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Insecticidal biopotentials of *Ageratum conyzaides, Azadirachta indica* and *Chenopodium ambrosioides* essential oils against leaf webber, *Eucosma critica* Meyrick (Lepidoptera: Eucosmidae)

Rajani and BS Chandel

Abstract
The intensive and indiscriminate use of insecticides in agriculture has caused many problems and contaminated with water, air and soil causing environmental pollution and hazaourdous to human health and beneficial organisms. The present study was carried out to evaluate the larvicidal properties of eleven indigenous botanicals growing abundantly in the vicinity of Kanpur region of U.P., India. The eleven edible and non-edible oils and one synthetic insecticide ie; *Ageratum conyzaides* Linn., *Argemone maxicana* Linn., *Arachis hypogea* Linn., *Azadirachta indica* A. juss., *Brassica juncea* Linn., *Chenopodium ambrosioides* Linn., *Mentha arvensis* Linn., *Mentha longifolia* Linn., *Ocimum basilicum* Linn., *Pongamia glabra* Vent. *Ricinus communis* Linn. and Endosulphan were studied against 3rd instar larvae of *Eucosma critica* Meyrick (Lepidoptera: Eucosmisdae). The laboratory trial was done in three glass petridishes (10cm diameter) and replicated thrice by using each selected extracts per petri-dish. To record the ten larvae of *E. critica* were released inside each pair of petri-dishes and allow them to remain for 24 hours. These petri-dishes were kept as such under control conditions 27± 1.00 C^0 and Rh 75± 5 and mortality count was taken after 6h, 12h, 24 hours of exposure peroids. The plant oils of *A. conyzaides* gave the best results when compared with the remaining ten extractives. The *A. conyzaides* extract gave the 78.10 per cent larval mortality, which is followed by *A. indica* (76.05 per cent), *C. ambrosioides* (73.40 per cent), *R. communis* (69.94 per cent), Endosulphan (71.41 per cent), *P. glabra* (68.01 per cent), *O. basilicum* (65.33 per cent), *A. maxicana* (57.50 per cent), *M. arvensis* (51.91 per cent), *M. longifolia* (50.97 per cent), *B. juncea* (61.42 per cent) and *A. hypogea* (37.15 per cent) etc. The plant oils of *A. conyzaides* differs significant from remaining once except *A. indica*, whereas, Endosulphan, *P. glabra*, *O. basilicum*, *A. maxicana*, *M. arvensis*, *M. longifolia*, *B. juncea* and *A. hypogea*, respectively. which, does not differ significantly to one another. *A. hypogea* proved least toxic giving only 36.5 per cent mortality of the larvae of *Eucosma critica*.

Keywords: *Ageratum conyzaides, Argemone maxicana, Eucosma critica* and *biorational*

1. Introduction
Pigeonpea, *Cajanus cajan* (L.) Millsp, is one of the most important pulses and forms a regular proteinous diet of majority of people of this country. It is very important pulse crop and ranks only next to grain in its consumption and availability (Ayyar, 1963) [1]. India accounts pigeonpea for about 85.0 per cent of total supply in the world. *C. cajan* occupies an area of about 32.38 lac ha under cultivation with the total production of 23.16 lac metric tonnes and the productivity 7.15 q ha. Out of total cultivated area, U.P. occupies 5.26 lac ha, with the total production of 7.0 lac metric tonnes and 13.3 q ha^{-1} productivity as per estimate of Directorate of Pulses Research (Anonymous,1978) [2]. Pigeonpea, *C. cajan* crop contains 25.3 per cent protein, 57.2 per cent carbohydrate, 1.7 per cent fat and 12.2 per cent water (Meyrick, 1912) [3].

The main limiting factors in increasing the crop production, is the lack of high yielding and resistant genotypes for crop field and under storage conditions prevailing in different parts of the country (Lal *et al.*, 1980) [4]. Thus, insect-pests are mainly responsible for the considerable reduction in the enormous amount of stored pulses grains (Singh and Singh, 1978a and Singh and Singh, 1978b) [5, 6].This important leguminous crop is subjected to the attack of a large number of insect-pests, namely, gram pod borer, *Heliothis armigera* Hub. (Loganath *et al.* 2000 and Malarvannan *et al.* 2008a) [7, 8], pod fly, *Melanagromyza obtusa* Malloch (Bindra and Singh, 1972, Thobbi and Singh, 1978) [9, 10]. Leaf webber, *Eucosma critica* Meyrick (Pruth, 1969 and Srivastava, 1974) [11, 12]. Beside these plume-moth, *Exelastis atomosa* W. (Sinha *et al.*1977) [13]. Bud butter fly, *Euchrysops cnejus* F. spotted pod borer, *Maruca testululis* Geyer

and pod bug, *Clavigralla gibbosa* Spin. and gram podfly are also damage pulse crop (Shetgar and Puri, 1978) [14]. Out of these insects, *Eucosma critica* has been found causing enormous damage to red gram in various parts of U.P. and its adjoining States (Fletcher, 1916) [15]. Parshad and Rao (1964) have noted varied degree of its incidence in different parts of India. At times, it may cause 100.0 per cent infestation. It was once considered to be a minor pest of pigeon pea, but now, has assumed the status of a major pest) [16].

Chemical control has proved to be successful weapon all over the world. The synthetic insecticides have been found very promising in suppressing this pest, but they are hazardous to mammals including men and domestic animals. Their use may, however, result the development of high degree of resistance in insects (Patel, *et al.*1997) [17]. No systematic approach has so far been adopted to work out economical effective control measures of *Eucosma critica*. The complicated problem of pest management has oriented the attention of agricultural experts and administrators for rethinking of its solution. It is realized now, that for satisfactory solution of many of the major problems in the pest management researches, study of insect life history and its extent of damage is of rime importance. It is accepted that knowledge of the factors that influence the distribution and abundance of insect-pests will be more essential arms in wagging effective warfare against these injurious enemies. With advancement in awareness about the adverse effect of insecticides, entomologists have concerted their efforts for evolving other more convenient and safer alternative methods *viz.*, the use of resistant genotypes and indigenous plant products for reducing the ravages of the pests (Brahmaprkash, 2004) [18]. In recent past, the use of indigenous plant materials have acquired an important position in the modern approaches of pest control, as they are comparatively safer to mammals and higher animals due to their rapid bio-degradable nature (Gupta *et al.* 1988, Makanjuola, 1989, Maredia *et al.*1992, Gbolade *et al.* 1999, Lale, and Mustapha 2000,) [18, 20, 21, 22, 23].

Considering the above facts in view, the present studies were undertaken to determine the effect of edible, non-edible extracts and oils against *Eucosma critica* on Pigeonpea, *Cajanus cajan*. An attempt has also been made to observe the bionomics of *Eucosma critica* and evaluate the effect of different oils on the growth, development and control of the *Eucosma critica*.

2. Materials and Mathods

2.1 Mass Culture of *Eucosma critica* Meyrick

The larvae of *Eucosma critica* Meyrick were obtained from the mustard experimental fields of farmers of Fattepur Dakshin village, Kanpur Nagar and maintained in the laboratory on natural diets. The collected larvae were kept for at least 5 days in the laboratory to check, whether or not, there are any other infections before using them for experiments. *Eucosma critica* Meyrick required for the study were mass reared on cruciferous leaves in the laboratory. The mass culturing was initiated by confining 10 larvae of *Eucosma critica* in the plastic containers of 59 x 21 x 18 cm having green mustard leaves which were covered with muslin cloth and secured tightly with rubber band. Mass culturing of *Eucosma critica* larvae was done at 28 ± 2º C temperature in the plastic container and observed daily.

2.2. Collection of raw Materials

The plant materials used in the present investigation were collected mainly from cultivated fields of the farmers, wasteland and wild areas in the vicinity of Kanpur region. The collected six materials viz; *Ageratum conyzaides* Linn., *Argemone maxicana* Linn., *Arachis hypogea* Linn., *Azadirachta indica* A. juss., *Brassica juncea* Linn., *Chenopodium ambrosioides* Linn., *Mentha arvensis* Linn., *Mentha longifolia* Linn., *Ocimum basilicum* Linn., *Pongamia glabra* Vent. *Ricinus communis* Linn. Were used for their insecticidal efficacy against larvae of *Eucosma critica* Meyrick.

2.3 Powder Preparation

Fresh collected plant materials like aerial parts and leaves etc) were washed with tap water and kept in the laboratory for 7 days for shadow air drying before making powder. Electric grinder was used to have coarse powder then these were passed through a 60-mesh sieve to get fine powder. Powders were kept in polythene bags at room temperature and properly sealed to prevent quality loss.

2.4. Preparation of Extractives

For the extraction, Soxhlet Apparatus was used; about 20g powder of each category was extracted with 300 ml of alcohol and distilled water). Extractions of each category of powder were done in about 12 hrs. After soxhlet extraction, the material was run on rotary evaporator. The extracts were concentrated on rotary evaporator by removing the excess solvent under vacuum. After evaporation of solvent the remaining extracted material was kept on water bath for removing remaining solvent from the extracts. The extracts were stored at 4° C prior to application.

2.5 Experimental Apparatus

More Than one hundred glass petri-dishes (15cm diameter) were used for the experiment, One hand compression poly sprayer and muslin cloth was required for covering the petri-dishes and ridges of plots either going or coming the larvae in the cruciferous leaves in the petri-dishes.

2.6 Preparation of Stock Solution

In order to prepare 50 ml. stock solution of three per cent concentration, calculated amounts of technical grades of endosulfan and different concentrations i.e. 0.5, 1.0, and 2.0%, of elven plant materials i.e., *Ageratum conyzaides* Linn., *Argemone maxicana* Linn., *Arachis hypogea* Linn., *Azadirachta indica* A. juss., *Brassica juncea* Linn., *Chenopodium ambrosioides* Linn., *Mentha arvensis* Linn., *Mentha longifolia* Linn., *Ocimum basilicum* Linn., *Pongamia glabra* Vent. *Ricinus communis* Linn. Were taken. This amount was measured with the help of micropipette or weighed with electrical balance as the case may be and poured into 50 ml. volumetric flaks and ten ml. of benzene was added to dissolve it and then adjusted the volume up to 50 ml. with benzene.

2.7 Preparation of Emulsifier Solution

Five gm of triton X-100 was accurately weighed with the help of electrical balance in a weighing tube and then poured into a 1000 ml. volumetric flask. Five hundred ml of distilled water was added to it. The flask was vigorously shaken to mix the triton X-100 with distilled water. This gave emulsifiable water of 0.5%, 1.0, 2.0% concentration and endosulfan (0.002,0,004 and 0.007%), formulating allowance was given to the actual ingredient present in its technical grade.

The formula used to find out actual amount of stock solution required for making various concentrations of an insecticide is given below:

$$\text{Amount of Stock Solution} = \frac{\text{Concentration required X amount required}}{\text{Concentration of Stock Solution}}$$

Table 1: Details of the selected plant parts and their common name

Botanical Name	Common Name	Part Used
Ageratum conyzaides Linn.	Goat weed	Arial part
Argemone maxicana Linn.	Satyanashi	Seed oil
Azadirachta indica A. juss.	Neem	Seed oil
Arachis hypogea Linn.	Groundnut	Seed oil
Brassica juncea Linn.	Brown mustard	Seed oil
Chenopodium ambrosioides L.	Indian warm seed	Seed oil
Mentha arvensis Linn.	Cornmint	Leaves
Mentha longifolia Linn.	Horsemint	Leaves
Ocimum basilicum Linn.	Sweetbasil	Leaves
Pongamia glabra Vent.	Karanja	Seed oil
Ricinus communis Linn.	Castorbean	Leaves
Endosulfan.	Trade name-Thiodon	M/s.Hoechst pharmaceuticals Ltd, Mumbai

Table 2: Preparation of different formulations of the selected plant materials

Concentration (%)	Amount of Stock Solution (ml)	Amount of Benzene (ml)	Amount of Emulsifiable Water (ml)	Total Amount (ml)
0.25	2.50	22.50	475.00	500.00
0.50	5.00	20.00	475.00	500.00
1.00	10.00	15.00	475.00	500.00
1.50	15.00	10.00	475.00	500.00
2.00	20.00	5.00	475.00	500.00
Endosulfan	35 EC			0.700

Insecticidal Bioassay

Third instars larvae third instar larvae of *Eucosma critica* were used to test the biological efficacy of each insecticide. Preliminary laboratory trials were conducted to formulate the various concentrations for further experiments to determine a suitable concentration on which insect mortality ranging from 15.0 to 85.0 per cent could be obtained. One ml. of each of the three concentrations of various insecticides was sprayed with the help of Potter's tower at 0.28 kg per sq.cm. pressure in clean petri-dishes of 10 cm diameter and kept under an electric fan to dry the films of insecticides. Twenty (twenty four hour starved) larvae of the similar age were then released over the dry film. After conducting the preliminary trials the regular experiments were carried out under laboratory conditions. The third instar larvae of *Eucosma critica* were used for the purpose. The insecticides of the plant origins were tested by dry film technique. The spraying of the insecticides was done in glass petri-dishes (10cm diameter) by potters spray tower, using 1.0 ml. of solution (insecticidal preparation) per petri-dish. Three concentrations were tested in three replications, along with over control (Benzene + emulsified water). To record the mortality, the spray petri-dishes were gently shaken under an electric fan till the liquid phase evaporated leaving behind a uniform dry film of insecticide on the glass surface. The spray tower was thoroughly rinsed with the insecticide solution. Ten larvae of known age were then released inside each pair of petri-dishes and allow remaining there up to two hours. After which, they were transferred to the fresh petri-dishes containing fresh food for feeding. These petri-dishes were kept as such under control conditions (27 $\pm$ 2ºC temp. 75 $\pm$ 5% relative humidity) and mortality count was taken after 6, 12, 24 hours of exposure.

For contact toxicity test, the fresh leaves of arhar, *Cajanus cajan* were taken from unsprayed field and washed thoroughly with tap water. The each leaf was dipped into desired concentration of each extract and dried under the fan, then kept them into petri-dishes (15 cm in diameter) separately. A control with Benzene + emulsified water was run simultaneously. Now, ten known healthy larvae and adults of bug were released into each petri-dishes after drying the extract of treated leaf. The mortality of the nymph and adult aphids were counted after 6, 12, 24 hours of the released. For the assessment of the toxic effect, the mortality counts were taken 6 hr, 12hr and.24hr. after treatment. In the mortality counts, both dead and moribund larvae were counted as dead, which could be easily distinguished from the living ones on examination with naked eyes or binocular microscope, where necessary and they showed no signs of life despite prodding's. The observed mortality of the larvae in the treatments was adjusted with mortality occurring in control by Abbott's formula (1925) [24]. In insecticidal test, the percentage mortality was converted into transformed back value. Thus data were subjected to statistical analysis of variance and comparison was made with the corresponding results obtained among their extracts and control.

Results and Discussion

Table 3: Mean Mortality of *Eucosma critica* Meyrick in case of different combination in laboratory condition:

Treatment	Concen-tration	Mean Mortality% After		
		6 hrs.	12 hrs.	24 hrs.
Ageratum conyzaides Linn..	0.5	54.78 (66.7)	61.22 (76.8)	71.56 (90.0)
Ageratum conyzaides Linn	0.1	83.85 (98.9)	77.70 (95.5)	83.85 (98.9)
Ageratum conyzaides Linn.	2.0	90.00 (100.0)	90.00 (100.0)	90.00 (100.0)
Argemone maxicana Linn.	0.5	52.77 (63.4)	59.00 (73.5)	63.44 (80.0)
Argemone maxicana Linn.	1.0	77.70 (95.5)	83.85 (98.9)	83.85 (98.9)
Argemone maxicana Linn.	2.0	83.85 (98.9)	90.00 (100.0)	90.00 (100.0)
Azadirachta indica A. Juss.	0.5	39.15 (39.9)	48.85 (56.7)	52.78 (63.4)
Azadirachta indica A. Juss.	1.0	48.85 (56.7)	52.78 (63.4)	59.01 (73.5)
Azadirachta indica A. Juss.	2.0	66.15 (82.3)	66.15 (82.3)	83.85 (98.9)
Arachis hypogea Linn.	0.5	0.00 (0.0)	23.85 (16.4)	35.21 (33.3)
Arachis hypogea Linn.	1.0	6.14 (1.1)	30.99 (26.5)	41.15 (43.3)
Arachis hypogea Linn.	2.0	18.44 (10.3)	41.15 (43.3)	59.00 (73.5)
*Brassica junce*a Linn.	0.5	37.22 (36.6)	43.77 (43.9)	45.00 (50.0)
Brassica juncea Linn.	1.0	41.15 (43.3)	46.92 (53.4)	48.84 (56.7)
Brassica juncea Linn.	2.0	54.78 (66.7)	56.79 (70.0)	59.00 (73.5)
Chenopodium ambrosioides L.	0.5	39.15 (39.9)	48.85 (56.7)	52.78 (63.4)
*Chenopodium ambros*ioides *L*	1.0	48.85 (56.7)	52.78 (63.4)	59.01 (73.5)
Chenopodium ambrosioides L	2.0	66.15 (82.3)	66.15 (82.3)	83.85 (98.9)

Mentha arvensis Linn.	0.5	23.85 (16.4)	43.07 (46.6)	52.77 (63.1)
Mentha arvensis Linn.	1.0	30.99 (26.5)	46.92 (53.4)	72.29 (89.7)
Mentha arvensis Linn.	2.0	41.15 (43.3)	66.14 (83.6)	90.00 (100.00)
Mentha longifolia Linn.	0.5	37.22 (36.6)	42.99 (46.5)	50.84 (60.1)
Mentha longifolia Linn.	1.0	41.15 (43.3)	48.84 (56.7)	59.00 (73.5)
Mentha longifolia Linn.	2.0	46.92 (56.7)	59.00 (73.5)	72.78 (91.2)
Ocimum basilicum Linn.	0.5	43.07 (46.6)	54.78 (66.6	50.00 (73.5)
Ocimum basilicum Linn.	1.0	53.77 (53.4)	68.85 (87.0)	50.00 (73.5)
Ocimum basilicum Linn.	2.0	59.00 (73.5)	83.85 (98.8)	90.00 (100.00)
Pongamia glabra Vent.	0.5	43.07 (46.6)	59.00 (73.5)	77.70 (95.5)
Pongamia glabra Vent.	1.0	48.84 (56.7)	66.14 (83.6)	83.85 (98.8)
Pongamia glabra Vent.	2.0	66.14 (83.6)	90.00 (100.00)	90.00 (100.00)
Ricinus communis Linn.	0.5	41.15 (43.3)	43.97 (46.6)	46.92 (53.4)
Ricinus communis Linn.	1.0	52.77 (63.4)	54.78 (66.7)	61.22 (76.8)
Ricinus communis Linn.	2.0	68.85 (87.0)	71.56 (90.0)	83.85 (98.9)
Endosulphan	0.002	43.07 (46.6)	59.00 (73.5)	77.70 (95.5)
Endosulphan	0.005	48.84 (56.7)	66.14 (83.6)	83.85 (98.8)
Endosulphan	0.007	66.14 (83.6)	90.00 (100.00)	90.00 (100.00)
Control (untreated)	00.00	00.00 (00.0)	21.14 (13.04)	07.04 (01.5)

(Figures within parenthesis represent in mean percentage transformed back value).

1. C.D. for controls Vs treated = 3.6441
2. C.D. for plant extracts means = 2.7737
3. C.D. for concentrations means = 1.2093
4. C.D. for period means = 1.2255

C.D. for plant extracts X Conc. means at the same period =10.1142

The analysis of variance in table 3 shows that the main effect of eleven edible and non-edible oils and endosulphan, concentrations and periods as well as "Control versus treated" in first order interaction "periods and concentrations". The second order interaction are more highly significant except the first order interaction "insecticide x concentration" and the Second order interaction" period x insecticide x concentration, which is non-significant. The effect of control Vs treatment is also significant at 0.5 per cent level of significance.

Table 4: Mean Mortality percentage of plant extract in to concentration for the *Eucosma critica* Meyrick under laboratory condition

S.No	Treatment	Mean	Mortality%	After	Mean
		6 hrs.	12 hrs.	24 hrs.	%
1.	*Ageratum conyzaides*	62.52 (78.7)	81.80 (98.0)	90.00 (100.0)	78.10 (95.8)
2.	*Arachis hypogea*	15.00 (6.7)	37.09 (36.3)	59.38 (74.0)	37.15 (36.5)
3.	*Argemone maxicana*	46.92 (53.4)	53.54 (64.7)	72.04 (90.5)	57.50 (71.1)
4.	*Azadirachta indica*	58.40 (72.5)	81.80 (98.0)	87.95 (99.8)	76.05 (94.2)
5.	*Brassica juncea*	41.76 (44.4)	85.64 (99.4)	56.86 (70.1)	61.42 (55.4)
6.	*Chenopodium ambrosioides*	64.64 (81.7)	75.57 (93.8)	80.00 (97.0)	73.40 (92.8)
7.	*Mentha arvensis*	32.00 (28.8)	52.04 (62.2)	71.69 (90.1)	51.91 (62.0)
8.	*Mentha longifolia*	41.76 (44.4)	50.28 (59.2)	60.88 (76.3)	50.97 (60.4)
9.	*Ocimum basilicum*	49.00 (57.0)	69.16 (87.3)	77.84 (90.3)	65.33 (82.6)
10.	*Pongamia glabra*	53.64 (64.9)	70.40m (88.8)	80.00 (97.0)	68.01 (86.0)
11.	*Ricinus communis*	60.00 (75.0)	71.88 (90.3)	77.95 (95.6)	69.94 (88.3)
12.	Endosulphan	52.69 (63.2)	77.71 (90.1)	83.85 (98.8)	71.41 (87.7)
13.	Control (Untreated)	00.00 (00.0)	00.00 (00.0)	21.14 (13.04)	07.04 (01.5)

(Figures within parenthesis represent in mean percentage the transformed back value).

1. C.D. for period means at the same plant extracts = 6.6944
2. C.D. for plant extract means at the same period = 5.8834

The table 4 reveals that indigenous plant oils of *Ageratum conyzaides* Linn. gave the best results when compared with the remaining seven selected naturally occurring plant extracts. The *Ageratum conyzaides* Linn. gave the 78.10 per cent larval mortality, which is followed by *Azadirachta indica* A. juss (76.05 per cent), *Chenopodium ambrosioides* Linn. (73.40 per cent), *Ricinus communis* Linn, (69.94 per cent), Endosulphan (71.41 per cent), *Pongamia glabra* Linn. (68.01 per cent), *Ocimum basilicum* Linn. (65.33 per cent), *Argemone maxicana* (57.50 per cent), *Mentha arvensis* Linn. (51.91 per cent), *Mentha longifolia* Linn. (50.97 per cent), *Brassica juncea* Linn. (61.42 per cent) and *Arachis hypogea* Linn. (37.15 per cent) etc.The plant extract of *Ageratum conyzaides* Linn. differs from significant remaining once except *Azadirachta indica*, whereas *Azadirachta indica*, Endosulphan, *Pongamia glabra*, *Ocimum basilicum*, *Argemone maxicana*, *Mentha arvensis*, *Mentha longifolia*., *Brassica juncea* and *Arachis hypogeal*, respectively. which, does not differ significantly to one another. *Arachis hypogea* proved least toxic giving only 36.5 per cent mortality of the larvae of *Eucosma critica* in the laboratory experiments.

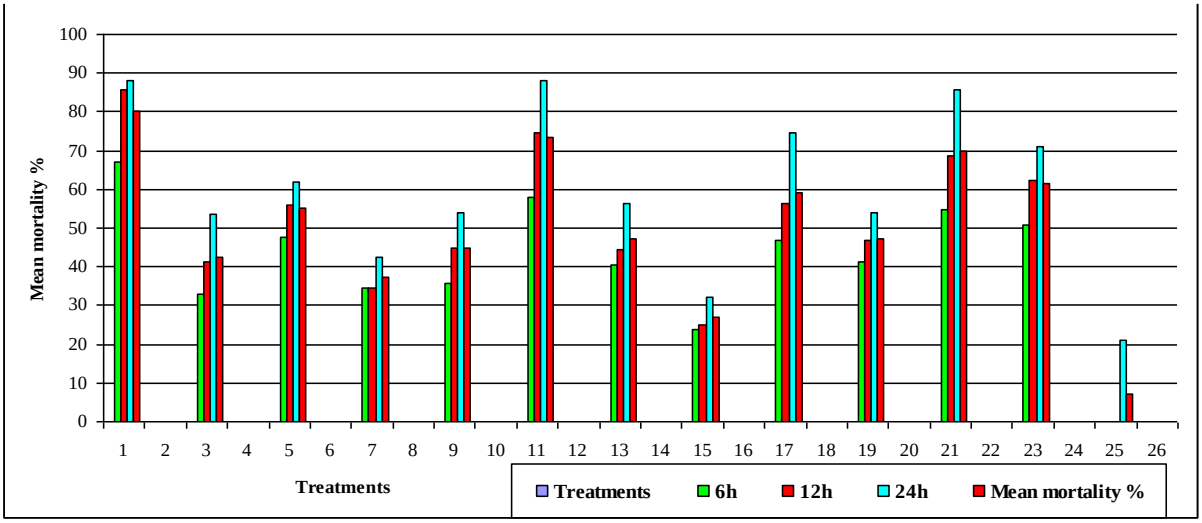

Fig 1: Mean mortality of E. *critica* in different exposure period irrespective of treatments

Table 5: Mean mortality of *Eucosma critica* in different exposure period irrespective of concentration

S.No	Treatments	Mean	Mortality%	After	Mean
		0.5/ 0.002%	1.0/ 0.005%	2.0/ 0.007%	%
1.	*Ageratum conyzaides*	67.05 (84.8)	85.91 (99.49)	87.95 (99.88)	80.30 (97.2)
2.	*Arachis hypogea*	33.04 (29.7)	41.21 (43.4)	53.55 (64.7)	42.6 (44.9)
3.	*Argemone maxicana*	47.59 (54.6)	55.9 (67.3)	61.78 (77.6)	55.09 (67.3)
4.	*Azadirachta indica*	34.56 (32.2)	34.35 (31.9)	42.55 (45.8)	37.15 (36.5)
5.	*Brassica juncea*	35.73 (34.1)	44.99 (49.9)	53.78 (65.1)	44.83 (49.7)
6.	*Chenopodium ambrosioides*	58.00 (72.0)	74.46 (92.9)	87.95 (99.88)	73.47 (92.0)
7.	*Mentha arvensis*	40.45 (42.1)	44.33 (48.9)	56.33 (69.3)	47.03 (53.6)
8.	*Mentha longifolia*	23.85 (16.4)	25.09 (18.0)	32.17 (28.4)	27.03 (20.7)
9.	*Ocimum basilicum*	46.97 (53.4)	56.19 (69.1)	74.64 (93.0)	59.26 (73.9)
10.	*Pongamia glabra*	41.09 (43.2)	46.95 (53.4)	54.01 (65.5)	47.35 (54.1)
11.	*Ricinus communis*	54.67 (66.6)	68.59 (86.7)	85.90 (99.49)	69.72 (88.0)
12.	Endosulphan	50.85 (60.2)	62.19 (78.2)	70.9 (88.4)	61.31 (77.0)
13.	Control (Untreated)	00.00 (00.0)	00.00 (00.0)	21.14 (13.04)	07.04 (01.5)

(Figures within parenthesis represent the transformed back value).

1. C.D. for period means at the same concentration = 4.0987
2. C.D. for concentration means at the same period = 3.1122

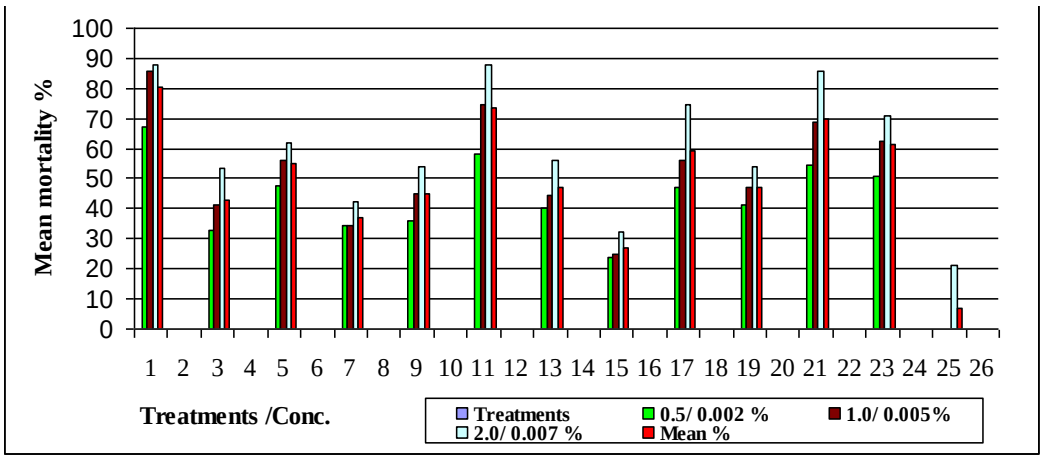

Fig 2: Mean mortality of E. *critica* in different exposure period irrespective of concentration

The table 5 indicated that overall mean concentration gave the 80.8 per cent mortality of third instar larvae of *Eucosma critica*. The table 5 also indicated that over all the three concentrations differ significantly from each other. The concentration 2.0 per cent is superior to concentration 1.0 and concentration 0.5 per cent of plant extracts. The concentration of 2.0 per cent killed the maximum percent (97.2 per cent) of third instar larvae of *Eucosma critica* followed by 1.0 per cent concentration (92.0 per cent) and 0.5 per cent (20.7 per cent) of larvae, respectively.

It was also observed that the difference in percentage of kill of larvae in concentration of 2.0 per cent and 1.0 per cent is greater than the difference in percentage of kill of larvae in 1.0 per cent and 0.5 per cent in all the three periods. The difference in percentage kill of larvae in period 24 hrs and 12 hrs is greater than the difference in percentage kill in period 12 hrs and 6 hrs in all the three concentrations.

Table 6: Mean Mortality percentage of *Eucosma critica* to different exposure periods, irrespective of treatments under laboratory conditions.

Treatments	*Groups*	Mean	*Mortality%*	After	*Mean*
		6 hrs.	12 hrs.	24 hrs.	
Plant oils and Endosulphan	G1	44.48 (49.1)	53.34 (64.4)	63.45 (80.1)	53.8 (64.0)
Control (untreated)	G2	00.00 (00.0)	00.00 (00.0)	21.14 (13.04)	07.0 (01.5)

(Figures within parenthesis represent mean percentage transformed back value)

1. C.D. for period means at control = 13.0055

2. C.D. for period means at treated = 02.4476

C.D. for control Vs treated at the same period = 08.4467

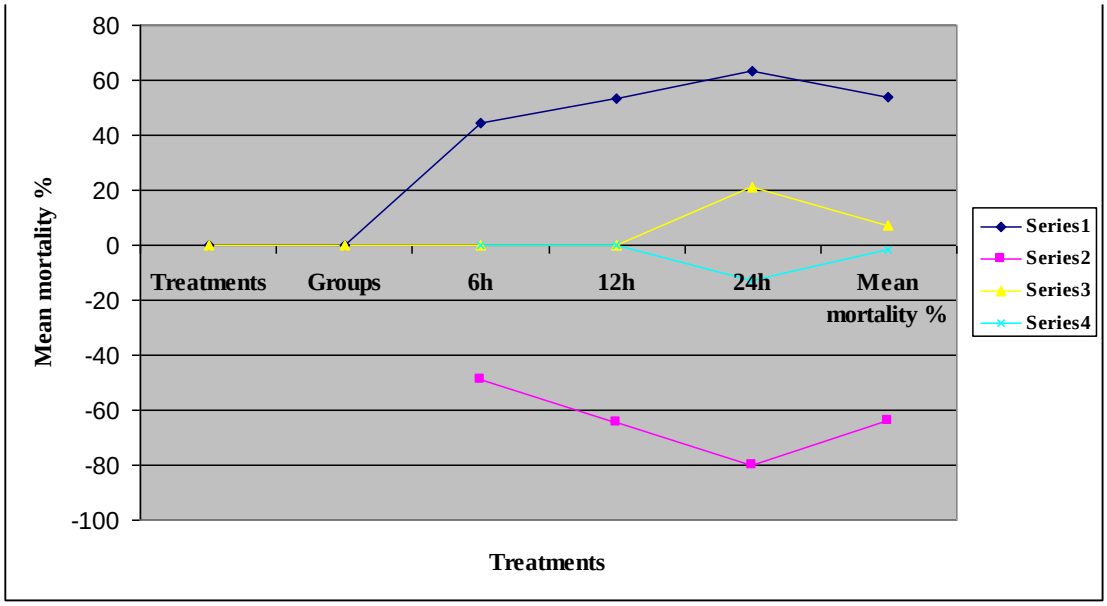

Fig 3: Mean mortality of E. *critica* of different exposure periods irrespective of treatments under laboratory conditions

The table 6 indicates that the maximum percentage of larvae killed was (80.1 per cent) after 24 hrs and minimum larval mortality percentage (64.0 per cent) after six hours. The period of 24 hrs is significantly superior to period of 12 hrs and 6 hrs periods in both control and plant oils.The overall effect of all the plant extracts in killing the larvae is greater than that of untreated control in all the three periods. Finally, it can be concluded on the basis of the table 6 that all the 11 plant extract and endosulphan are highly toxic to third instar larvae leaf webber, *Eucosma critica*. Among all the 11 plant oils and endosulphan, the rhizome extract of *Ageratum conyzaides* Linn. is the most toxic to the third instar larvae of *Eucosma critica* and placed at the top of the merit, whereas *Arachis hypogea* Linn. leaf extracts placed at the bottom of the merit of the insecticidal effectiveness all eleven selected plant oils and endosulphan.

Table 7: Analysis of variance table of mean mortality percentage of the larvae of *Eucosma critica* Meyrick in laboratory.

Source	D.F.	S.S	M.S.S.	F. Calculated Value
Replications	2	1548.2200	775.7764	31.7875
Control Vs treated	1	1981.2411	24912.0080	1020.7199***
Treatments (I)	11	16994.0300	1545.0041	633.3032***
Concentrations (C)	2	13075.7600	6537.8845	267.8759**
Insecticides X Concentrations	22	1724.2700	96.5578	3.9562**
Error (a)	72	1757.2550	24.4063	--
Total	98	37080.7761	-	-
Periods (Pd)	2	18593.3700	9296.8650	151.8029***
Pd. (Control Vs. Treated	2	1296.3193	649.6956	10.6178***
PeriodsX Treatments	22	1562.5633	71.0256	1.5973**
PeriodsX Concentrations	4	1400.5973	275.1490	4.4927**
Period X Conc. X Treatments	44	68.0556	09.4063	0.15312^{NS}
Error (b)	148	9067.1611	61.2431	--
Total	198	31988.0666	-	-

N.S. = Non significant
** = Significant at 0.1 level of significance
*** = Significant at 0.01 level of significance.

The finding of the present investigation revealed that extract of *Argemone Mexicana Azadirachta indica* and *Chenopodium ambrosioides* possesses remarkable insecticidal activity against 3rd instar larvae of *Ecosma critica*, Based on percentage reduction of larvae, the following order of mortality was observed- *Ageratum conyzaides* (78.10) > *Azadirachta indica* A. juss (76.05 per cent) > *Chenopodium ambrosioides* Linn. (73.40 per cent) > *Ricinus communis* Linn., (69.94 per cent) > Endosulphan (71.41 per cent) > *Pongamia glabra* Linn. (68.01 per cent)> *Ocimum basilicum*

Linn. (65.33 per cent)> *Argemone maxicana* (57.50 per cent)> *Mentha arvensis* Linn. (51.91 per cent)> *Mentha longifolia* Linn. (61.42 per cent)> *Brassica juncea* Linn. (55.4 per cent) > *Arachis hypogea* Linn. (37.15 per cent), respectively.

In the conformity of above insecticidal biopotency, the toxicity of extractives of *Argemone mexicana* was tested against 3rd instar larvae of *Ecosma critica* In our study mortality increased with increase in concentration at all the doses up to 24 hrs of exposure. Similar to the present investigation, several studies documented the insecticidal activity of *Argemone mexicana* on different pests. Malarvannan *et al*. (2008, 2008a) found that toxic properties of leaf crude extracts of *A. maxicana* against two lepidoptenan species, *Spodoptera litura* and *Helicoverpa armigera* [25].Majeed and Abidunnisa (2011) reported that ultra-low concentrations (0.5 to 0.80 g/cm2) of aqueous crude extracts from leaves of *Argemone mexicana* L. caused 80 to 96% repellency of adults of *T. castaneum* and the rice weevil *Sitophilus oryzae* (L.) at 1 h after application [26]. Kangade and Zambare (2013) conduvted a laboratory trial at 1.5 and 2.0 mL/kg concentrations of rice grains coated with *Argemone mexicana* leaf extracts were fed by the larvae of C. cephalonica and reported that up to 40% larval mortality observed [27].

Zeinab and Abou, (2015) showed the toxic effect of chloroform and methanol leaves and seeds crude extracts of *Argemone mexicana* against medically important vectors Cx. pipiens and Ae. Aegypti [28] Sharma *et al*., (2016) evaluated the effect of *Argemone mexicana* leaves extract of different solvents on gut of *Heliothis armigera* (Hub.) and after 24 and 96 hours of treatment *Heliothis armigera* showed severity of the damage of epithelial lining and epithelial cells with vacuoles at certain places [29].Ashwini *et al.*, (2017) found that the toxicity bioassay of *A. mexicana* extracts caused greater mortality on third instars larvae (LD50 = 5.33 mg-1) than *C. inerme* (LD50 = 7.26 mg-1). In many countries, plant derived products are being used by the farmers from ancient times and it triggered the scientists to search for eco-friendly insecticides from plant kingdom [30].

5. Conclusion

Bio-chemical substances may have anti-insect properties against insects. Based on this principle, botanical pesticides are invented and utilized for control of insect pests. Conclusively**,** *Ageratum conyzaides, Azadirachta indica* A. juss and *Chenopodium ambrosioides* Linn. showed strong insecticidal biopotency with 70 t0 to 100,00 per cent larval mortality. Keeping in view the imperative demand of safer plant protects and aiming to minimize the negative effects of pesticides, present study is undertaken to study the impact of plant extracts on control of 3rd instars larvae of *Eucosma critica.*

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7. References

1. Ayyar TVR. Pests of Pulses- *arhar* leaf and shoot folder (*Eucosma critica* M.). Handbook of Economic Entomology for South India, Govt. Press, Madras, 1963, 186-202.
2. Anonymous, Pest distribution and associated crop losses in piogeon pea. ICRISAT Annual Report 1977-78, Hyderabad (A.P.) India, 1978, 1(60).
3. Meyrick, E. Description of Indian Micro-leidoptera: Eucosmidae. *Eucosma ludicra NSP*. J Bom. Nat. Hist. Soc. 1912; 21(3):867.
4. Lal SS, Yadav CP, Dias CAR. Important Pests of Pulse Crops in India and their Management. AICPIP Regional Station, IARI, Kanpur. 1980; (2):1-9.
5. Singh RN, Singh KM. Succession of insect-pests in early varieties of red gram, *Cajanus cajan* (L.) Millsp. Indian J. Ent. 1978a; 40(1):1-6.
6. Singh RN, Singh KM. Succession of insect-pests in early varieties of red gram, *Cajanus cajan* (L.) Millsp. Indian J. Ent. 1978a; 40(1):1-6.
7. Loganatha M, Babu Sundara PC, Balasubramanian G. Efficacy of biopesticides against *Helicoverpa armigera* on chickpea (*Cicer arietinum*). I. J Ent. 2000; 62(1):53-59.
8. Malarvannan S, Senthil KS, Giridharan R, Nair S. Bioefficacy of *Argemone mexicana* against American bollworm, *Helicoverpa armigera* (Hubner), (Noctuidae: Lepidoptera). Hexapoda. 2008a; 15:49-55.
9. Bindra OS, Singh Harcharan. *Tur* pod fly, *Melanagromyza obtusa* Malloch. (Diptera: Agromyzidae)." Pesticides. 1972; 6(7):11-12 & 22.
10. Thobbi VV, Singh BU. Control of pod fly (*Melangromyza obtusa* Malloch) on pigeon pea (*Cajanus cajan* L. Millsp.) Pesticides. 1978; 12(5):23-24.
11. Pruthi HS. Eucosmidae- Other well known Indian species are *Eucosma critica* Meyr. (*tur* leaf caterpillar), *Enarmonia pseudonectis* Meyr. (Sunnhemp stem borer). Text book on Agricustural Entomology, ICAR, New Delhi, 1968, 410.
12. Srivastava OS. Chemical control of the *tur* leaf caterpillar, *Eucelis critica* Meyr. Indian J. Ent. 1974; 36(4):359-360.
13. Sinha MM, Yadav RP, Kumar A. Evaluation of some insecticides for the control of plum moth (*Exelastis atomosa* Walsche) and pod fly (*Melanagromyza obtusa* M.) on red gram, (*Cajanus cajan* L.) Pesticides. 1977; 11 (3):29-30.
14. Shetgar SS, Puri SN. Chemical control of pod borers infesting pigeon pea, *Cajanus cajan* L." Indian J. Pl. Prot. 1978; 6(i):45-47.
15. Fletcher TB. One hundred notes of Indian Insects. A new pest of *Arhar*. Agric. Res. Inst. Pusa Bull. 1916; 59:28.
16. Parshad B, Rao BRS. Records of some Hymenopterous parasites of *Eucosma critica* Meyrick (Lepidoptera: Eucosmisdae) from Uttar Pradesh. Indian J Ent. 1964; 26(4):462-463.
17. Patel NB, Patel JJ, Jayani DB, Patel JR, Patel BD. Bio efficacy of conventional insecticides against pests of *okra"*. Indian J. Ent. 1997; 59(1):51-53.
18. Brahmaprkash GP, Chandrapraksh J Ganeshaih Shanker. Pulse yields: Feedings the pulse". Current Science. 2004; 87(7):859.
19. Gupta HC, Verma JP, Bareth SS, Mathur BN. Evaluation of some non-edible oils as grain protectant in wheat and their subsequent effect on germination." Indian J. Ent. 1988; 50(2):147-150.
20. Makanjuola WA. Evaluation of extract of *neem, Azadirachta indica* A. Juss for the control of some stored product pests. J. Stored Product Research. 1989; 25(4):231-237.
21. Maredia KM, Segura OL, Mihm JA. Effects of neem, *Azadirachata indica*, on six species of maize insect pests.

Tropical Pest Management. 1992; 38(2):190-195.
22. Gbolade AA, Onayade OA, Ayinde BA. Insecticidal activity of *Ageratum conyzoides* Linn. volatile oil against *Callosobruchus maculatus* Fabr. in seed treatment and fumigation laboratory tests. Insect Sci. Applic. 1999; 19(2/3):237-240.
23. Lale NES. Mustapha Efficacy and acceptability of *neem*, *Azadirachta indica* A.Juss. seed oil and pirimiphos-methyl applied in three storage devices for the control of *Callosobruchus maculatus* Fabr. (Coleoptera: Bruchidae), *Zeitschrift Fuer Pflanzenkrankheiten Und Pflanzenschutz.* 2000; 107(4):399-405.
24. Abbot WS. A method of computing the effectiveness of an insecticide. J. Econ. Ent. 1925; 18:165-267.
25. Malarvannan S, Giridharan R, Sekar S, Prabavathy VR, Nair S. Bioefficacy of crude and fractions of *Argemone mexicana* against tobacco caterpillar, *Spodoptera litura* (Noctuidae: Lepidoptera). J Biopest. 2008; 1:55-62.
26. Majeed S, Abidunnisa T. Study on repellent activity of *Argemone mexicana* on *Tribolium castaneum* and *Sitophilus oryzae*. International Journal of Pharmaceutical Research and Development. 2011; 3:206-211.
27. Kangade YP, Zambare SP. Effect of extracts of *Argemone mexicana* leaves on the development of *Corcyra cephalonica* (Stainton) for the protection of the stored grains. Indian Journal of Applied Research. 2013; 3:20-22.
28. Zeinab S, Abou E. Strong larvicidal properties of *Argemone mexicana* L. against medically important vectors Culex pipiens and Aedes aegypti. Int. J. Mosq. Res. 2015; 2:09-12.
29. Sharma CT, Patil GP, Sharma NS, Zambare SP. Effect of *Argemone mexicana* Leaves Extract at Different Solvents on Gut of *Heliothis armigera* (Hub) Int. J Life. Sci. Scienti. Res. 2016; 2(3):293-296.
30. Ashwini Devarshi A, Yankanchi SR. Ovicidal and toxic effects of certain plant extracts to the castor semilooper, *Achaea janata* L. (Noctuidae: Lepidoptera) Indian J Agric. Res. 2017; 51(4):345-349