International Journal of Agricultural and Applied Sciences, December 2021, 2(2):49-59
https://www.agetds.com/ijaas
ISSN: 2582-8053
https://doi.org/10.52804/ijaas2021.228

Research Article

OPEN ACCESS

Bioefficacy of plant extracts on ovicidal and oviposition deterrent against sugarcane stalk borer *Chilo auricilius* Dudgeon (Lepidoptera: Crambidae)

Rashid Mumtaz
Department of Biochemistry, Deanship of Educational Services. Qassim University, Al Qassim, Saudi Arabia
Corresponding author e-mail: rashidmumtazkhan@gmail.com
(**Received:** 27/06/2021; **Revised:** 10/09/2021; **Accepted:** 23/10/2021)

ABSTRACT
Sugarcane is a long-duration crop of 10-12 months and therefore is liable to be attacked by several insect pests. The present study aimed at assessing the ovicidal, oviposition, and larvicidal potential of two medicinal indigenous plants. Bioefficacy of *Nerium indicum* Mill. and *Murrya koenigii* L. spreng leaves extracts were tested against *Chilo auricilius* D. sugarcane stalk borer. The plant extracts prepared by sequential extraction method using a different solvent like, petroleum, chloroform, methanol, distilled water, and acetone at different concentrations were used. Ovipositional behavior of adult moths and the hatching percentage of the eggs were recorded using the choice method for each fraction of the plant extract. The chloroform extract of *N. indicum* 2.66% eggs/female and chloroform/petroleum ether extracts of *M. koenigii 9.33*% eggs/female were found to be effective, and reduced oviposition as compared to other extracts. At 20% concentration, petroleum ether and distilled water extracts of *N. indicum* 52.00 and petroleum ether extract of *M. koenigii* gave the lowest larval survival (74.00,72.00 and 70.00%) after 24, 48, and 72 h of exposures, respectively. However, petroleum ether extract of *N. indicum* at 8, 10, and 20% concentration survival of three days old eggs were registered at 60, 58, and 56%, whereas petroleum ether extract of *M. koenigii* at similar concentration recorded 77, 47, and 72% survival.
Keywords: Plant extracts, Bioefficacy, Sugarcane stalk borer.

INTRODUCTION
Sugarcane, *Saccharum officinarum* L. is the most important cash crop of the world fulfilling 60 percent of the sucrose requirement. Global production of sugarcane in 2018 was 1.91 billion tonnes, with Brazil producing 39% (746.8 million tonnes) of the world's total, India with 20%, (376.9 million tonnes), and China and Thailand producing about 6% (108.1 million tonnes). As an important commercial crop of Indian agriculture, sugarcane provides raw material to the sugar industry, the second largest agro-based industry after textiles. Sugarcane in India is cultivated broadly with two distinct agro-climatic regions known as tropical and subtropical regions. All India estimates for 2013-14 indicated a crop area of 4.99 M ha with an average cane yield of 70.50 t/ha and sugar recovery of 10.23%. Sugarcane is liable to attack by insect pests right from planting till harvest. The pests cause enormous losses about 8 to 10 percent of the total sugarcane crop in the country is damaged by insects every year. Out of 200 insect pests found infesting sugarcane crops (David and Nandgopal, 1986), only two dozen are recognized as major ones. These include moth borers, termites, black bugs, scale insects, mealybug, perilla, whiteflies, and the most recent one sugarcane wooly aphid, etc. Sugarcane stalk borer, *Chilo auricilius* Dudgeon is the pest of sugarcane that belongs to Order: Lepidoptera Family: Crambidae. In India, the first time reported from Bengal in 1905 (Dudgeon, 1905 and Lefroy, 1906) a pest of sugarcane at Pusa, Bihar (Fletcher and Gosh, 1919) and caused a heavy loss in India 3.32 million tones (Chaudhary, 1981).

Higher plants are a rich source of novel natural substances that can be used to develop environmentally safe methods for insect control (Jbilou et al., 2006). The pesticide plants reported so far are distributed in 189 plant families and there are more than 2400 plants spp. as pesticidal (Singh, 2000). New plant-based insecticides, (Jaipal and Singh,1985) repellants and larvicides for controlling insects are more environmentally safe, biodegradable, and target-specific against the insects. Considerable efforts have been focused on plant-derived materials, potentially useful as commercial insecticides. The toxic effects of plant products on some pests have been studied. (Essien, 2004; Erturk *et al.*; 2004; Koona and Dorn, 2005; Chapagain and Wieseman, 2005). (Roy et al. 2005) established leaf extracts of Shiyalmutra *(Blumea lacera)* as botanical insecticides against lesser grain bore and rice weevil. (Christos *et al.* 2005) showed that there is a significant difference between the application of various commodities and the insecticidal effects of plants. (Pandey and Singh. 1998), (Kumar, S. *et al.*2011) reported the bioefficacy of plant products as an insecticide against certain important insect pests.

MATERIALS AND METHODS

The Bioefficacy of natural plant extracts against the sugarcane stalk borer was investigated under laboratory conditions. Adult *C. auricilius* were collected from field sugarcane of the North State of India. These adults were reared in the laboratory with help of standard rearing techniques (Mehta & David (1978). Ten pairs of freshly emerged moths were released for egg-laying on potted sugarcane plants (about 60 days old) covered with iron wire mesh ovipositioning cage and after 4 days the eggs were collected and sterilized. Obtained larvae were transferred to a fresh diet and reared until pupation; healthy pupae were transferred to Petri dishes with filter paper. Pupae with disease symptoms were discarded and healthy pupae were placed in an emergence cage provided with a moistened synthetic sponge at the bottom. The plants for the assessment of insecticidal properties were chosen based on their resistance to insect attack, known poisonous properties, and the presence of odoriferous components. Selected plants were air-dried under shade at room temperature, dried materials were ground to powder in a simple electric grindings mill, and 100 g sample of the ground plant material was taken for extraction. The sequential extraction of plant material was carried out in a soxhlet extractor using different solvents in a sequence based on their polarity. The sequence of solvents followed like petroleum ether, chloroform, methanol, and distilled water. The extraction was done at 40 to 100°C for 20 to 24 h with each solvent accordingly and solvents were removed with the help of a flashpoint evaporator. Used 10 mg of each fraction was diluted to 50 ml with analytic reagent (AR) grade acetone. The test solutions of required concentrations were prepared by diluting the required quantity of the aforementioned stock solution with acetone and makeup volume of 100 ml in a volumetric flask. The efficacy of plant extracts on the ovipositional behavior, viability of eggs, and incubation period was tested. Oviposition jars of 6 × 8” were used for the study purpose and each jar was provided with a 2 cm thick layer of moist sand placed at the bottom. The sand layer was covered with a circular piece of paper and was divided into five sectors of equal areas and the inner sidewall as well. Each strip/sector was treated with different fractions of a particular plant product dissolved in acetone. However, one strip/sector was treated with acetone only and the untreated check was also kept. Two pairs of newly emerged adults were released inside each jar and covered with a muslin cloth. The eggs from each strip and sector were kept in Petri dishes and the numbers of larvae hatched were recorded every day. Observations were also made for the incubation period, viability, and oviposition index. For ovicidal action against the eggs where the homogenous egg mass of one-two and three days age were selected and eggs masses were dipped in plant extract for few five seconds. Six concentrations were tested against eggs of different age groups and check (acetone treated) and untreated (control) was also run simultaneously and the average percentage of eggs hatched was recorded. Each treatment group had three replicates and observed percent ovicidal activity was corrected by using Abbott’s standard formula (Abbott, 1925). On emergence, moths were collected and released for egg-laying in the ovipositioning cage. The experiments were carried out in the laboratory at 27 ± 2°C and 65 ± 5% RH. The data about different experiments were subjected to statistical analysis by standard practices using a completely randomized design (CRD). The square root transformation was used in ovipositional behavior experiments by adding a factor of 0.5; while in ovicidal and survival experiments, the data were transformed using angular transformation. The analysis was carried out by a “micro-32” computer.

RESULTS AND DISCUSSION

Effects of *Nerium indicum* Mill leaves extracts

Effect on Oviposition

Studies on the oviposition deterrence of extracts revealed that the number of eggs laid on untreated areas (control) was more than in all other treatments. The average number of eggs (82.00 and 67.00%) eggs were laid on control and check strips/sectors respectively, when compared to chloroform 6, petroleum ether 12 methanol 30, and distilled water extracts 45% at 5% concentration. The data showed order of effectiveness of various extracts as follows: chloroform extract > petroleum ether extract > methanol, extract > distilled water extracts at 10% concentration. Similar orders of the effectiveness of extracts were found at 20% concentration. This revealed that chloroform extract and petroleum ether extract was most effective and reduced the oviposition on treated strips/sector when compared to other extracts.

The selection of oviposition sites in the choice experiment showed that females gave less preference to the sites, which were treated with different concentrations of petroleum ether and chloroform extracts, while the methanol and water extracts treated strips/sectors were comparatively more preferred by the female for oviposition when compared to control. A perusal of Table 1. revealed that female was completely repelled from strips/sectors, which were treated with petroleum ether and chloroform extracts at a 20 percent level. However, it was found that some of the eggs were deposited by fa females at 5 and 10 percent concentration of petroleum ether and chloroform extracts treated strips/sectors, but out of which none of the eggs were hatched out Table 1. The viability of eggs was reduced by methanol and distilled water at 5, 10, and 20 percent concentrations of extracts.

The oviposition indexes revealed the lowest oviposition index was 0.31 on methanol extract treated strips/sectors at 20 percent concentration followed by 10 percent (0.36) and 5 percent (0.40) concentrations of respective extract, water extract at 20 percent (0.48), 10 percent (0.50) and 5 percent (0.58) concentrations respectively. The average number of egg masses varied from 2.0 to 4.0 on treated strips/sectors and also on control and check treatments. It was also found that the average hatching period of eggs increased about one day, for the eggs which were deposited on methanol extract treated strip/sector, while in general, it was 3 days on other treatments over check and control (Table 1).

Effect on larval survival

The toxicity of petroleum ether, chloroform, methanol, and distilled water extracts of *N. indicum* on *C. aurelius* (larvae) was given in Table 2. The data revealed that at 20 percent concentration 24 hrs after treatment, petroleum ether, distilled water, and methanol extracts gave 52.00, 52.00, and 62.00 percent survival of larvae respectively. The 10 percent concentration of water extract was also found to be effective and gave 62.00 percent survival of larvae after 24 hrs exposure.

After 48 and 72 hrs, exposure to the petroleum ether and water extracts again proved to be equally effective (52.00 percent) at 20 percent concentration. This was followed by a 10 percent concentration of water extract of 62.00 percent and a 20 percent concentration of methanol extract (62.00 percent). The chloroform extract was also effective and reduce the survival of larvae (65.00 percent) at 20 percent concentration, while it was (75.00 percent) at 10 percent levels of respective extracts.

However, the factors of solvent, concentration, and their interactions showed highly significant at 24 hrs and 48 hrs exposure. The effects on the survival of larvae revealed that higher concentrations of petroleum ether and water extracts proved to be the most effective.

Ovicidal action

For one-day-old eggs, it was observed from Table 3. that all the tested extracts gave more or less similar reduction in survival of eggs. The higher concentrations of extracts proved to be more effective when compared to lower concentrations of the extract. However, the 10 and 20 percent concentrations of chloroform extract proved to be the most effective and reduce the survival of one-day-old eggs 71.00 and 70.00 percent respectively.

For two days old eggs, it was found that all the extracts at 20 percent level gave more or less similar effects. However, petroleum ether extract proved to be the most effective at 20 percent level and gave 64.00 percent survival of eggs followed by 10 and 20 percent concentration of chloroform extract (68.00 percent), petroleum ether extract (68.00 percent) and methanol extract gave (71.00 percent) at 20 percent concentration. For three days old eggs, petroleum ether extract proved to be the most effective and gave 60.00, 60.00, 58.00, and 56.00 percent survival of eggs over control at 4, 8, 10, and 20 percent concentrations respectively. A similar order of effectiveness was observed of chloroform extract-treated eggs at 4, 8, 10, and 20 percents levels and gave 68.33, 68.33, 64.00, and 60.00 percent survival of eggs. It was found that methanol and water extract also proved to be effective. However, Table 3. data showed after one and Three days that solution and concentration were highly significant, while their interaction showed non-significant.

Effects of *Murrya koenigii* (L. sponge) leaves extract

Effect on oviposition

Studies on the oviposition deterrence of extracts Table 4. revealed that the number of eggs laid on the untreated areas (control) was more than in all other treatments. The average number of eggs 85.00 and 77.00 were laid on control and check strips/sectors respectively when compared to petroleum ether extract (10.66), methanol extract (12.00), chloroform extract (13.00), and distilled water 37.00 treated strips/sector at 5 percent concentration recorded. Similar orders of the effectiveness of each extract were observed at 10 and 20 percent concentrations of respective extracts treated strips/sectors. The data revealed that chloroform and methanol ether extract had the highest oviposition deterrent activity amongst the tested extracts followed by petroleum ether extracts and distilled water extracts.

It was found that the viability of eggs on the treated strips/sectors was slightly affected. This clearly showed that these extracts were only repelled the female from the treated surface but did not affect the viability of eggs. The data revealed that a 20 percent concentration of chloroform extract gave the lowest oviposition index (0.04) followed by a 20 percent concentration of petroleum ether (0.05) and methanol extract (0.05). The oviposition indexes of other treated strips/sectors also showed superiority over control but their ratio of eggs was too high when compared to control (Table 4).

The average number of eggs masses was almost 2.0 on all the treated strips/sectors except in distilled water extract, where it was 3.0 in number when compared to control (4-5). It was also recorded that all the tested extracts slightly affected the average hatching period (4-6 days) of eggs compared to the control (3 days).

Effect on larva survival

The toxicity of different extracts was evaluated on 2 to 3 days old larvae after 24, 48, and 72 hrs using the foliar application method. The observations (Table 5.) revealed that all the tested extracts of petroleum ether, chloroform, methanol, and distilled water were not found to be effective to reduce the survival of larvae but somehow, they were more or less superior over control. Maximum results showed after 72 hrs exposure at petroleum ether extract and methanol extract (70.00 percent) at 20 percent concentration. However, Table 5. data showed that factors a (solvent) b (concentration) and their interactions were highly significant at 24, 48, and 72 hrs exposure.

Ovicidal action

The toxicity of extracts was evaluated against one-two-and three-days old eggs 24 hrs after treatment. Data revealed that extracts were slightly superior over control (Table 6).

Table 1. Number of eggs laid by *C. auricilius* and their viability on the treated strips/sectors of *N. indicum* leaves extracts (Choice Method)

Treatments plant extracts	Average number of eggs laid by female				Average number of eggs hatched				Oviposition index			Average number of egg mass			Average hatching period (in days)		
	extract concentration (%)				extract concentration (%)				extract concentration (%)			extract concentration (%)			extract concentration (%)		
	5	10	20	Mean	5	10	20	Mean	5	10	20	5	10	20	5	10	20
Petroleum ether extract	12.00 (3.52)	3.00 (1.83)	0.00 (0.70)	5.00 (2.02)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	2	2	-	-	-	-
Chloroform extract	6.00 (2.53)	2.00 (1.55)	0.00 (0.70)	2.66 (1.60)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.06 (0.25)	0.03 (0.19)	0.00 (0.70)	3	2	-	-	-	-
Methanol extract	30.00 (5.51)	30.00 (5.51)	28.00 (5.32)	29.33 (5.45)	22.00 (4.73)	20.00 (4.52)	18.00 (4.28)	20.00 (4.51)	0.40 (0.94)	0.36 (0.92)	0.31 (0.89)	2	2	2	4	4	4
Distilled water extract	45.00 (6.73)	44.00 (6.66)	42.00 (6.51)	43.66 (6.64)	42.00 (6.51)	34.00 (5.87)	30.00 (5.52)	35.33 (5.97)	0.58 (1.03)	0.50 (0.99)	0.48 (0.98)	4	4	4	3	3	3
Acetone as check	67.00 (8.21)	64.00 (8.03)	63.00 (7.96)	64.66 (8.07)	67.00 (8.21)	90.00 (9.51)	60.00 (7.77)	72.33 (8.50)	0.82 (1.14)	0.75 (1.11)	0.75 (1.11)	3	4	4	3	3	3
Control	82.00 (9.08)	88.00 (9.40)	86.00 (9.30)	85.33 (9.26)	78.00 (8.85)	78.00 (8.85)	58.00 (7.64)	71.33 (8.45)	-	-	-	3	4	4	3	3	3

Data in parentheses represents square root transformation

Factor	Sig.	SEm ±	CD at 5%	Sig.	SEm ±	CD at 5%
A	** (**)	0.90 (0.89)	2.60 (0.25)	** (**)	0.73 (0.59)	2.11 (0.17)
B	** (**)	0.64 (0.63)	1.84 (0.18)	** (**)	0.52 (0.42)	1.49 (0.12)
A B	** (**)	1.57 (0.15)	4.51 (0.44)	** (**)	1.27 (0.10)	3.66 (0.29)

A= Concentration
B= Solvent

Table 2. Survival of *C. auricilius* larvae on different leaves extracts of *N. indicum* (Feeding Method)

Treatments plants extract concentra tion (%)	(%) Survival of Larvae														
	After 24 hrs exposure					After 48 hrs exposure					After 72 hrs exposure				
	Petro- leum Ether extract	Chloro- form Extract	Metha- nol Extract	Disti- lled water extract	Mean	Petro- leum Ether extract	Chloro- form Extract	Metha- nol Extract	Disti- lled water extract	Mean	Petro- leum Ether extract	Chloro- form Extract	Metha- nol Extract	Disti- lled water extract	Mean
2	77.00 (61.35)	100.00 (90.00)	100.00 (90.00)	92.00 (73.59)	92.25 (78.73)	80.00 (63.47)	100.00 (90.00)	100.00 (90.00)	92.00 (73.59)	93.00 (79.26)	75.00 (60.03)	95.00 (77.12)	95.00 (79.69)	92.00 (73.86)	89.25 (72.67)
4	75.00 (60.03)	95.00 (77.19)	95.00 (77.19)	90.00 (71.62)	88.75 (71.51)	75.00 (60.03)	93.00 (74.82)	95.00 (77.19)	89.00 (70.66)	88.00 (70.67)	72.00 (58.05)	89.00 (70.66)	95.00 (77.12)	89.00 (70.78)	86.25 (69.15)
8	72.00 (58.05)	88.00 (69.85)	80.00 (63.47)	85.00 (67.23)	81.25 (64.65)	70.00 (56.79)	90.00 (71.69)	77.00 (61.35)	85.00 (67.23)	80.50 (64.26)	70.00 (56.88)	80.00 (63.50)	78.00 (62.05)	85.00 (67.40)	78.25 (62.46)
10	72.00 (58.05)	80.00 (63.47)	80.00 (63.47)	62.00 (51.94)	73.50 (59.23)	70.00 (56.79)	77.00 (61.35)	75.00 (60.03)	62.00 (51.94)	71.00 (57.53)	64.66 (53.52)	75.00 (60.00)	75.00 (60.00)	62.00 (51.95)	69.16 (56.37)
20	52.00 (46.14)	69.00 (56.17)	62.00 (51.94)	52.00 (46.14)	58.75 (50.10)	52.00 (46.14)	65.00 (53.73)	62.00 (51.94)	52.00 (46.14)	57.75 (49.49)	52.00 (46.14)	65.00 (53.73)	62.00 (51.94)	52.00 (46.14)	57.75 (49.49)
Acetone as check	100.00 (90.00)	92.00 (73.59)	95.00 (77.19)	100.00 (90.00)	96.75 (82.69)	95.00 (77.19)	93.00 (74.82)	95.00 (77.19)	100.00 (90.00)	95.75 (79.80)	95.00 (77.12)	92.00 (73.59)	92.00 (73.59)	95.00 (77.19)	93.50 (75.37)
Control	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	96.00 (78.62)	100.00 (90.00)	99.00 (87.15)

Data in parentheses represents angular transformation

Factor	**Sig.**	**SEm ±**	**CD at 5%**	**Sig.**	**SEm ±**	**CD at 5%**	**Sig.**	**SEm ±**	**CD at 5%**
A	** (**)	0.38 (0.30)	1.07 (0.87)	** (**)	0.39 (0.33)	1.11 (0.95)	** (**)	0.59 (0.59)	1.68 (1.67)
B	** (**)	0.50 (0.40)	1.42 (1.16)	** (**)	0.52 (0.44)	1.47 (1.26)	** (**)	0.78 (0.78)	2.23 (2.21)
A B	** (**)	1.00 (0.81)	2.84 (2.32)	** (**)	1.04 (0.89)	2.94 (2.53)	ns (ns)	1.57 (1.56)	4.46 (4.43)

A= Solvent
B= Concentration

Table 3. Ovicidal action of leaves extracts of *N. indicum* Mill against *C. auricilius*

Treatments plants extract concentra tion (%)	(%) survival of eggs														
	One day old eggs					Two days old eggs					Three days old eggs				
	Petro- leum Ether extract	Chloro-form Extract	Metha-nol Extract	Disti-lled water extract	Mean	Petro- leum Ether extract	Chloro-form Extract	Metha-nol Extract	Disti-lled water extract	Mean	Petro- leum Ether extract	Chloro-form Extract	Metha-nol Extract	Disti-lled water extract	Mean
2	85.00 (67.23)	74.00 (59.35)	81.00 (64.17)	81.00 (64.17)	80.25 (63.73)	76.00 (60.67)	73.00 (58.76)	81.00 (64.17)	77.00 (61.42)	76.75 (61.26)	70.00 (56.82)	70.00 (56.82)	76.00 (60.67)	74.00 (59.40)	72.50 (58.43)
4	77.00 (61.35)	74.00 (59.35)	78.00 (62.04)	76.00 (60.67)	76.25 (60.85)	75.00 (60.02)	72.00 (58.05)	76.00 (60.67)	76.00 (60.67)	74.75 (59.85)	60.00 (50.79)	68.33 (55.80)	76.00 (60.67)	73.00 (58.76)	69.33 (56.51)
8	77.00 (61.35)	74.00 (59.35)	78.00 (62.04)	76.00 (60.67)	76.25 (60.85)	74.00 (59.35)	70.00 (56.82)	72.00 (58.16)	76.00 (60.67)	73.00 (58.75)	60.00 (50.79)	68.33 (55.80)	73.00 (58.76)	73.00 (58.76)	68.58 (56.033)
10	77.00 (61.35)	71.00 (57.42)	76.00 (60.67)	76.00 (60.67)	75.00 (60.03)	68.00 (55.55)	68.00 (55.55)	75.00 (60.03)	73.00 (58.74)	71.00 (57.47)	58.00 (49.60)	64.00 (53.13)	73.00 (58.76)	73.00 (58.76)	67.00 (55.06)
20	74.00 (59.35)	70.00 (56.79)	74.00 (59.35)	75.00 (60.00)	73.25 (58.87)	64.00 (53.19)	68.00 (55.76)	71.00 (57.44)	72.00 (58.08)	68.75 (56.12)	56.00 (48.45)	60.00 (50.78)	65.00 (53.81)	67.33 (55.15)	62.08 (52.05)
Acetone as check	86.00 (68.05)	86.00 (68.05)	86.00 (68.05)	86.00 (68.05)	86.00 (68.05)	86.00 (68.05)	86.00 (68.05)	85.66 (68.00)	85.66 (68.00)	85.83 (68.03)	83.00 (65.69)	83.00 (65.69)	83.00 (65.69)	83.00 (65.69)	83.00 (65.69)
Control	90.00 (71.81)	90.00 (71.81)	90.00 (71.81)	90.00 (71.81)	90.00 (71.81)	90.00 (71.81)	90.00 (71.81)	90.00 (71.81)	90.00 (71.81)	90.00 (71.81)	90.00 (71.80)	90.00 (71.80)	90.00 (71.80)	90.00 (71.80)	90.00 (71.801)

Data in parentheses represents angular transformation

Factor	**Sig.**	**SEm ±**	**CD at 5%**	**Sig.**	**SEm ±**	**CD at 5%**	**Sig.**	**SEm ±**	**CD at 5%**
A	** (**)	0.51 (0.42)	1.45 (1.19)	* (ns)	0.97 (0.68)	2.76 (1.93)	** (**)	0.96 (0.65)	2.74 (1.86)
B	** (**)	0.68 (0.55)	1.93 (1.57)	** (**)	1.29 (0.90)	3.66 (2.56)	** (**)	1.28 (0.86)	3.62 (2.46)
A B	ns (ns)	1.36 (1.11)	3.86 (3.15)	ns (ns)	2.58 (1.81)	7.32 (5.12)	ns (ns)	2.56 (1.73)	7.25 (4.92)

A= Solution
B= Concentratio

Table 4. Number of eggs laid by *C. auricilius* & their viability on the treated strips/sectors of *M. koenigi* leaves extracts (Choice Method)

Treatments plant extracts	Average number of eggs laid by female				Average number of eggs hatched				Oviposition index			Average number of egg mass			Average hatching period (in days)		
	extract concentration (%)				extract concentration (%)				extract concentration (%)			extract concentration (%)			extract concentration (%)		
	5	10	20	Mean	5	10	20	Mean	5	10	20	5	10	20	5	10	20
Petroleum ether extract	10.66 (3.28)	10.00 (3.07)	9.00 (3.07)	10.55 (3.29)	8.00 (2.90)	6.00 (2.54)	4.00 (2.11)	6.00 (2.51)	0.15 (0.80)	0.15 (0.80)	0.05 (0.21)	2.0	2.0	2.0	4	4	4
Chloroform Extract	13.00 (3.66)	10.00 (3.23)	5.00 (2.33)	9.33 (3.07)	5.00 (2.33)	6.00 (2.53)	2.00 (1.55)	4.33 (2.14)	0.13 (0.79)	0.11 (0.78)	0.04 (0.20)	2.0	2.0	2.0	4	4	4
Methanol Extract	12.00 (3.52)	10.00 (3.23)	6.00 (2.54)	9.33 (3.10)	5.00 (2.31)	5.00 (2.31)	3.00 (1.85)	4.33 (2.16)	0.14 (0.79)	0.12 (0.78)	0.05 (0.21)	2.0	2.0	2.0	4	4	6
Distilled water extract	37.00 (6.11)	35.00 (5.95)	25.00 (5.03)	32.33 (5.70)	22.00 (4.73)	20.00 (4.52)	20.00 (4.52)	20.66 (4.59)	0.45 (0.97)	0.35 (0.92)	0.20 (0.83)	3.0	3.0	3.0	3.6	3.0	4
Acetone as check	77.00 (8.80)	75.00 (8.68)	68.00 (8.27)	73.33 (8.58)	71.00 (8.45)	65.00 (8.08)	60.00 (7.77)	65.33 (8.10)	0.91 (1.18)	0.85 (1.16)	0.54 (1.01)	4.0	4.0	4.0	3.6	3.6	3
Control	85.00 (9.24)	86.00 (9.30)	123.00 (11.11)	98.00 (9.88)	77.00 (8.79)	74.66 (8.66)	115.00 (10.74)	88.88 (9.40)	-	-	-	5.0	5.0	4.0	3	3	3

Data in parentheses represents square root transformation

Factor	**Sig.**	**SEm ±**	**CD at 5%**	**Sig.**	**SEm ±**	**CD at 5%**
A	** (**)	1.00 (0.10)	2.87 (0.28)	** (**)	0.99 (0.96)	2.85 (0.27)
B	ns (**)	0.71 (0.70)	2.03 (0.20)	** (ns)	0.70 (0.68)	2.01 (0.19)
A B	** (**)	1.73 (0.17)	4.98 (0.49)	** (**)	1.72 (0.16)	4.94 (0.48)

A= Concentration
B= Solvent

Table 5. Survival of larvae on different leaves extracts of *M. Koenigi* (Feeding Method)

Treatments plants extract concentra tion (%)	(%) Survival of Larvae														
	After 24 hrs exposure					After 48 hrs exposure					After 72 hrs exposure				
	Petro- leum Ether extract	Chloro- form Extract	Metha- nol Extract	Disti- lled water extract	Mean	Petro- leum Ether extract	Chloro- form Extract	Metha- nol Extract	Disti- lled water extract	Mean	Petro- leum Ether extract	Chloro- form Extract	Metha- nol Extract	Disti- lled water extract	Mean
2	95.00 (77.50)	90.00 (71.62)	95.00 (77.50)	98.00 (83.77)	94.50 (77.60)	95.00 (77.50)	90.00 (71.62)	95.00 (77.50)	96.00 (78.67)	94.00 (76.32)	95.00 (77.50)	90.00 (71.69)	95.00 (77.50)	96.00 (78.67)	94.00 (76.34)
4	92.00 (73.72)	90.00 (71.62)	94.00 (75.90)	95.00 (77.50)	92.75 (74.69)	92.00 (73.72)	90.00 (71.62)	94.00 (75.90)	92.00 (73.65)	92.00 (73.72)	92.00 (73.72)	90.00 (71.69)	94.00 (75.90)	92.00 (73.62)	92.00 (73.74)
8	82.00 (64.91)	90.00 (71.62)	93.00 (74.92)	94.00 (75.90)	89.75 (71.84)	82.00 (64.91)	88.00 (69.85)	93.00 (74.92)	92.00 (73.59)	88.75 (70.82)	82.00 (64.91)	84.00 (66.49)	93.00 (74.92)	92.00 (73.62)	87.75 (69.99)
10	74.00 (59.35)	85.00 (67.39)	85.00 (67.39)	94.00 (75.90)	84.50 (67.51)	74.00 (59.35)	85.00 (67.39)	80.00 (63.47)	90.00 (71.69)	82.25 (65.47)	72.00 (58.07)	84.00 (66.49)	81.00 (64.16)	90.00 (71.60)	81.75 (65.08)
20	74.00 (59.35)	82.00 (64.91)	75.00 (60.03)	85.00 (67.39)	79.00 (62.92)	72.00 (58.07)	82.00 (64.91)	75.00 (60.03)	85.00 (67.39)	78.50 (62.60)	70.00 (56.79)	82.00 (64.91)	70.00 (56.80)	83.00 (65.71)	76.25 (61.05)
Acetone as check	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
Control	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)

Data in parentheses represents angular transformation

Factor	**Sig.**	**SEm ±**	**CD at 5%**	**Sig.**	**SEm ±**	**CD at 5%**	**Sig.**	**SEm ±**	**CD at 5%**
A	** (**)	0.55 (0.58)	1.56 (1.65)	** (**)	0.54 (0.50)	1.53 (1.43)	** (**)	0.48 (0.46)	1.37 (1.32)
B	** (**)	0.72 (0.77)	2.06 (2.18)	** (**)	0.71 (0.67)	2.03 (1.89)	** (**)	0.64 (0.62)	1.81 (1.75)
A B	** (**)	1.45 (1.54)	4.13 (4.37)	** (**)	1.43 (1.34)	4.06 (3.79)	** (**)	1.28 (1.24)	3.63 (3.51)

A= Solvent
B= Concentration

Table 6. Ovicidal action of leaves extracts of *M. Koenigii* against *C. auricilius*

Treatments plants extract concentra tion (%)	(%) Survival of eggs														
	One day old eggs					Two days old eggs					Three days old eggs				
	Petro- leum Ether extract	Chloro-form Extract	Metha-nol Extract	Disti-lled water extract	Mean	Petro-leum Ether extract	Chloro-form Extract	Metha-nol Extract	Disti-lled water extract	Mean	Petro- leum Ether extract	Chloro-form Extract	Metha-nol Extract	Disti-lled water extract	Mean
2	84.00 (66.49)	84.00 (66.49)	84.00 (66.49)	84.00 (66.49)	84.00 (66.49)	82.00 (64.91)	83.00 (65.69)	80.00 (63.63)	80.00 (63.45)	81.25 (64.42)	82.00 (64.91)	80.00 (63.44)	78.00 (62.05)	80.00 (63.44)	80.00 (63.46)
4	81.00 (64.17)	81.00 (64.17)	80.00 (63.47)	84.00 (66.49)	81.50 (64.57)	80.00 (63.63)	80.00 (63.63)	80.00 (63.63)	80.00 (63.63)	80.00 (63.63)	80.00 (63.44)	80.00 (63.44)	78.00 (62.05)	77.00 (61.35)	78.75 (62.57)
8	80.00 (63.47)	80.00 (63.47)	80.00 (63.47)	82.00 (64.91)	80.50 (63.83)	80.00 (63.63)	80.00 (63.63)	80.00 (63.63)	80.00 (63.63)	80.00 (63.63)	77.00 (61.35)	77.00 (61.35)	78.00 (62.05)	77.00 (61.35)	77.25 (61.52)
10	75.00 (60.03)	77.00 (61.42)	77.00 (61.42)	80.00 (63.47)	77.25 (61.59)	74.00 (59.35)	77.00 (61.42)	75.00 (60.03)	74.66 (59.86)	75.16 (60.17)	74.00 (59.35)	76.00 (60.67)	76.00 (60.67)	76.00 (60.67)	75.50 (60.34)
20	72.00 (58.07)	77.00 (61.42)	77.00 (61.42)	79.00 (62.73)	76.25 (60.91)	72.00 (58.07)	74.00 (59.35)	75.00 (60.03)	77.00 (61.42)	74.50 (59.72)	72.00 (58.05)	73.00 (58.72)	72.00 (58.05)	73.00 (58.72)	72.50 (58.39)
Acetone as check	81.00 (64.17)	81.00 (64.17)	81.00 (64.17)	81.00 (64.17)	81.00 (64.17)	85.00 (67.39)	85.00 (67.39)	85.00 (67.39)	85.00 (67.39)	85.00 (67.39)	88.00 (69.85)	88.00 (69.85)	88.00 (69.85)	88.00 (69.85)	88.00 (69.85)
Control	84.00 (66.49)	84.00 (66.49)	84.00 (66.49)	84.00 (66.49)	84.00 (66.49)	88.00 (69.85)	88.00 (69.85)	88.00 (69.85)	88.00 (69.85)	88.00 (69.85)	88.00 (69.85)	88.00 (69.85)	88.00 (69.85)	88.00 (69.85)	88.00 (69.85)

Data in parentheses represents angular transformation

Factor	**Sig.**	**SEm ±**	**CD at 5%**	**Sig.**	**SEm ±**	**CD at 5%**	**Sig.**	**SEm ±**	**CD at 5%**
A	ns (ns)	0.72 (0.51)	2.05 (1.46)	ns (ns)	1.11 (0.79)	3.15 (2.25)	ns (ns)	0.56 (0.43)	1.59 (1.23)
B	** (**)	0.95 (0.68)	2.71 (1.94)	** (**)	1.47 (1.05)	4.17 (2.98)	** (**)	0.74 (0.57)	2.10 (1.62)
A B	ns (ns)	1.91 (1.36)	5.43 (3.88)	ns (ns)	2.94 (2.10)	8.34 (5.97)	ns (ns)	1.48 (1.14)	4.21 (3.25)

A= Solution
B= Concentration

It was found that only higher concentrations of extracts were able to slightly reduce the viability of eggs, otherwise, lower concentrations of extracts did not have any effect on the viability of eggs in comparison to control. Similarly, after three days old eggs data showed maximum survival of eggs was petroleum ether extract and methanol extract (72.00 and 72.00 percent) at 20 percent concentration followed by chloroform extract and distilled water extract 73.00 percent. (Nitin, H. et al.2014)

Bioefficacy of *M. koengii* tested against *Spilosoma obliqua* and *Spodoptera litura*. (Tara, and Sharma 2010, Siti, M.M., et al. 2018 and Nalesh, B. et al. 2021) toxicity against *Tribolium castenium* insect pests. *M. koengii* (leaves) contain essential oil and *glucoside koeningin* (Chopra et al. 1980). The Repellent activity of chloroform, methanol, and petroleum ether extracts to female moths might be due to the high level of essential oils and glucoside "Koeinigin" in the extracts. It was observed that the deterrent effect on oviposition increased gradually with increased extracts concentration from 5 to 20 percent and this can be attributed to the presence of a high number of principal components in the extracts. Observations on survival and ovicidal action did not show any promising results. Based on the above discussion, it was concluded that the extracts of *M. koengii* (leaves) could be used as a repellent/deterrent against *C. auricilius*.

Our results are by those obtained by, (Rao, 1955, 1957) extracts possess insecticidal effects against *S. oryzae* and observed the cent-percent mortality. (Saradamma et al.1988 and Shukla *et al.* 2012) *N. indicum* leaves have reduced the population of insect pests, (Dhanasekaran, S. et al.2013) larvicidal, ovicidal, and repellent activity of *N. indicum*. Our results are by those obtained by quoted researchers. The results clearly showed that extract possesses deterrent and insecticidal activity. It may be due to the presence of some alkaloids in the extracts, which might be responsible for the deterrent and insecticidal activities of *N. indicum* extracts on *C. auricilius*.

CONCLUSION

Botanical insecticides are natural chemicals extracted from plants with insecticidal properties and used as an excellent alternative to synthetic or chemical pesticides for crop protection to avoid negative or side effects of synthetic insecticides. Botanical pesticides have various chemical properties and modes of action and effect on insects in different ways namely; toxicants, repellents, feeding deterrents/antifeedants, growth retardants, and attractants. Therefore, it is preferable to use the botanical insecticides instead of synthetic insecticide. Using botanical insecticidal and being promoted and research is being conducted to find new sources of botanical insecticides. The findings of the present investigations indicate that botanical derivatives might be useful as insect control agents. *M. koengii* and *N. indicum* extracts tested were effective to some degree in reducing the ovipositional preferences, and increasing the inhibition rates of the larval survival and ovicidal action. As per low concentrations of these two plants extract were less effective against the target pest. Moreover, to minimize the severe damage caused by insect pests, the traditional use of plant products proved to be highly effective against insects. Application of plant extracts an inexpensive and effective technique and its easy adaptability will give additional advantages leading to acceptances of this technology by farmers. A study to improve the effectiveness of botanical derivatives as insecticides will benefit agricultural sectors, also have less environmental impact in term of insecticidal hazard.

REFERENCES

Chapagain, B.P., and Wiesman, Z. 2005. Larvicidal activity of the fruit Mesocarp extract of *Balanites aegyptiaca* and its saponin fractions against *Aedes aegypti*. Dengue Bulletin. 29.

Chaudhary, J.P. 1981. Distribution extent of damage and control of sugarcane stalk borer, *Chilo auricilius* Dndgn. Proc. National Symp. Stalk borer, Karnal, 7-19. Google Scholar

Chopra, R.N., Nayar, S.L., and Chopra, I.C. 1980. Glossary of Indian medicinal plants. Reprint. New Delhi, *Council of Scientific and Industrial Research*, PP.300.

Christos,G.A., Demetrius, C.K., Nickolas, G.K. and Maria, A.V. 2005. Insecticidal effect of neemazal against tree stored- product beetle species on rye and oats. J.Econ.Entomol., 98(5): 1733-1738.

David, H., Nadagopal, V. and Anatha, N, K. 1986. Recent studies on the control of white grubs, Holotrichia serrata Blanch infesting sugarcane. *Journal of Soil Biology and Ecology*, 6: 117-127.

Dhanasekaran, S., Krishnappa, K., Anandan, A. and Elumalai, K.2013. Larvicidal, ovicidal and repellent activity of selected indigenous medicinal plants against malarial vector Anopheles stephensi (Liston.), dengue vector Aedes aegypti (Linn.) and Japanese encephalitis vector, Culex tritaeniorynchus (Giles.) (Diptera: Culicidae) *J. of Agri.Tech.* Vol. 9(1): 29-47.

Dudgeon, C.C. 1905. Description of new species of moths form India and Burma. J. Bombay Nat. Hist. Soc., 16: 399-405.

Erturk, O., Vedat, S.and Ahmet Y.K. Koc. 2004.Antifeedent and toxicity effects of some plants extracts on *Yponomeuta malinellus* Zell. (LEP: Yponomeutidae) L. *Plant Prot. Res.*, 44(3): 125-135.

Essien, J.P. 2004. Insecticidal potential of an orally administered metabolic extract of *Aspergillus niger* on *Chrysomya cholopyga* (Green bottle fly) larvae.*J. Applied Environ.Manage*.,8(1): 45-48.

Fletcher, T.B. and Ghosh, C.C. 1919. First record of *Chilo auricilius* from Pusa (Bihar). Proc. ent. meet., 3: 355-417.

Jaipal, S. and Zile S. 1985. Reproductive deterrent activity in crude extracts of some common Indian plants. Behavioural and physiological approaches in pest management) Edited by Regupathy, A. and Jayaraj, S.J., P.34-37

Jbilou, R., Ennabili, A. and Sayaha, F. 2006. Insecticidal activity of four medicinal plant extracts against Tribolium castaneum (Herbst) (Coleoptera:Tenebrionidae). *Afr.J. Biotech*., 5 (10):936-940.

Koona,P., and Dorn, S.2005. Extracts from *Tephrosia vogelii* for the protection of stored legume seeds against damage by three bruchid species. *Ann. Applied Biol*., 147(7):43-47.

Kumar S, Wahab N, Warikoo R.2011. Bioefficacy of *Mentha piperita* essential oil against dengue fever mosquito *Aedes aegypti* L. *Asian Pacific Journal of tropical Biomedicine*.1(2):85–88.

Lefroy, H.M. 1906. Moth borer of Sugarcane, maize and sorghum in west India. *Agric. J. India*, 10: 97-113.

Mehta Usha K. and David H. 1978. A laboratory technique for rearing the sugar-cane internode borer, *Chilo indicus* K. on an artificial medium. lndian Sugar 28, 38-41.

Nalesh, B.,Shantaram, B. and Ashutosh, N.2021. Effect of plant extracts (*Murrya koenigii*, *Eucalyptus*,and *Ricinus communis*) against the red flour beetle (*Tribolium castenium* Herbst). The research view: *A multidisciplinary journal part A: Sci. and Tech*.77-88.

Nitin, H., Thodsare, Priyanka, B. and Rajesh, P. S.2014. Bioefficacy of Murraya koenigii oil against Spilosoma obliqua and Spodoptera litura. *J. of Entomo. and Zool. Studies.* 2 (4): 201-205.

Pandey, K.P. and Singh, S. 1998. Evaluation of plant products as an insecticide against top borer *Scirpophaga excerptalis* Walker in Sugarcane Entomology, 23 (3): 235-237.

Rao, D.S. 1955. Insecticidal potential of the corolla of flowers. *Indian J. Entomol*, 17 (1): 121-124.

Rao, D.S. 1957. The insecticidal properties of petals of several common plants of *India. Econ. Bot*., 11: 274-276.

Roy, B., R. Amin and Uddin, M.N. 2005. Leaf extracts of Sihyalmutra (*Blumea lacera*) as botanical insecticides against lesser grain borer and rice weevil. *J. Biol. Sci*., 5 (2):201-204.

Sardamma, K., Dale, D. and Mohandas, N. 1988. Plant extracts for the management of insect pests of vegetables. National Symposium on Integrated pest control – Progress and perspectives, Oct. 15-17, 1987, PP. 444-446.

Shukla C., S., Devendra, N.P., Sandeep, S. 2012. Pesticidal effect of euphorbia, nerium and calotropis latex on some larvae of crop damaging pests.*Inter. J. of Pharmacy and Pharmaceutical Sci*. 4(4): 256-260.

Singh, R. P. 2000. Botanicals in pest management: An Ecological prospective. In Dhaliwal, G. S. and Singh, B. (Eds.), Pesticides and environment. New Delhi: Commonwealth Publishers. PP. 279-343.

Siti, M.M., Aisyah, S.K., Azlinda, M., Mohd Ariff, N. I., Amirudin, M.Z., Adida,M. 2018.The Bio-Efficacy of crude leaf extract (*Murraya Koenigii*) as botanical termiticides against subterranean termite, *Coptotermes Gestroi. Inter.J. of Engi. & Tech.*, 7 (4.42) 78-80.

Tara, J.S., and Sharma, M., 2010. Survey of insect pest diversity on economically important plant, *Murrya koenigii*. *J. of Entomo. Res.* 34(3):265-270.

Citation: Rashid Mumtaz 2021. Bioefficacy of plant extracts on ovicidal and oviposition deterrent against sugarcane stalk borer *Chilo auricilius* Dudgeon (Lepidoptera: crambidae). *International Journal of Agricultural and Applied Sciences*, **2**(2):49-59. https://doi.org/10.52804/ijaas2021.228