged plants, stand count at harvest and dry pod yield of hot pepper at Bako in the 2005 cropping season are indicated in (Table 2). *M. lanceolata* and *neem* resulted in significantly lower amount of damaged plants, significantly higher amount of plants at harvest and pod yield than the untreated check and most of the other botanicals (Table 2). Both botanicals were as effective as the synthetic insecticide in all of parameters considered.Similarly in 2006 cropping season *M. lanceolata* and *neem* treatments performed significantly better than almost all of the other botanicals and in the untreated check in all of parameters measured (Table 3).

The percentages of damaged plants in *A. indica* and *M. lanceolata* were very low compared with the percent damaged plants observed in the untreated check (Table 4). The amount of damaged plants in *A. indica and M. lanceolata* treated plots were comparable to that of synthetic insecticide. Moreover stand count at harvest and dry pod yield (qt/ha) of hot pepper were very high for the two botanicals and Diazinon 60 EC treatments as opposed to the untreated check where termite's damage was very high and the amount of plants at harvest and pod yield were very low (Table 4).

DISCUSSION

The study has shown that *M. lanceolata* and *A. indica* have promising potential to use against termite on hot pepper. These botanicals have showed similar effects with that of synthetic insecticide, Diazinon 60 EC. The findings agree with the results of *Fekede* (2002) who reported that *M. lanceolata* was as effective as the synthetic fungicide, *Thiram* in controlling sorghum head smut.According to ICRA (1998) *C. macrothachys* and *T. minuta* have repellant properties against termite and *D. stramonium, F. vasta, neem leaves* and *Chenopodium* have shown insecticidal effects.

However, our findings do not agree with the above report since *T. minuta*, *D. stramonium*, *F. vasta* and *Chenopodium* did not provide significant control of the pest. The effectiveness of neem observed in the present study agrees with that of Gold et al. (1991) and Epilla et al. (1988) who reported that, these plants posses insecticidal, repellent, or antifeedant properties. Several species of plants have been reported as being toxic or repellent to termites, however, only neem and *Ipomea fistulosa* products have been field-tested (Gold et al., 1991). According to Brown (1962), incorporating such plants and their derivatives into annual cropping systems may provide ecologically sound methods of termite control. Moreover, Gold et al.,(1991); Logan et al., (1999); and Schroth et al., (1992) have reported that, *Neem* and *Ipomea fistulosa* mulches help to reduce termite activity for seven weeks and suggested that this should be given important consideration in termite control strategies. Our study confirmed that the two botanicals can be effective for integrated termite management practice.

Table 3: Effect of different botanical plants against termite damage, stand count at harvest and dry pod yield (qt/ha) of hot pepper at Bako, Western Ethiopia in 2006 cropping season.

Treatments	Percent damaged Plants	Stand count at harvest (No.)	Dry pod yield quintal/ha (qt/ha)
Maesa lanceolata	12.22 ± 2.22 **g**	52.00 ± 1.52 **a**	2.51 ± 1.11 **ab**
Chenopodium spp	40.00 ± 4.41 bc	36.00 ± 2.64 bcd	1.87 ± 0.26 bcd
Azadrachta indica	13.89 ± 1.47 **fg**	51.33 ± 0.67 **a**	2.79 ± 0.27 **a**
Croton macrostachyus	26.67 ± 2.54 de	39.33 ± 2.18 bc	1.95 ± 0.29 bcd
Tagetes minuta	25.56 ± 2.93 de	36.00 ± 2.08 bcd	1.69 ± 0.28 cde
Datura stramonium	23.33 ± 1.67 def	39.67 ± 0.33 b	.98 ± 0.15 e
Vernonia amygdalina	25.56 ± 6.19 de	41.00 ± 0.58 b	1.90 ± 0.19 bcd
Phytolacca dodecandra	38.33 ± 1.92 bc	33.33 ± 2.96 cd	1.97 ± 0.19 bcd
Nicotina tobaccum	31.67 ± 1.92 cd	36.67 ± 1.20 bcd	1.44 ± 0.14 de
Shinus mole	46.67 ± 6.74 b	32.00 ± 4.04 d	1.68 ± 0.59 cde
Ficus vasta	57.22 ± 4.94 a	25.33 ± 3.28 e	1.64 ± 5.14 cde
Diazinon 60% EC	16.67 ± 0.96 **efg**	49.00 ± 1.15 **a**	2.30 ± 0.21 **abc**
Untreated check	45.00 ± 2.54 b	33.00 ± 1.52 d	1.91 ± 0.31 bcd
CV%	19.91	9.59	24.80
LSD	6.08	6.283	7.73
Mean	30.98	38.82	1.89

Means followed by the same letter within a column are not significantly different from each other at 5% level of probability (DMRT

Table 4. Effects of A. indica and M. lanceolata on the number of damaged plants, stand count at harvest and dry pod yield (qt/ha) of hot pepper on large plot size (9.3 m × 9.1m) without replication at Bako, Western Ethiopia in 2007 cropping season.

Treatments	Percent damaged plants	Stand count at harvest (No.)	Dry pod yield (qt/ha)	Yield advantage over the check
A. indica	16.38	335	13.82	7.2
M. lanceolata	14.64	344	16.54	9.92
Diazinon 60EC	14.39	345	15.95	9.33
Untreated check	39.45	241	6.62	

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