Effects of the Medicinal Plant Leaf Extract on the Rice Weevil, *Sitophilus oryzae* (L.)

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Abstract

In this study, leaf extracts from eleven medicinal plants were examined for their effect on repellency, mortality, progeny production and loss in grain weight caused by the rice weevil, *Sitophilus oryzae* (L.). The plant extracts were applied at 0.5% W/V. Orientation of adult weevil to *Gloriosa* treated grains was less (9.0 nos.), followed by *Lippia* (14.7) and *Piper* (16.0) as compared to acetone (31.7) and water controls (30.0). The orientation of rice weevil adult expressed as Excess Proportion Index ranged between -0.11 and -0.54 for the different leaf extracts tested. Adult mortality was maximum in *Piper* treated grains (38.1%) followed by *Lippia* (36.2%) and *Lantana* (34.8%). In *Lippia* treated grains the mean progeny production was 58.6 numbers and the progeny build up was suppressed by ten times as compared to the water control (585.0 nos.). Minimum per cent loss in grain weight was observed in *Lippia* treated grains (0.4) followed by *Piper* (19.0) and *Gloriosa* (27.0). Acetone and water control recorded the grain weight loss of 41.7 and 62.5 per cent respectively. It could be concluded from this study that ethanolic extract of *Lippia*, *Piper* and *Gloriosa* possess toxic principles with significant insecticidal and repellent effect and could be a potential grain protectant against *S. oryzae.*

Rice weevil, *Sitophilus oryzae* (L.), (Curculionidae: Coleoptera) is a major pest of cereals like rice, sorghum, wheat, barley and maize both in field before harvest and in storage. The white apodous grub and the reddish brown adults are internal feeders and cause serious quantitative and qualitative losses to cereal grains. Owing to the advantages of the botanical insecticides over the synthetic ones in stored produce insect pest management these are extensively studied. Different types of plant preparations such as powders, solvent extracts, essential oils and whole plants are being investigated for their insecticidal activity including their action as fumigants, repellants, anti-feedants, anti-ovipositants insect growth regulators (Isman, 2000; Weaver and Subramanyam, 2000; Erturk *et al.*, 2004; Koul, 2004; Mordue, 2004; Negahban and Moharramipour, 2007).

Considerable efforts have been made to control rice weevil using the plant derived insecticides. Srinivasan *et al*. (2003) reported that *Calotropis* leaf extract recorded very low consumption rate besides exerting a significant effect on the survival of *S. oryzae* adults. Similarly Roy *et al.* (2005) showed leaf extract of *Blumea lacera* as botanical insecticides against lesser grain borer and rice weevil. Ethanol extract of *Melgota* (*Macaranga postulata*) was used for repellency and insecticidal activity against the rice weevil (Rahman *et al.*, 2007). The aim of this study was to determine the effect of medicinal plants in suppressing the rice weevil *S. oryzae* damage in stored rice.

Materials and Methods

Preparation of leaf extract: 500 g of fresh leaves of the 11 medicinal plants *viz*., 1) Bael, *Aegle marmelos*; 2) Sweet Basil, *Ocimum basilicum;* 3) Poduthalai, *Lippia nodiflora*; Kalihari, 4) *Gloriosa superba*; 5) Wild sage, *Lantana camara;* 6) Physic nut, *Jatropha curcas; 7)* Indian Privet, *Clerodendron inerme; 8)* Palas, *Butea frondosa; 9)* Custard apple, *Annona squamosa; 10)* Adulsa, *Adhatoda vasica* and 11) Pippal, *Piper longum* were collected, chopped and soaked in ethanol for 20 days. Later the leaf extracts were decanted individually, condensed with rotoevaporator and stored in brown glass bottles. Plant extracts were prepared to 0.5 per cent concentration using acetone and tested against the rice weevil, *S. oryzae*.

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Test insect: The initial stock culture of adult weevils were collected from farmers store house and maintained at 28±4 ^{0}C and 70±5 % relative humidity and under continuous darkness. Adults of *S. oryzae* were released into 200g of disinfected rice grains in plastic containers @ 25 nos. of mixed age and sex. Mouth of the container was covered with thin cloth and was incubated for 15 days. On the 15th day, the released adults were removed and the rice grains were kept without disturbance for two months for emergence of fresh adults. Newly emerged adults were collected daily and released in separate containers for continuous mass culturing. Adults of 7 – 10 days old age were used for the experimentation.

Details of the laboratory experiments: All the laboratory experiments were conducted at room temperature 28±4^{0}C and 70±5% relative humidity in the Storage Entomology Lab, Department of Agricultural Entomology, Agricultural College and Research Institute, Madurai during 2008 - 2009. The laboratory experiments had 13 treatments as follows. For comparison acetone treated and water treated controls were included.

- T_1 - Bael, *Aegle marmelos*
- T_2 - Sweet Basil, *Ocimum basilicum*
- T_3 - Poduthalai, *Lippia nodiflora*
- T_4 - Kalihari, *Gloriosa superba*
- T_5 - Wild sage, *Lantana camara*
- T_6 - Physic nut, *Jatropha curcas*
- T_7 - IndianPrivet, *Clerodendron nerme*
- T_8 - Palas, *Butea frondosa*
- T_9 - Custard apple, *Annona squamosa*
- T_{10} - Adulsa, *Adhatoda vasica*
- T_{11} - Pippal, *Piper longum*
- T_{12} - Acetone control
- T_{13} - Water control

Free choice tests

i. Adult orientation

Under free choice condition, 10g grains treated with different leaf extracts were arranged in circular manner. Three hundred and fifty freshly emerged adult weevils were released in the center. The number of adults oriented towards each treatment was counted at 24, 48 and 72 hours after treatment. Three replications were maintained.

Orientation of adult weevil recorded in the choice-number was expressed in terms of Excess Proportion Index (EPI) (Sakuma and Fukami, 1985). It is the proportion of the difference between the number of insects oriented towards the treatment (Nt) and that of the insects surrounding the control (Nc).

$$EPI = \frac{(Nt - Nc)}{(Nt + Nc)}$$

No choice test

i. Adult mortality

Under no choice condition, 10 g of treated grains along with acetone and water control were kept in separate boiling tubes (24 x 3 cm) and 10 freshly emerged adults were released in each tube. The adult mortality was recorded at 2, 7 and 14 days after release. Three replications were maintained.

ii. Progeny build up

Similar to adult mortality test, 50g of treated grains were confined with ten freshly emerged adults for three days. Forty days after their confinement, number of F_1 adults present in each treatment was counted to record the progeny build up. Similar, observations were recorded till the F_7 progeny. The experiment was replicated two times.

iii. Loss in grain weight

50 g of treated seeds were taken in containers separately and 10 freshly emerged adults were confined. Grain weight was recorded at monthly interval for eight months. The difference in the initial and final weight was recorded as loss in grain weight. The loss in grain weight was expressed as percentage. Two replications were maintained.

Statistical analysis: All the laboratory experiments were conducted in Completely Randomized Design (CRD) with thirteen treatments and two / three replications. The values collected were transformed either to arcsine or square root or log values depending on the condition. The transformed values were analyzed using single or two factors ANOVA. Mean values were sepaated by Duncan's Multiple Range Test.

Results

Free choice test

i.Adult orientation

Orientation of adult weevils to grains teated with different leaf extracts, measured as numbers ranged from 9.0 to 24.3. In acetone (31.6.) and water (30.0) treatment orientation of adults was significantly more compared to the leaf extract treated grains. The mean adult orientation to *Gloriosa* treated grains was less (9.0), followed by *Lippia* (14.6) and *Piper* (16.0) (Table1). The adult orientation to grains treated with *Ocimum*, *Lippia*, *Gloriosa*, *Lantana*, *Adhatoda* and *Piper* decreased as the time increased.

The Excess Proportion Index (EPI) was worked out to know the potential value of the plant materials in protecting the grains from stored product pest. The overall EPI values of the different leaf extracts ranged between -0.11 and -0.54. *Gloriosa* extract recorded the highest repellency of -0.54 followed by *Lippia* (-0.34), *Lantana* (-0.34) and *Piper* (-0.32) (Table 1).

No choice test

i. Adult mortality

The per cent adult mortality was maximum at 14 days after confinement and it ranged from 14.8 to 53.8 in treated grains. The mean adult mortality was maximum in *Piper* treated grains (38.1) followed by *Lippia* (36.2) and *Lantana* (34.8) (Table 2). *Lippia* and *Piper* treated grains at 14 days after confinement recorded the maximum adult mortality of 53.8 and 53.5 per cent, respectively, and these values y differed significantly from values of all other treatments.

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ii. Progeny production

Lowest adult F_1 to F_7 progeny of *S. oryzae* was recorded in *Lippia* treated grains and it significantly differed from all other medicinal plant leaf extracts as well as the acetone / water control. In *Lippia* treated grains the mean adult progeny recorded was 58.6 and the progeny build up was suppressed by ten times as compared to the water control (585). In F_7 generation the adult population in *Lippia* treated grains reached 78.5 numbers while in all the other treatments, this level was seen in F_2 itself (Table 4). The next best treatments were *Gloriosa* (312.) followed by *Piper* (333.7) which suppressed the progeny build up by 1.8 and 1.7 times, respectively, as compared to the water control. The per cent reduction in adult progeny build up was high in *Lippia* treated grains (89.9%) followed by *Gloriosa* (46.7%) and *Piper* (42.9%) (Table 3).

iii. Loss in grain weight

With regard to loss in grain weight, there was no considerable loss in grain weight upto four months. Minimum per cent loss in grain weight was observed in *Lippia* (0.4) treated grains followed by *Piper* (19%) and *Gloriosa* (27.1%). The rest of the treatments recorded grain loss ranging from 31.8 to 41.8%. Grain weight loss in acetone and water control were 41.7 and 62.5%, respectively. Reduction in grain weight loss as compared to the water control was highest in *Lippia* treated grains (99.4%) followed by *Piper* (69.6%) and *Gloriosa* (56.7%) (Table 4).

Discussion

Post harvest losses by insect pests in cereal commodities is significant. Treatment with chemical insecticide has great health hazard. Plants are a rich source of novel natural substances that can be used to develop environmentally safe methods for insect control in storage (Jbilou *et al.,* 2006). These plant material are edible, cheap, biodegradable and generally safe that will not contaminate food products. This study reports on the development of a safe promising grain protectant with medicinal plants for the control of rice weevil in the storage systems.

Of the eleven medicinal plants tested for its orientation, *Gloriosa* treated grains followed by *Lippia* and *Piper* dispayed high repellency. Rahman *et al.* (2007) tested the ethanol extract of melgota, *Macaranga postulata* at different concentrations for their repellency activity and reported that repellent effect was proportional to the concentration and higher concentration had stronger effect. However, repellency effect with be pronounced under multiple choice test and hence by itself can not offer an effective grain protection tactic.

Adult mortality was maximum in *Piper* extract treated grains followed by *Lippia* and *Lantana*. Similar result of botanicals having insecticidal activity and causing adult mortality in rice weevil has been reported by many workers (Srinivasan *et al.,* 2003; Roy *et al.,* 2005 and Rahman *et al.,* 2007). In long term effect, *Lippia* treated grains recorded lower progeny build up over 7 generations as compared to the water control. These effects could have resulted from lowered fecundity, fertility of adults and maggot and pupal mortality. Srinivasan *et al.* (2003) reported that *Ipomoea* had a distinct effect on the growth of *S. oryzae* adults and the developmental period increased.

Grain weight was observed was also minimum in *Lippia* treated grains followed by

Table 1: Influence of medicinal plants leaf extract on the orientation of rice weevil adults

Treatment	Number of adults oriented			
	24 h	48 h	72 h	Mean
Bael *Aegle marmelos*	24	21	20	21.67 $^{b-e}$
	-0.08*	-0.21	-0.20	-0.16
Sweet Basil *Ocimum basilicum*	23	21	18	20.67 $^{b-e}$
	-0.10	-0.21	-0.25	-0.19
Poduthalai *Lippia nodiflora*	13	16	15	14.67^{ab}
	-0.37	-0.33	-0.33	-0.34
Kalihari *Gloriosa superba*	9	8	10	9.00^{a}
	-0.51	-0.60	-0.50	-0.54
Wild sage *Lantana camara*	36	11	13	20.00 $^{b-d}$
	0.13	-0.49	-0.40	-0.34
Physic nut *Jatropha curcas*	23	22	22	22.33 $^{b-f}$
	-0.10	-0.19	-0.15	-0.15
Indian Privet *Clerodendron inerme*	34	19	30	27.67 $^{c-f}$
	0.10	-0.25	0.00	-0.12
Palas *Butea frondosa*	17	23	23	21.00 $^{b-e}$
	-0.24	-0.16	-0.13	-0.18
Custard apple *Annona squamosa*	26	22	25	24.33 $^{c-f}$
	-0.04	-0.19	-0.09	-0.11
Adulsa *Adhatoda vasica*	25	26	11	20.67 $^{b-e}$
	-0.06	-0.10	-0.46	-0.21
Pippal *Piper longum*	24	13	11	16.00 $^{a-c}$
	-0.08	-0.42	-0.46	-0.32
Acetone control	30	34	31	31.67 ^{f}
	0.03	0.03	0.02	0.03
Water control	28	32	30	30.00 ^{ef}
	1	1	1	1

Mean of three replications; In the column, means followed by same letters are not significantly different (P=0.05) by DMRT; * Excess Proportion values

Table 2. Influence of medicinal plants leaf extract on the mortality of adult rice weevil

Treatment	Adult mortality (%) * after days			
	2	7	14	Mean
Bael *Aegle marmelos*	2.22 (7.15)$^{n-p}$	7.08 (14.41)$^{l-n}$	14.78 (22.47)$^{i-k}$	8.03 (14.68)^{F}
Sweet Basil *Ocimum basilicum*	17.41 (24.38)$^{h-j}$	27.41 (31.47)$^{e-h}$	46.47 (42.97)^{ab}	30.43 (32.94)^{BC}
Poduthalai *Lippia nodiflora*	17.22 (24.48)$^{h-j}$	37.59 (37.72)$^{b-e}$	53.78 (47.17)^{a}	36.20 (36.46)^{AB}
Kalihari *Gloriosa superba*	7.89 (15.90)$^{k-m}$	17.04 (24.09)$^{h-j}$	46.67 (43.09)^{ab}	23.87 (27.69)^{DE}
Wild sage *Lantana camara*	21.63 (27.57)$^{f-j}$	40.48 (39.49)$^{b-d}$	42.29 (40.51)$^{a-c}$	34.80 (35.86)^{AB}
Physic nut *Jatropha curcas*	7.08 (14.41)$^{l-n}$	17.04 (24.20)$^{h-j}$	36.53 (37.15)$^{b-e}$	20.22 (25.25)^{E}
Indian Privet *Clerodendron inerme*	8.19 (15.41)$^{k-m}$	17.45 (24.57)$^{h-j}$	39.21 (38.73)$^{b-e}$	21.62 (26.24)^{DE}
Palas *Butea frondosa*	12.63 (20.48)$^{j-l}$	31.11 (33.75)$^{c-g}$	32.67 (34.84)$^{c-f}$	25.47 (29.69)^{CD}
Custard apple *Annona squamosa*	13.70 (21.65) $^{j-l}$	17.82 (24.89)$^{h-j}$	28.77 (32.42)$^{d-g}$	20.10 (26.32)^{DE}
Adulsa *Adhatoda vasica*	7.92 (16.13) $^{k-m}$	20.78 (26.84)$^{g-j}$	28.83 (32.48)$^{d-g}$	19.18 (25.15)^{E}
Pippal *Piper longum*	24.53 (29.35) $^{f-i}$	36.38 (37.08)$^{b-e}$	53.48 (47.01)^{a}	38.13 (37.81)^{A}
Acetone control	2.22 (7.14) $^{n-p}$	5.00 (10.59)$^{m-p}$	2.00 (6.36)^{op}	3.07 (8.03)^{G}
Water control	0.00 (0.41) ^{p}	0.00 (0.41)^{p}	0.00 (0.41)^{p}	0.00 (0.41)^{H}
Mean	10.97 (17.27)^{C}	21.17 (25.35)^{B}	32.73 (32.74)^{A}	

$^{\#}$ Values are subjected to Abbot's correction. * Mean of three replications
Figures in the parentheses are arc sine transformed values.
In the column, means followed by same letters are not significantly different (P=0.05) by DMRT

Table 3: Influence of medicinal plants leaf extract on the progeny production of rice weevil

Treatment	Progeny production (in numbers)							Mean
	F_1	F_2	F_3	F_4	F_5	F_6	F_7	
Bael *Aegle marmelos*	28.50 (1.45)^{a}	167.50 (2.22)^{a}	444.00 (2.62)^{a}	620.00 (2.79)^{a}	587.50 (2.75)^{a}	605.00 (2.77)^{a}	576.50 (2.76)^{a}	432.71 (2.48)^{DE}
Sweet Basil *Ocimum basilicum*	24.50 (1.35)^{a}	135.00 (2.13)^{a}	432.00 (2.60)^{a}	550.00 (2.72)^{a}	675.00 (2.81)^{a}	550.00 (2.74)^{a}	540.00 (2.73)^{a}	415.21 (2.44)^{CDE}
Poduthalai *Lippia nodiflora*	10.00 (0.98)^{a}	29.00 (1.38)^{a}	56.50 (1.75)^{a}	110.00 (2.01)	60.00 (1.78)^{a}	66.50 (1.82)^{a}	78.50 (1.89)^{a}	58.64 (1.66)^{A}
Kalihari *Gloriosa superba*	23.50 (1.35)^{a}	169.00 (2.03)^{a}	436.50 (2.48)^{a}	450.00 (2.53)^{a}	317.50 (2.49)^{a}	387.50 (2.56)^{a}	400.00 (2.54)^{a}	312.00 (2.28)^{B}
Wild sage *Lantana camara*	18.00 (1.26)^{a}	117.00 (2.05)^{a}	430.50 (2.63)^{a}	475.00 (2.68)	525.00 (2.72)^{a}	565.00 (2.75)^{a}	557.50 (2.75)^{a}	384.00 (2.41)^{BCD}
Physic nut *Jatropha curcas*	29.50 (1.47)^{a}	147.50 (2.17)	455.00 (2.58)^{a}	600.00 (2.75)^{a}	775.00 (2.88)^{a}	750.00 (2.87)^{a}	685.00 (2.81)^{a}	491.71 (2.46)^{DEF}
Indian Privet *Clerodendron inerme*	28.50 (1.16)^{a}	235.00 (2.26)^{a}	395.00 (2.55)^{a}	600.00 (2.76)^{a}	650.00 (2.80)^{a}	575.00 (2.75)^{a}	457.50 (2.65)^{a}	420.14 (2.42)^{BCD}
Palas *Butea frondosa*	49.00 (1.69)^{a}	172.50 (2.22)^{a}	481.00 (2.68)^{a}	700.00 (2.83)^{a}	750.00 (2.87)^{a}	627.50 (2.80)^{a}	537.50 (2.73)^{a}	473.93 (2.55)^{DEF}
Custard apple *Annona squamosa*	22.50 (1.33)^{a}	175.00 (2.24)^{a}	679.00 (2.83)^{a}	775.00 (2.88)^{a}	600.00 (2.78)^{a}	576.00 (2.76)^{a}	625.00 (2.79)^{a}	493.21 (2.52)^{DEF}
Adulsa *Adhatoda vasica*	33.00 (1.42)^{a}	302.50 (2.44)^{a}	638.50 (2.80)^{a}	600.00 (2.78)^{a}	675.00 (2.83)^{a}	622.50 (2.79)^{a}	590.00 (2.77)^{a}	494.50 (2.55)^{DEF}
Pippal *Piper longum*	15.00 (1.17)^{a}	79.00 (1.86)^{a}	414.50 (2.54)^{a}	475.00 (2.66)^{a}	425.00 (2.59)^{a}	437.50 (2.63)^{a}	490.00 (2.69)^{a}	333.71 (2.31)^{BC}
Acetone control	61.50 (1.79)^{a}	218.50 (2.33)^{a}	507.00 (2.70)^{a}	753.00 (2.88)^{a}	775.00 (2.87)^{a}	642.50 (2.81)^{a}	660.00 (2.82)^{a}	516.79 (2.60)^{EF}
Water control	122.50 (2.08)^{a}	417.50 (2.60)^{a}	780.00 (2.89)^{a}	700.00 (2.83)^{a}	825.00 (2.91)^{a}	762.50 (2.88)^{a}	487.50 (2.69)^{a}	585.00 (2.70)^{F}
Mean	35.85 (1.42)^{A}	181.92 (2.15)^{B}	445.69 (2.51)^{C}	569.85 (2.70)^{C}	587.69 (2.70)^{C}	551.35 (2.69)^{C}	514.19 (2.66)^{C}	

*Mean of two replications.
Figures in the parentheses are log transformed values.
In the column, means followed by same letters are not significantly different (P=0.05) by DMRT

Table 4: Influence of medicinal plants extract on the grain weight loss

Treatment	% Loss in grain weight at DAC					Mean
	120	150	180	210	240	
Bael *Aegle marmelos*	35.62 (36.64)^{a}	36.26 (37.03)^{a}	38.09 (38.11)^{a}	41.43 (40.06)^{a}	43.45 (41.22)^{a}	38.97 (38.61)^{D}
Sweet Basil *Ocimum basilicum*	29.66 (32.73)^{a}	31.10 (33.61)^{a}	31.77 (34.02)^{a}	32.87 (34.66)^{a}	37.31 (37.65)^{a}	32.54 (34.53)^{CD}
Poduthalai *Lippia nodiflora*	0.00 (0.41)^{a}	0.27 (2.97)^{a}	0.36 (2.63)^{a}	0.41 (3.64)^{a}	0.98 (4.23)^{a}	0.40 (2.78)^{A}
Kalihari *Gloriosa superba*	19.77 (24.19)^{a}	27.50 (31.39)^{a}	28.77 (32.21)^{a}	29.52 (32.70)^{a}	29.70 (32.82)^{a}	27.05 (30.66)^{BC}
Wild sage *Lantana camara*	22.58 (26.22)^{a}	32.13 (34.40)^{a}	33.64 (35.35)^{a}	34.56 (38.97)^{a}	36.17 (36.93)^{a}	31.82 (33.76)^{CD}
Physic nut *Jatropha curcas*	26.02 (30.22)^{a}	35.71 (35.85)^{a}	43.97 (41.47)^{a}	47.20 (43.38)^{a}	47.78 (43.71)^{a}	40.14 (38.93)^{D}
Indian Privet *Clerodendron inerme*	23.23 (28.54)^{a}	34.63 (35.56)^{a}	35.49 (33.98)^{a}	37.81 (37.48)^{a}	41.21 (39.66)^{a}	34.47 (35.04)^{CD}
Palas *Butea frondosa*	39.56 (38.92)^{a}	40.78 (39.65)^{a}	41.52 (40.08)^{a}	41.59 (40.12)^{a}	43.65 (41.35)^{a}	41.42 (40.02)^{D}
Custard apple *Annona squamosa*	37.83 (37.96)^{a}	39.42 (38.87)^{a}	40.62 (39.59)^{a}	42.53 (40.71)^{a}	45.50 (42.42)^{a}	41.18 (39.91)^{D}
Adulsa *Adhatoda vasica*	32.88 (34.97)^{a}	42.09 (40.37)^{a}	43.68 (41.31)^{a}	44.22 (41.61)^{a}	45.91 (42.59)^{a}	41.76 (40.17)^{D}
Pippal *Piper longum*	14.36 (15.96)^{a}	18.95 (25.18)^{a}	20.17 (26.08)^{a}	20.67 (26.45)^{a}	20.95 (26.65)^{a}	19.02 (24.23)^{B}
Acetone control	31.85 (34.28)^{a}	33.63 (35.42)^{a}	41.81 (40.28)^{a}	47.14 (43.36)^{a}	53.96 (47.28)^{a}	41.68 (40.12)^{D}
Water control	48.58 (44.18)^{a}	60.95 (51.34)^{a}	66.16 (54.47)^{a}	66.72 (54.79)^{a}	70.05 (56.84)^{a}	62.49 (52.32)^{E}
Mean	27.84 (29.63)^{A}	33.34 (33.97)^{AB}	35.85 (35.35)^{B}	37.44 (36.76)^{B}	39.74 (37.95)^{B}	

Mean of two replications.
Figures in the parentheses are arcsine transformed values.
In the column, means followed by same letters are not significantly different (P=0.05) by DMRT

Piper and *Gloriosa*. *Calotropis* leaf extract recorded very low consumption rate besides exerting a significant effect on the survival of *S. oryzae* adults (Srinivasan *et al.,* 2003).

Several plant extracts have have been shown to display insecticidal properties and can control pests through affecting their biological activities (Schmutterer, 1995; Mostafa *et al.,* 1996; Musabyimana *et al*., 2001; Tinzaara *et al*., 2006). Arannilewa *et al.* (2006) reported that the petroleum ether extract of *Aristolochia ringens* (Vahl.) to be a potent bioinsecticide for protecting maize grains from *S. zeamais* infestation and damage.

Our results suggested effectiveness of leaf extract of *Gloriosa* followed by *Lippia* and *Piper* in exerting toxic effect on the rice weevil, *S.. oryzae.,* a major pest of cereals like rice, sorghum, wheat, barley and maize. However, prior to their use as botanical insecticide, toxicity tests against humns and other animals need to be conducted.

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