Insecticidal activity of twenty plant powders on mortality, adult emergence of *Sitophilus oryzae* L. and grain weight loss in paddy

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ABSTRACT

Laboratory studies were conducted to study the effect of twenty plant powders (2 per cent) against rice weevil, *Sitophilus oryzae* L (Colepotera: Curculionidae) infesting paddy grains. Among them *Vitex negundo* L. (Verbenaceae) was found to be significantly the best compared to other treatments. At two days after the treatment highest mortality was registered in *Nelumbium speciosum* Wild (Verbenaceae) (59.9%) followed by *Alpinia officinarum* Hance (Zingiberaceae) (49.9%), *Azadirachta indica* A.Juss (42.2%) and by *Glorisa superpa* L. (Liliaceae) (30.8%). At 7 days after the treatment, 99.1 per cent mortality was recorded in *V. negundo* followed by *A. officinarum* (96.6%), *N. speciosum* (94.4%) and in untreated control, 46.6 per cent mortality was observed. In another experiment, minimum adult emergence was registered in *A. indica* (18.00), *A. officinarum* (18.00), *G. superpa* (20.00), when compared to 98.00 adult weevils in untreated control. At 45th day after treatment grain weight loss was minimum (10.58%) in *A. indica* compared to untreated control (39.21%). At 60th days after treatment grain weight loss was minimum (13.01%) in *A. indica* compared to untreated control (49.22 %). At 90th day after treatment lowest grain weight loss was observed in *A. indica* (18.55%) and highest grain weight loss was seen in *C. halicacabum* (40.80%).

Key words: Insecticidal activity, Plant powders, *Sitophilus oryzae*, paddy grains.

INTRODUCTION

Rice is a crop that feeds almost half the planet. It is a stable food for more than 70 per cent Indians and a source of the livelihood for 120-150 million rural households. It contributes to 43 per cent of the total food production and 53 per cent of cereal production in India (Mahadevappa, 2004). The rice weevil *Sitophilus oryzae* L. (Colepotera: Curculionidae) is a serious pest of various food grains like rice, wheat and maize under storage (Baloch, 1992). Rice weevil cause heavy losses of stored food grain quantitatively and qualitatively through out the world (Arannilewa *et al.,* 2002). Many synthetic insecticides have been found effective against stored product pests but proved to be hazardous to men and domestic animals. The over reliance on and non judicious use of synthetic pesticides especially insecticides since last four decades led to wide spectrum of pests problem like pests resistance to chemicals, resurgence of pests, residues in food and soil and risks to human and animal health, besides environmental pollution. Many plants possess activities against stored grain pests (Mohapatra and Gupta, 1998; Ketkar, 1986 ; Dubey *et al.,* 2008, 2009). Rajendran and Sriranjini (2008) studied the on plant essential oils and their constituents as fumigants against *S. oryzae*. In the present study twenty plant powders were tested for the mortality, adult emergence and grain weight loss caused by *S. oryzae* infesting paddy grains.

MATERIAL AND METHODS

Laboratory experiments were carried out at Agricultural College and Research Institute (AC&RI), Killikulam. *S. oryzae* was mass cultured and the insect culture was further multiplied on paddy grains in plastic containers in the laboratory. *S. oryzae* were maintained at ambient laboratory temperature (28 ± 2^{o}C) and relative humidity (70 ± 5%) conditions. Plant parts of different species (Table 1) were collected, shade dried and powdered using a pulverizer (fritsch rotor speed mill pulverisette 14) with the rotational speed at 14, 000 rpm. Powders of ten plant powders (2.00 per cent) were tested for their insecticidal action in comparison with activated clay (1.00 per cent). Twenty grams of paddy grains were taken in petridishes. The plant powders @ 2 per cent (w/w) were added to paddy grains and shaken thoroughly. Thirty newly emerged adults were released into each petridish and kept in the laboratory. Mortality was recorded every 24 hrs one to seven days. Three replications were maintained for each treatment.

In another experiment twenty grams of paddy grains were taken in glass bottles and the plant powders @ 2 per cent (w/w) were added to paddy grains and shaken thoroughly.

Table 1. The plant species evaluated against *S. oryzae*

Name of the plants	Parts used	Name of the plants	Parts used
Abutilon indicum L. Sweet (Malvaceae)	Leaves	*Lantana camara* L. (Verbenaceae)	Leaves
Anisomales malabarica R.(Lameaceae)	Leaves	*Leucas aspera* Spreng (Lameaceae)	Leaves
Alpinia officinarum Hance. (Zingiberaceae)	Rhizomes	*Lippia nodiflora* L. (Verbenaceae)	Whole plant
Asparagus racemosus Wild. (Liliaceae)	Tubers	*Nelumbium speciosum* Wild (Verbenaceae)	Seeds
Azadirachta indica A. Juss. (Meliaceae)	Leaves	*Ocimum canum* L. (Lameaceae)	Leaves
Cardiospermum halicacabum Lour. (Sapindaceae)	Leaves	*Sesbania grandiflora* (L.) (Fabaceae)	Leaves
Cassia angustifolia Vahl.(Fabaceae)	Leaves	*Strychnuos nuxvomica* L. (Leganiaceae)	Seeds
Curcuma longa Valet.(Zingiberaceae)	Rhizomes	*Vitex negundo* L. (Verbenaceae)	Leaves
Glorisa superpa L. (Liliaceae)	Tubers	*Withania somnifera* Dunal. (Solanaceae)	Roots
Helicteres isora Lour.(Sterculiaceae)	Fruits	*Zingiber officinale* Rosc (Zingiberaceae)	Rhizomes

Then the glass bottles were covered firmly using muslin cloth. Five pairs of newly emerged adults of *S. oryzae* were released to each glass bottle, covered firmly and kept in laboratory conditions. Three replications were maintained for each treatment. On 20 th day after the release (DAR) of beetles all the dead insects were removed from the bottles to prevent them from mixing with first generation (F_1) offspring. The number of newly emerged adults were counted and removed from the bottle once in every three days till the complete emergence of F_1 offspring. On 45th, 60th and 90th days after the treatment grain weight loss was taken and percentage was worked out.

Statistical analysis

The methods of Gomez and Gomez (1984) were followed in scrutinizing the data from various experiments. Square root and angular transformations were adopted for the data in numbers and percentage respectively (Abbott, 1925). Means in simple CRD analysis were separated by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The results revealed that highest mortality was observed in activated clay (96.6%) followed by *N. speciosum, A. officinarum, A. indica* and *V. negundo* at two day after the treatment (Table 2) while in control 5.5 per cent mortality was observed. Among the treatments, cent per cent mortality was registered in activated clay followed by *N. speciosum, A. officinarum, A. indica* and *V. negundo* 3 days after the treatment**.** At 4 days after the treatment mortality was 93.1, 87.7, 81.0 and 67.7 per cent in *V. negundo A. officinarum , N. speciosum* and *A. indica,* respectively. At 5 days after the treatment the highest mortality was observed in *V. negundo* followed by *A. officinarum, N. speciosum, C. longa* and *A. indica*. After 6 days, highest mortality was recorded in *V. negundo* which was followed by *A. officinarum, N. speciosum, C. longa* and *A. indica.*

Among the plant powders *V. negundo* treated seeds showed highest mortality (99.1%) while the lowest mortality was observed in *Cassia angustifolia* (46.5%) 7 days after the treatment when compared to untreated check. The present findings corroborate with the finding of Bhuiyah (1988) who reported that *V. negundo* leaf powder treated corn seeds showed high mortality to corn weevil and Ivbijaro (1983) who found that *A. indica* seed powder at the rate of 5 g/20 g maize caused 100 per cent mortality of *S. oryzae* within ten days**.** Saljoqi Munir *et al.* (2006) observed that extracts of *Melia azdarach* caused mortality in rice weevil, *S. oryzae*.The smoke generated by heating *A. indica leaves* caused cent per cent mortality of *S. oryzae* after 48 hr of the treatment (Prasantha, 2002). Though report on *A. officinarum* is locking, a report on *A.galanga* (Ahamad and Ahmed, 1991) could support the present finding.Only 18.00 adult weevils emerged from *A. officinarum* and *A. indica* (Table 3) treated paddy grains followed by activated clay (21.0) *N. speciosum* (25.66) among the different treatments while in untreated check 98 beetles emerged. In the same way neem leaf powder 2 parts per 100 parts of seeds reduced the adult emergence (Ivbijaro,1983). *A. galanga* rhizome extract treated with maize reduced the adult emergence and suppressed F1 progeny development of maize weevil, *S. zeamais* (Niber *et al.*, 1992).

At 45 days after the treatment only (10.50%) weight loss was observed in grain treated with *A. indica*, followed by activated clay, *N. speciosum, G. superpa, A. malabarica* and *A. officinarum* treated paddy grains, while 39.21 per cent loss was observed in untreated control**.** Ambika Devi and Mohandas (1982) reported that extract of A. *indica* one per cent admixed with rice

Table 2. Effect of plant powders on the mortality of rice weevil, *Sitophilus oryzae in paddy* grains

Treatments	Cumalitive mortality on							
	1 DAT	2 DAT	3 DAT	4 DAT	5 DAT	6 DAT	7 DAT	Mean
S. grandiflora	14.2(22.3)	19.7(26.9)	46.4(43.8)	53.3(46.9)	65.6(54.0)	79.9(63.4)	86.5(68.6)	52.2(46.5)
C. angustifolia	4.2(9.1)	19.9(26.4)	21.9(28.5)	31.1(33.8)	42.2(40.5)	44.8(46.5)	46.5(43.4)	30.0(32.6)
O. canum	9.7(18.1)	15.1(23.4)	20.9(27.5)	29.9(33.1)	59.9(50.7)	66.6(54.7)	75.3(60.9)	39.6(38.3)
A. malabarica	5.3(13.5)	19.9(26.5)	26.5(31.3)	40.9(41.2)	66.9(54.7)	80.9(64.7)	88.7(70.5)	43.9(43.2)
L. aspera	7.4(15.9)	20.8(27.6)	28.7(32.7)	44.4(41.8)	48.7(44.7)	55.3(47.9)	66.6(55.0)	38.8(37.9)
A. racemosus	7.4(14.9)	18.6(26.0)	30.9(34.1)	55.5(48.2)	64.3(53.7)	74.5(61.4)	88.7(70.5)	49.4(44.5)
G. superpa	4.2(9.1)	30.8(34.4)	31.9(34.1)	46.6(43.0)	58.8(50.1)	83.2(64.1)	93.2(74.8)	49.8(44.2)
S. nuxvomica	5.5(13.4)	19.7(26.9)	40.9(41.2)	58.8(50.1)	66.5(55.0)	77.6(62.1)	87.6(69.68	50.9(45.4)
A. indicum	4.4(11.9)	21.99(28.5)	27.6(32.0)	38.88(38.5)	49.9(45.0)	67.6(54.7)	74.5(61.4)	40.7(38.8)
A. indica	4.4(11.4)	44.2(42.5)	49.9(45.0)	67.7(55.8)	78.8(63.7)	86.5(69.2)	90.9(73.3)	60.3(51.5)
W. somnifera	2.2(7.1)	24.4(29.6)	43.3(41.1)	51.1(45.6)	58.8(50.1)	67.7(55.5)	72.2(58.2)	45.6(41.0)
H. isora	4.4(11.)	24.4(29.2)	47.7(43.7)	59.9(50.7)	69.6(56.8)	74.4(59.6)	83.3(65.9)	51.9(45.2)
C. halicacabum	7.7(16.1)	29.9(33.1)	39.9(39.2)	63.3(52.7)	74.4(59.6)	83.3(65.9)	87.7(69.6)	55.1(48.0)
N. speciosum	39.9(39.1)	59.9(50.8)	75.5(60.5)	81.0(64.3)	87.7(69.8)	87.7(69.8)	94.4(79.1)	75.1(61.9)
L. camara	2.2(7.1)	11.1(19.4)	31.1(33.8)	42.2(40.4)	44.4(41.7)	51.1(45.6)	57.7(49.5)	34.2(33.9)
L. nodiflora	2.2(7.1)	19.9(26.5)	25.5(30.3)	36.6(37.2)	39.9(39.2)	44.4(41.8)	48.8(44.3)	31.0(32.3)
V. negundo	6.6(14.9)	40.0(39.1)	49.3(44.5)	93.3(75.5)	95.0(77.7)	97.5(82.4)	99.1(86.6)	68.6(60.1)
A. officinarum	5.55(13.4)	49.9(44.9)	73.3(59.0)	87.7(69.5)	91.1(72.7)	94.4(76.5)	96.6(79.4)	71.2(59.3)
C. longa	9.9(18.2)	27.7(31.7)	38.8(38.5)	62.2(52.0)	83.3(65.9)	86.6(68.6)	92.2(73.87)	57.2(49.8)
Z. officinale	12.1(21.4)	19.8(26.7)	36.5(37.5)	54.3(45.9)	59.9(50.7)	84.3(66.9)	88.7(70.6)	50.8(45.6)
Activated clay	96.6(79.4)	100.0(89.4)	100.0(89.4)	100.0(89.4)	100.0(89.4)	100.0(89.4)	100.0(89.4)	99.5(87.9)
Control	0.0(0.5)	7.7(16.1)	16.6(24.0)	27.7(31.7)	32.2(34.5)	39.9(39.2)	46.6(43.0)	30.0(30.9)

stored for six months significantly reduced the percentage of damage caused *S. oryzae* in the store during six months storage period.

At 60 days after the treatments minimum percentage of grain weight loss was observed in *A. indica*, *A. officinarum*, *G. superpa* and activated clay was 13.01, 16.11, 17.28 and 19.22 per cent respectively compared to 49.22 per cent in untreated control. At 90 days after the treatments lowest percentage of seed weight loss was observed in *A. indica* (18.55) followed by *A. officinarum* (18.56%) while in control 75.50 per cent was observed. Akinnusi (1986) reported that neem leaves and seeds at 2.5 per cent concentration provided good protection to paddy grains and reduced grain weight loss. Among the plant powders 99.1 per cent mortality was recorded in *V. negundo* followed by *A. officinarum* (96.6%) and *N. speciosum* (94.4%). Minimum adult emergence was registered in *A. indica*, (18.00) and *A. officinarum* (18.00) followed by *G. superpa* (20.00). Lowest grain weight loss was observed in *A. indica* (18.56) treated grains followed by *A. officinarum* (18.56). Eventhough *V.negundo* is able to kill the *S.oryzae*, it could not check the population build up and grain loss. *A.indica* leaves and *A.officinarum* rhizomes can be used for managing *S.oryzae* in storage.

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Table 3. Effect of plant powder on adult emergence of *Sitophilus oryzae* and grain weight loss (in %)

Treatments	No. of adults emerged	Grain loss (in %) After 45 days	After 60 days	After 90 days
S. grandiflora	37.00(1.62)^{d}	17.50(24.50)^{b}	27.50(31.62)^{c}	37.55(41.82)^{c}
C. angustifolia	35.00(1.59)^{c}	18.58(25.53)^{bc}	27.58(31.62)^{c}	37.58(41.82)^{c}
O. canum	33.32(1.86)^{c}	15.86(23.41)^{b}	23.86(26.41)^{bc}	29.83(33.95)^{b}
A. malabarica	33.33(1.86)^{c}	13.01(20.30)^{a}	18.50 (28.70)^{b}	27.25(31.71)^{b}
L. aspera	26.66(1.49)^{b}	19.83(25.95)^{bc}	29.83(33.95)^{c}	39.84(42.80)^{c}
A.racemosus	38.50(1.81)^{d}	14.61(22.91)^{ab}	22.64(25.91)^{bc}	26.66(36.91)^{bc}
G. superpa	20.00(1.30)^{a}	12.28(19.78)^{a}	17.28(24.46)^{b}	27.28(31.46)^{b}
S. nuxvomica	22.21(1.96)^{ab}	16.11(24.30)^{c}	26.11(30.30)^{c}	36.10(40.32)^{c}
A. indicum	38.00(1.80)^{d}	27.25(31.71)^{d}	31.25(35.71)^{d}	37.27(41.79)^{c}
A. indica	18.00(0.89)^{a}	10.50(14.70)^{a}	13.01(20.30)^{a}	18.55 (25.66)^{a}
W. somnifera	26.33(1.40)^{b}	16.02(24.22)^{b}	18.55 (28.70)^{b}	29.22(33.82)^{b}
H. isora	29.02(1.80)^{bc}	17.11(25.33)^{b}	27.11(31.33)^{c}	37.11(41.33)^{c}
C. halicacabum	31.11(1.78)^{bc}	20.90 (26.99)^{bc}	30.88(34.99)^{d}	40.80(43.80)^{d}
N. speciosum	25.66(1.88)^{b}	12.22 (19.77)^{a}	18.01(25.46)^{b}	28.22(32.4)^{b}
L. camara	34.00(1.80)^{c}	16.66(24.99)^{b}	32.22(36.77)^{d}	33.66 (37.9)^{bc}
L. nodiflora	23.66(1.36)^{ab}	19.66(26.66)^{c}	27.55(31.66)^{c}	38.66(41.88)^{c}
V. negundo	32.33(1.86)^{c}	23.66(26.90)^{c}	28.21(31.70)^{c}	38.28(42.77)^{c}
A. officinarum	18.00(25.40)^{a}	13.50(20.52)^{a}	16.11(24.30)^{a}	18.56 (28.71)^{a}
C. longa	27.55(1.77)^{b}	19.55(25.55)^{bc}	22.55(32.66)^{bc}	38.55(42.85)^{c}
Z. officinale	28.50(1.87)^{bc}	18.11(25.33)^{bc}	27.11(30.33)^{c}	37.11(41.33)^{c}
Activated clay	21.00(0.93)^{ab}	13.20(19.70)^{a}	19.22(25.44)^{b}	26.50 (32.70)^{b}
Untreated check	98.00(1.63)^{e}	39.21(38.88)^{d}	49.22(48.88)^{e}	71.50(58.30)^{e}

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