SHORT COMMUNICATION

Evaluation of Some Botanicals Against Maize Weevil, *Sitophilus zeamais Motsch.* (Coleoptera: Cruculionidae) on Stored Sorghum under Laboratory Condition at Sirinka

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Abstract

Sixteen botanical products were tested for their efficacy to control maize weevil, *Sitophilus zeamais* on stored sorghum seeds, under laboratory conditions. For comparison, three more treatments- primiphos methyl, malathion and untreated check were included and the experiment was replicated three times. Within 28 days after treatment, some botanical products caused 100 percent mortality of the weevil, which was comparable to the two synthetic insecticides. These were seed and leaf powder of *Chenopodium ambrosioides*, stem powder of *Cissus rotundifolia*, leaf powder of *Jatropha curcas* and seed powder of *Phytolocca dodecandra*. The botanicals, which caused over 50 percent cumulative mortality of the weevils at 14 days after treatments include, *C. ambrososiodes* (seed, leaf), *J. curcas* (leaf), *P. dodecandra*, *C. rotundifolia* (stem) and *Maesa lanceolata* (leaf). The effect of the promising botanical treatments on weevil progeny survival as well as on seed germination and seed weight loss are discussed.

Introduction

Sorghum, *Sorghum bicolar* (L) Moench, is the major food crop grown by million of people in Ethiopia. It grows in a wide range of environments although it is dominant in low land regions where drought and poor harvest are common occurrence (Birhane 1977). One of the major factors attributed to poor harvest in this area is the problem of insect pests. To date more than 38 insect pests of stores are recorded attacking sorghum in Ethiopia (Adhanom & Abraham 1986). Of these insect pests, maize weevil, *Sitophilus zeamais* Motsch, is most common and destructive pest inflicting heavy damage and losses on stored sorghum. The weevil, *S. zeamais,* is cosmopolitan, and occurs in the tropical and subtropical belts as well as in warmer temperate region of all continents and is regarded very serious major pest of stored sorghum (Schmutterer 1990). Infestation often starts in the field and is carried later into the grain stores. About 15 percent weight loss had been reported in traditional storage facilities in Ethiopia (Yemane & Yilma 1989).

The search for effective, cheap, and safe grain protectant is very important for developing countries like Ethiopia where synthetic insecticides are unavailable, costly and also possess high toxicity to the users and the environment. Moreover, the use of insecticides alone has not, in a majority of cases, solved problems of storage pests as such insect pests are developing resistance against insecticides (Dick 1988). Thus, using little agro-chemicals and relying on traditional grain protectants could be useful. The use of botanical control is environmentally friendly and economical for many resource poor farmers. To date over 1600 plant species have been identified to possess insecticidal properties (Michael et al. 1985). Farmers, in Ethiopia, use local herbs by mixing with grain to reduce infestation in stored grains (Yemane & Yilma 1989). Based on the investigation made by Adane & Abraham (1995) and Mekuria (1995), there are promising botanicals which have insecticidal activity in the control of maize weevil.

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The objective of this study was, therefore, to evaluate the efficacy of some locally available botanicals obtained from farming system survey in the region, for the control of storage pests with the ultimate goal of developing effective, safe and cheap integrated storage insect pests management system.

Materials and Methods

Sixteen botanical products that were available in the area were tested after the plant parts were air-dried and crushed in to fine powder (Table 1). The experimental sorghum seed (local Degalit) was exposed to low temperature (-4c°) in deep refrigerator for 48hrs to kill weevils, if there was previous infestation. 200 gm of disinfested seed was added in plastic jar of volume 300ml. There were three such jars for each treatment and the experiment was laid in CRD. 30 newly emerged adult weevils were introduced in to each plastic jar. Primiphos methyl (Actellic 2% dust) and Malathion 5% dust were applied at the rate of 10ppm (50gm/100kg of seed) as standard checks. Each botanical was applied at the rate of 4% w/w. The trial was conducted under room temperature of 25-28°C. Number of dead weevils was recorded every week for one month starting the day the weevils were introduced. After removing all remaining adult weevil at 28 days after treatment, progeny emergence was recorded. 100 seeds were taken at random from each replication of a treatment for germination test. The seeds were placed in petri dishes containing moistened filter paper and number of germinated seeds was recorded after seven days. Percent weight loss was estimated using Count and Weight method taking 1000 seeds randomly from each replication of all treatments (Gwinner et al. 1996). The data was transformed to arcsine scale prior to analysis.

$$\text{Weight loss (\%)} = \frac{(Wu \times Nd)-(Wd \times Nu)}{Wu \times (Nd + Nu)}$$

Where, *Wu = weight of undamaged grains*
Nu = number of undamaged grains
Wd = weight of damaged grains
Nd = number of damaged grains

Results

There were ($P<0.05$) significant differences among treatments in the rate of mortality (Table 2). Leaf powder of *J. carcas*, seed and leaf powder of *P. dodecandra*, *C. ambrosioides* and stem powder of *C. rotundifolia* significantly affected weevil mortality. They inflicted the highest mortality (100%) equal to the synthetic insecticides (Primiphos methyl 2% and malathion 5% dust). Similarly, *M. lanceolata (*leaf powder*)*, Neem (leaf powder), *R. chalepensis* (seed powder), tobacco (leaf powder) caused mortality of 90 percent and above. In some of these treatments, high percent mortality was recorded at 7 and 14 days after treatments. In addition, *P. dodecandra, M. lanceolata* and *C. ambrosioides* (seed powder) had caused 44.4, 42.2 and 98.8 % mortality, respectively, at 7 days after treatments. Leaf part of *J. carcas*, *C. ambrosioides*, *C. rotundifolia and Neem* SP, caused 52.2, 50.0, 55.6, and 43.3, percent weevil mortality, respectively, at 14 days after treatments. However, in other treatments there was no significant difference compared to untreated check.

Some of the botanicals were as effective as synthetic insecticides with a difference of only in speed of action. All weevils died within the first week of treatment on grains treated with primiphos methyl 2% dust and malathion 5% dust. Except *C. ambrosioide*s (seed powder), which caused comparable high early mortality as synthetic insecticides, most botanicals apparently had slight gradual killing effect on weevils. The gradual killing capacity has an advantage in catching up with progeny development to paralyze the newly emerged offspring. Lower number of progeny were recorded on grains treated with primiphos methyl 2%, Malathion 5%, *C. ambrosioid* (seed powder), *D. stramonium, P. dodecandra*, *M. lanceolata,* neem SP, *J. curcas* and pertsian lilac LP, where all were significantly different from the remaining treatments and the check (Table 3). Sorghum seed treated with *R. prinoides*, *C. macrostachys*, *H. abyssinica*, *R. chalepensis, C. siamea and V. amygdalina* produced large number of progenies.

The botanical treatments did not affect the germination percentage of sorghum. Good germination capacity was observed with Primiphos methyl 2% dust, malathion 5% *C.*

ambrosioides SP, tobacco, C. *rotundifolia*, neem SP, and wild oil nut treated sorghum. Although there were no significant differences among treatments in weight loss percentage, less weight loss percentage was recorded on grains treated with *C. ambrosioides* SP and Neem SP (Table 3). Weight loss and Germination percentage did not reflect the actual figure, instead other factors like weevil damage, fungus and other storage insects also accounts for the observed difference.

Table 1. Botanicals with their scientific, local and common names and their part used in the study.

Botanicals scientific name	**Local name**	**Common name**	**Part used**
Adrichta indica	Kinin	Neem	LP[b]
Azadrichta indica	Kinin	Neem	SP
Cassia siamea	Yefereng digita	Kassod tree	LP
Chenopodium ambrosioides	Gime	[a]	LP
Chenopodium ambrosioides	Gime	[a]	SP
Cissus rotundifolia	Chube	[a]	Stem powder
Croton macrostachys	Bisana	Croton	LP
Datura stramonium	Atsefaris	Thorn apple	LP
Hagenia abyssinica	Kosso	Hagenia *	LP
Jatropha curcas	Ayderke	Wild oil nut	LP
Maesa lanceolata	Kelewa	[a]	LP
Melia azadlrachta	-	Persian lilac	LP
Millettia ferruginea	Birbira	[a]	LP
Nicotina tobaccum	Timbaho	Tobacco	LP
Phytolaca dodecandra	Endod	[a]	SP
Rhamnus prinoides	Gesho	[a]	LP
Ruta chalepensis	Tena adam	[a]	LP
Vernonia amygdalina	Girawa	Bitter leaf	LP
Primiphos methyl			Dust
Malathion Dust 5%			Dust
Untreated check			

[a] Indigenous plants of Ethiopia
[b] SP = Seed Part, LP = Leaf Part

Table 2. Effect of treatments on adult weevil mortality (%), in the laboratory*

Scientific names of botanical plants	Percent mean mortality at days after treatments				Cumulative mortality
	7	14	21	28	
Azadrichta indica LP	10.0	3.0	43.3	34.4	90.7ab**
Azadrichta indica SP	5.6	43.3	22.2	13.3	84.4ab
Cassia siamea	10.0	12.2	18.9	20.0	61.1bcd
Chenopodium ambrosioides LP	7.8	50.0	18.9	23.3	100.0a
Chenopodium ambrosioides SP	98.9	0.0	1.1	0.0	100.0a
Cissus rotundifolia	12.2	55.6	18.9	13.3	100.0a
Croton macrostachys	7.8	21.1	8.9	11.1	48.9cde
Datura stramonium	20.0	21.1	15.6	28.9	85.6ab
Hagenia abyssinica	4.4	5.6	13.3	23.3	46.6cde
Jatropha curcas	20.0	52.2	16.7	11.1	100.0a
Maesa lanceolata	42.2	18.9	12.2	24.4	97.7a
Melia azadirachta	3.0	4.4	54.4	18.9	80.7ab
Millettia ferruginea	6.7	14.4	6.7	6.7	34.5cde
Nicotina tobaccum	7.8	36.7	21.1	24.4	90.0ab
Phytolaca dodecandra	44.4	27.8	18.9	8.9	100.0a
Rhamnus prinoides	4.4	2.2	28.9	40.0	75.5abc
Ruta chalepensis	22.2	15.6	21.1	38.9	97.8a
Vernonia amygdalina	21.0	14.4	6.7	5.7	47.8cde
Primiphos methyl	98.9	1.1	0.0	0.0	100.0a
Malathion Dust 5%	98.9	0.0	1.1	0.0	100.0a
Untreated check	14.3	6.7	21.1	21.1	63.2bcd
CV %	28.29	28.29	28.46	31.21	17.28

** Data are subjected to square root transformed before analysis*
*** Values with the same letter indicate no significant differences among treatments (P<0.05).*

Discussion

From Table1 different botanicals controled maize weevils. According to Adane & Abraham (1995) differences were observed among botanicals in speed of action within a month of storage period. *C. ambrosioides* SP (98.9%), *P. dodecandra* SP (44%), *M. lanceolata* (42%) and *R. chalepensis* (22%) caused high percent mortality at 7 days after treatment. *Cissus rotundifolia* (57%), wild oil nut (52%), *C. ambrosioides* LP (50%), neem SP (43%) and tobacco (37%) had also caused high percentage mortality 14 days after treatment. Similar fast actions of *C. ambrosioide*s LP was observed in earlier studies (Mekuria 1995) in which *C. ambrosioide*s (leaf part) had comparable effect to the synthetic insecticides in both speed of action and efficacy.

The extent to which the botanicals affected the survival of subsequent progeny has found to vary among them. In progeny count, only live adults of newly emerged weevils were recorded but there were few dead offspring. This also indicated that the active ingredients of botanicals reached the site of action gradually and paralyzed the newly emerged offspring. On each day after treatment, particularly on 21 and 28 days after treatment, the summation of dead and live weevils were greater than the original inserted number of weevils in some of the replications. It was because of the counting of dead newly emerging offsprings, contributed to this inequality. During germination test, some of the treatments were affected by fungus resulting in decrease of germination percentage.

The results have shown that the four botanicals are effective in causing cumulative mortality of 100 percent, comparable to the two synthetic insecticides. The botanicals showed good potential in the controlling maize weevils were *J. curcas* leaf powder, C. *rotundifolia* stem powder, *P. dodecandra* seed powder *C. ambrosioides* seed and leaf powder and can solve poor resource farmers' problems by integrating them with other cultural measures.

Table 3. The effect of different treatments on progeny emergence and germination of sorghum seeds (values are mean of three replications)*

Scientific names of botanical plants	Progeny No.	Seed germination (%)	% Weight loss
Azadrichta indica LP	9.7 defg**	77.0ab	25.6b
Azadrichta indica SP	5.7 efg	82.7a	15.1b
Cassia siamea	23.3 abcde	51.3abc	47.6ab
Chenopodium ambrosioides LP	15.3 becdf	66.0abc	16.6b
Chenopodium ambrosioides SP	0.0 g	83.7a	8.7b
Cissus rotundifolia	12.3 becdef	84.0a	23.5b
Croton macrostachys	62.0 a	41.7abcd	24.5b
Datura stramonium	3.7 defg	53.3abc	23.9b
Hagenia abyssinica	38.3 abc	59.3abc	26.6b
Jatropha curcas	5.7defg	80.0ab	19.7b
Maesa lanceolata	1.7 fg	1.3d	65.8a
Melia azadiracta	7.3 defg	75.3abc	18.6b
Millettia ferruginea	23.3 abcd	56.7abc	22.3ab
Nicotina tobaccum	13.3 cdef	81.0ab	20.5ab
Phytolaca dodecandra	6.0 defg	25.0cd	47.0ab
Rhamnus prinoides	43.7 ab	66.7abc	25.3b
Ruta chalepensis	17.3 abcde	71.0abc	23.8b
Vernonia amygdalina	20.0 abc	47.3abcd	44.6ab
Primiphos methyl 2%	1.7 fg	81.7ab	14.3b
Malathion 5%	0.0 g	88.3a	7.7b
Untreated check	17.3 abcde	30.7bcd	39.6b
CV %	36.67	41.1	48.26

** Values are subjected to square root transformation before analysis.*
*** Values with the same letter indicates no significant difference among treatments*

The present study has shown the potential of botanical products in controlling the maize weevil on stored sorghum in Ethiopia. However, further research efforts are needed to determine the application dosage, the active ingredient, persistence, and the long term impact on pest complex in large stores and in farmers' conditions.

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