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Rajani
Biorational Laboratory, Department of Zoology, D.B.S. College, Affiliated to CSJM University, Kanpur, Uttar Pradesh, India

Corresponding Author:
Rajani
Biorational Laboratory, Department of Zoology, D.B.S. College, Affiliated to CSJM University, Kanpur, Uttar Pradesh, India

Assessment and prospects of toxicological potential of naturally occurring extractives in the management of leaf Webber, *Eucosma critica* Meyrick (Lepidoptera: Eucosmidae) in agro ecosystem

Rajani

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Abstract
A field experiment was conducted to test the toxicological bioefficacy of three plant extract namely: *Ageratum conyzoides* Linn., *Argemone mexicana* Linn., *Arachis hypogea* Linn.and one synthetic chemical were worked out against third instar larvae of *Eucosma critica* Meyrick under field conditions. The observations were taken constantly to record the food plants and other alternate host plants of *Eucosma critica* Meyrick. It was observed that *arhar, Cajanus cajan* (L.) Millsp., is the only host plant of *Eucosma critica* Meyrick. The *Ageratum conyzoides* Linn. gave the 80.18 per cent larval mortality, which is followed by, Endosulfan (64.62 per cent), *Argemone mexicana* (42.33 per cent) and *Arachis hypogea* Linn. (28.51 per cent) were found to be significant, when compared to control. It was obvious from the results that reduction of third instar larvae was very high, when treated with *Ageratum conyzoides* Linn. Followed by Endosulphan, *Argemone mexicana* Linn. and *Arachis hypogea* Linn. were found to be significant, when compared to control and other three selected plant oils and endosulfan.

Keywords: *Ageratum conyzoides, Cajanus cajan, Eucosma critica*

1. Introduction
Pigeon pea (*Cajanus cajan* (L.) Millsp.), commonly known as red gram or tur or Arhar, is a very old crop of this country. After gram, arhar is the second most important pulse crop in the country (Ayyar, 1963) [1]. *Cajanus cajan* is the most important grain legume crop of rain-fed agriculture in semi-arid tropics. It is both a food crop and a cover and forage crop with high levels of proteins and important amino acids like methionine, lysine and tryptophan. This biological activities of the compounds isolated, pharmacological actions and clinical studies of *C. cajan* extracts apart from its general details. The *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) [2].

Our country accounts pigeon pea for about 85.0 per cent of total supply in the world and red gram, *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) [4].In India, More than 80% of tur production comes from Maharashtra, Uttar Pradesh, Madhya Pradesh, Karnataka, Gujarat, Andhra Pradesh, Tamil Nadu and Bihar are the major growing states.

Farmers grow it in various production systems as a mixed crop, intercrop or as a perennial crop using long established traditional practices (Chauhan, 1990) [5]. It has been grown in some traditional cropping systems since centuries buthas been incorporated into several others only in the last two decades (Bindra and Singh, 1967) [6].

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) [7]. 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) [8, 9].

Pigeonpea (*Cajanus cajan* (L.) Millsp.) is attack by a large number of insect-pests, namely, Pod Borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuida) [10, 11], Leaf Webber, *Eucosma* (*Grapholita*) *critica* Meyr. (Lepidoptera: Eucomiidae) [12], Spotted pod borer *Maruca testulalis* (Geyer) (Lepidoptera: Pyralidae) [13], Pigeonpea Pod Fly, *Melanagromyza obtusa* (Malloch) (Diptera: Agromyzidae), Pod sucking Bugs, *Clavigralla gibbosa* Spinola *Clavigralla scutellaris* West wood), *Clavigralla tomentosicollis* Stal. *Riptortus dentipes* F. *Anoplocnemis curvipes* (Fabricius) (Hemiptera: Coreidae) *Nezara viridula* (L.) (Hemiptera: Pentatomidae), Plume moth complex, *Exelastis atomosa* (Walsingham) *Sphenarches anisodactylus* Wlk. (Lepidoptera: Pterophoridae), *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) [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]. Prashad 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 (Nair) [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, use of plant products in the management of this noxious insect-pest (Koul 1987, Gbolade *et al*. 1999, Joshi and Lockwood, 2000) [18, 19, 20, 2, 21]. 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 biodegradable nature[

2. Material and Methods

The insecticidal properties of eleven edible and non-edible oils and one synthetic insecticide namely: *Ageratum conyzoides* Linn., *Argemone mexicana* Linn., *Arachis hypogea* Linn., and Endosulphan were worked out against third instar larvae of *Eucosma critica* Meyrick under field conditions and the results are discussed as under:

The observations were taken to record the food plants and other alternate host plants of *Eucosma critica* Meyrick. It was observed that *arhar*, *Cajanus cajan* (L.) Millsp., is the only host plant of *Eucosma critica*. Thus, it appears that this is the specific pest of *arhar*, *Cajanus cajan*.

A contact toxicity trial was introduced to test the insecticidal properties of selected plant extract and endosulfan in three concentrations under field conditions affiliated to the Department of Zoology, D.B.S. College and field of the farmer of Fattepur village Kanpur. All the three concentrations (0.5/0.002, 1.0/0.005 and 2.0/0.007 percent) of each selected eleven selected plant oils and endosulan were sprayed on arhar plants (plots) and control plot were untreated and sprayed with emulsified water only. After treatment, the number of third instars twenty-four hours starved larvae of *Eucosma critica* Meyrick. Remained in each plot were released selected plant and were tagged for the recognition of the observation and covered by net to protect the larvae either coming or going from outside. The number of larvae/leaf/plot was recorded before spraying. Observations on mortality were recorded after 24 hrs, 48 hrs and 72 hrs of the spraying. Thus, the percentage reduction in larvae population considered for assessing the efficacy of treatment. The percentage reduction in larvae was converted into angular values (sin √ %). The data were statistically analyzed like that of laboratory experiments. (Abbott,1025) [22].

3. Experimental Findings

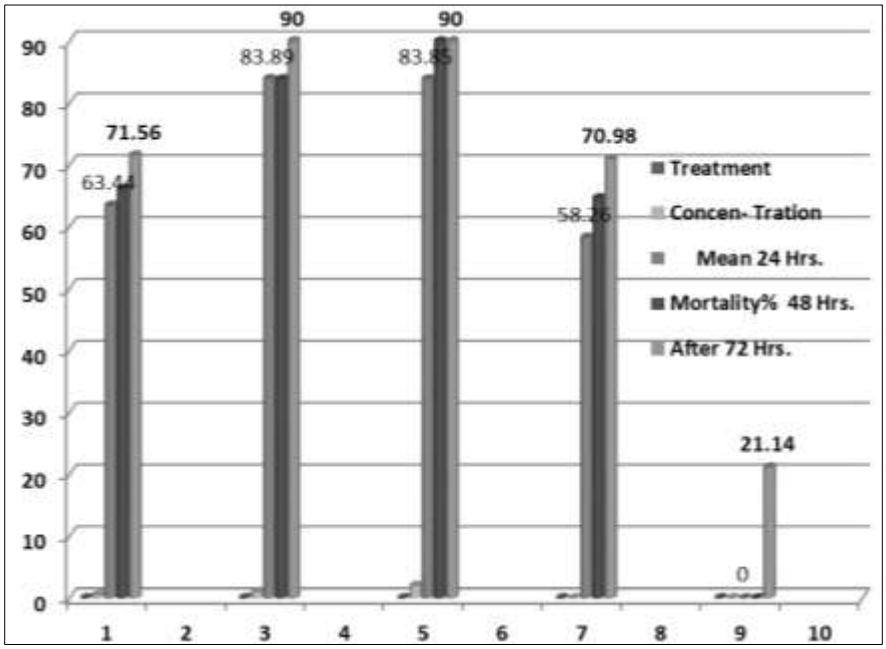

Fig 1: Mean Mortality of *Eucosma critica* Meyrick in case of different con of *Ageratum conyzoides* Linn under field condition

Table 1a: Mean Mortality of *Eucosma critica* Meyrick in case of different combination in field condition:

S. No.	Treatment	Concentration	Mean	Mortality %	After
			24 Hrs.	48 Hrs.	72 Hrs.
1a	*Ageratum conyzoides* Linn.	0.5	63.44	66.15	71.56
1b	*Ageratum conyzoides* Linn.	1.0	83.89	83.85	90.00
1c	*Ageratum conyzoides* Linn.	2.0	83.85	90.00	90.0
1d	Endosulfan	Endosulfa	58.26	64.64	70.98
1e	Control	Control	00.00	00.00	21.14

Table 1b: Mean Mortality of *Eucosma critica* Meyrick in case of different con of *Argemone maxicana* Linn. Linn under field condition

S. No.	Treatment	Concentration	Mean	Mortality%	After
			24 Hrs.	48 Hrs.	72 Hrs.
1a	*Ageratum conyzoides* Linn.	0.5	80.0	83.7	90.0
1b	*Ageratum conyzoides* Linn.	1.0	98.9	96.9	100
1c	*Ageratum conyzoides* Linn.	2.0	98.9	100	100
1d	Endosulfan	Endosulfa	72.3	81.7	89.4
1e	Control	Control	0	0	13.0

Table 2: Mean Mortality of *Eucosma critica* Meyrick in case of different con. *Argemone mexicana* Linn in field condition:

S. No.	Treatment	Concentration	Mean	Mortality%	After
			24 Hrs.	48 Hrs.	72 Hrs.
1a	.*Argemone mexicana* Linn.	0.5	63.44	66.15	71.56
1b	*Argemone mexicana* Linn.	1.0	83.89	83.85	90.00
1c	*Argemone mexicana* Linn.	2.0	83.85	90.00	90.0
1d	Endosulfan	Endosulfa	58.26	64.64	70.98
1e	Control	Control	00.00	00.00	21.14

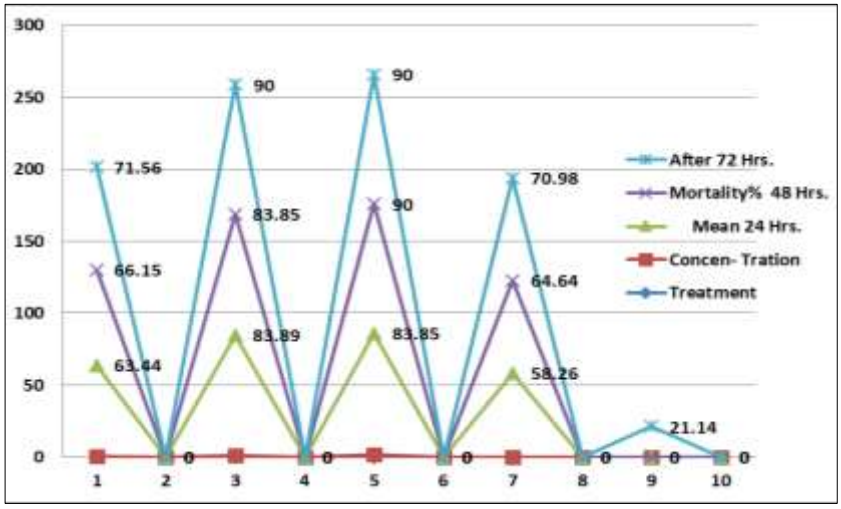

Fig 1b: Mean Mortality of *Eucosma critica* Meyrick in case of different con of *Argemone mexicana* Linn. Linn under field condition

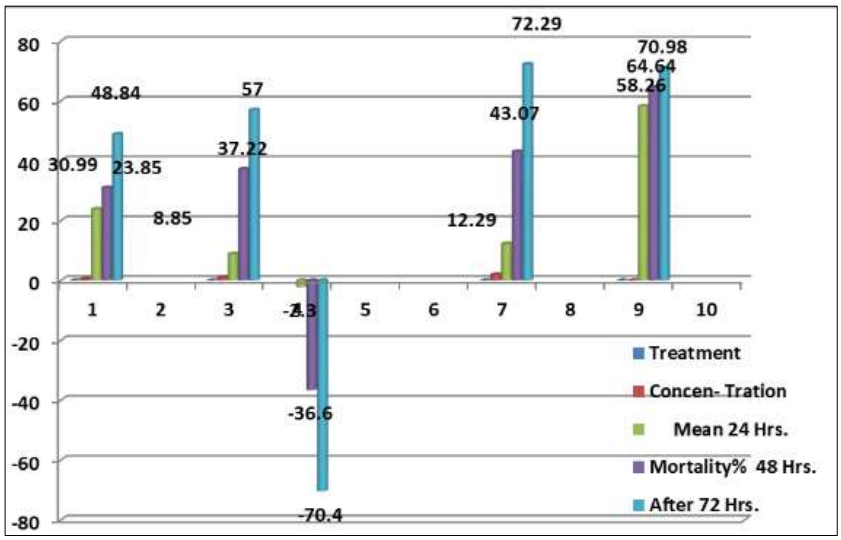

Fig 2: Mean Mortality of *Eucosma critica* Meyrick in case of different con. of *Ageratum conyzoides* Linn under field condition

Table 2a: Mean Mortality of *Eucosma critica* Meyrick in case of different con. *Argemone mexicana* Linn in field condition

S. No.	Treatment	Concentration	Mean	Mortality%	After
			24 Hrs.	48 Hrs.	72 Hrs.
1a	.*Argemone mexicana* Linn.	0.5	80.0	83.7	90.0
1b	*Argemone mexicana* Linn.	1.0	98.9	96.9	90
1c	*Argemone mexicana* Linn.	2.0	98.9	90.00 (100.0)	100
1d	Endosulfan	Endosulfa	72.3	81.7	89.4
1e	Control	Control	0	0	13.0

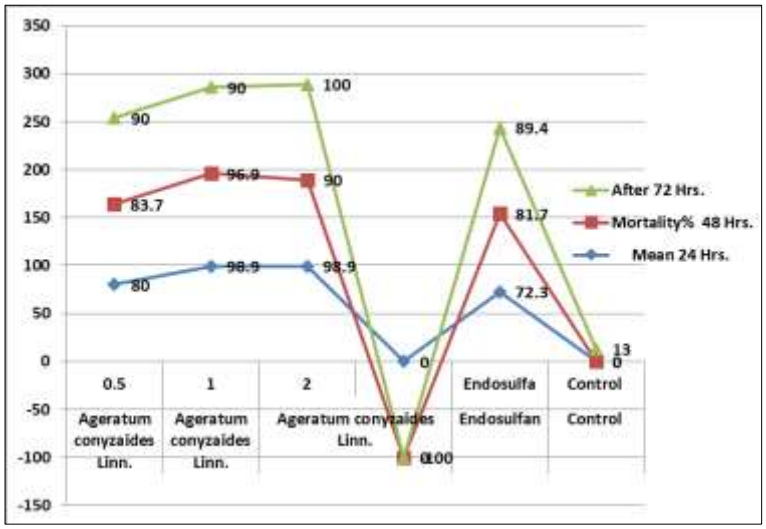

Fig 3: Mean Mortality of *Eucosma critica* Meyrick in case of different con. *Argemone mexicana* Linn in field condition:

Table 2b: Mean Mortality of *Eucosma critica* Meyrick in case of different combination in field condition:

S. No.	Treatment	Concentration	Mean	Mortality%	After
			24 Hrs.	48 Hrs.	72 Hrs.
2a	*Argemone mexicana* Linn.	0.5	15.00 (6.7)	37.22 (36.6)	46.92 (53.4)
2b	*Argemone mexicana* Linn.	1.0	23.85 (60.4)	45.00 (50.0)	54.78 (66.6)
2c	*Argemone mexicana*Linn.	2.0	30.99 (26.5)	54.66 (66.5)	75.00 (93.3)
2d	Endosulfan	Endosulfa	58.26 (72.3)	64.64 (81.7)	70.98 (89.4)
2e	Control	Control	00.00 (00.0)	00.00 (00.0)	21.14 (13.04)

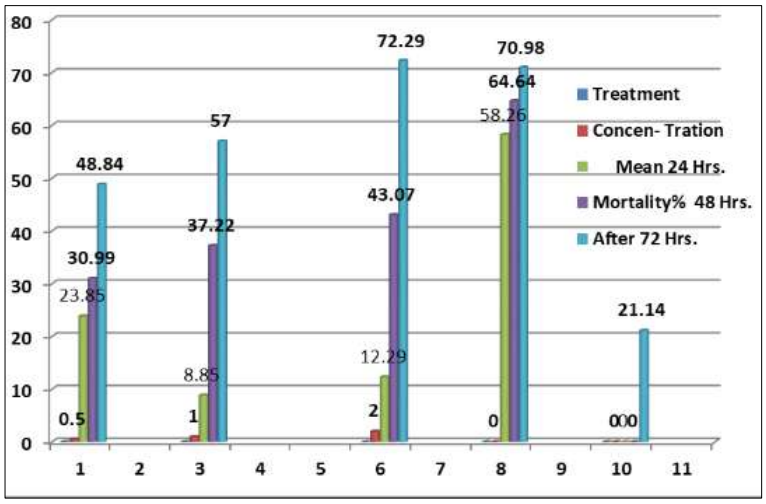

Fig 4: Mean Mortality of *Eucosma critica* Meyrick in case of different con. *Arachis hypogea* Linn. in field condition

Table 3: Mean Mortality of *Eucosma critica* Meyrick in case of different con. *Arachis hypogea* Linn. in field condition:

S. No.	Treatment	Concentration	Mean	Mortality %	After
			24 Hrs.	48 Hrs.	72 Hrs.
3a	*Arachis hypogea* Linn.	0.5	23.85	30.99	48.84
3b	*Arachis hypogea* Linn.	1.0	8.85	37.22	57.00
3c	*Arachis hypogea* Linn.	2.0	12.29	43.07	72.29
3d	Endosulfan	Endosulfa	58.26	64.64	70.98
3e	Control	Control	00.00	00.00	21.14

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

S. No.	Treatment	Concentration	Mean	Mortality%	After
			24 Hrs.	48 Hrs.	72 Hrs.
3a	*Arachis hypogea* Linn.	0.5	16.4	56.5	57.7
3b	*Arachis hypogea* Linn.	1.0	2.3	36.6	70.4
3c	*Arachis hypogea* Linn.	2.0	4.5	46.6	99.7
3d	Endosulfan	Endosulfa	72.3	81.7	89.4
3e	Control	Control	0	0	13.0

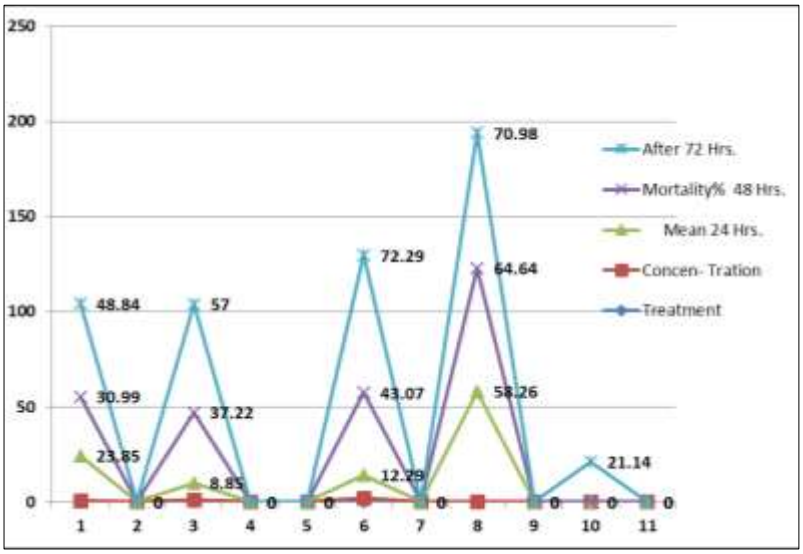

Fig 5: Mean Mortality of *Eucosma critica* Meyrick in case of different con of *Arachis hypogea* Linn in field condition:

Table 3b: Mean Mortality of *Eucosma critica* Meyrick in case of different exposure period irrespective of concentration under the Field condition.

S. No	Treatment	Mean	Mortality%	After	Mean mortality %
		24 hrs.	48 hrs.	72 hrs.	
1.	*Arachis hypogea* Linn	77.05	80.00	83.5	80.18
2.	*Arachis hypogea* Linn	23.28	45.63	58.09	42.33
3.	*Arachis hypogea* Linn	08.41	32.00	45.12	28.51
	Endosulfan	58.26	64.64	70.98	64.62
	Control	00.00	00.00	21.14	07.04

C.D. for period means at the same plant extracts = 7.0012
C.D. for plant extract means at the same period = 6.4000

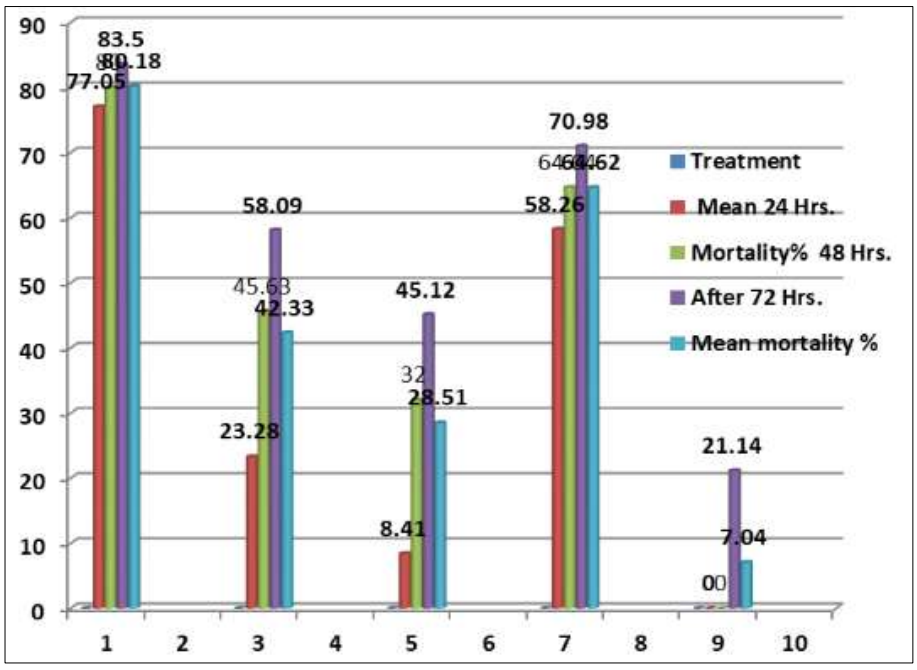

Fig 6: Mean Mortality of *Eucosma critica* Meyrick in case of different con. of extracts in field condition

Table 4: Mean Mortality of *Eucosma critica* Meyrick in case of different exposure period irrespective of concentration under the Field condition.

S. No	Treatments	Mean Mortality%		After	Mean mortality %
		24 Hrs.	48 Hrs.	72 Hrs.	
1.	*Ageratum conyzoides* Linn.	95.0	97.0	98.9	97.1
2.	*Argemone mexicana* Linn.	15.6	51.1	72.0	42.3
3.	*Arachis hypogea* Linn.	2.1	28.1	50.2	22.8
	Endosulfan	72.2	81.7	89.4	81.7
	Control	0	0	13.0	1.5

(Figures within parenthesis represent the transformed back value).

1. C.D. for period means at the same concentration = 4.9860
2. C.D. for plant extract means at the same period = 3.7022

The data depicted from the results that mean mortality percentage of third instar larvae of *E. critica* gave the best results when compared with the remaining two selected naturally occurring plant extracts.

The *Ageratum conyzoides* Linn. gave the 80.18 per cent larval mortality, which is followed by, Endosulfan (64.62 per cent), *Argemone mexicana* (42.33 per cent) and *Arachis hypogea* Linn. (28.51 per cent) were found to be significant, when compared to control.

The insecticide *Ageratum conyzoides* differs from significant remaining once except endosulfan whereas *Argemone mexicana* and *Arachis hypogea* Linn. which does not differ significantly to one another. *Arachis hypogea* Linn. proved least toxic giving only 28.51 per cent mortality of the larvae of *Eucosma critica* Meyrick. in the field experiments.

The 4 and figure 7 reveals that indigenous plant extract of *Ageratum conyzoides* Linn. gave the best results based on their transform back values, when compared with the remaining seven selected naturally occurring plant extracts. The *Ageratum conyzoides* Linn. gave the (97.1 per cent) larval mortality, which is followed by endosulfan (81.7 per cent),*Argemone mexicana* (42.3 per cent), and *Arachis hypogea* (22.8 per cent) etc. The insecticide *Ageratum conyoaides* differs from significant remaining once except Endosulfan, which does not differ significantly to one another *Arachis hypogea* proved least toxic giving only 22.8 per cent mortality of the larvae of *Eucosma critica* Linn. in the field experiments.

4. Result and Discussion

The depicted from the findings that *Ageratum conyzoides* Linn. gave the 80.18 per cent larval mortality, which is followed by, Endosulfan (64.62 per cent), *Argemone mexicana* (42.33 per cent) and *Arachis hypogea* Linn. (28.51 per cent) were found to be significant, when compared to control.

The insecticide *Ageratum conyzoides* differs from significant remaining once except endosulfan whereas *Argemone mexicana* and *Arachis hypogea* Linn. which does not differ significantly to one another. *Arachis hypogea* Linn. proved least toxic giving only 28.51 per cent mortality of the larvae of *Eucosma critica* Meyrick. in the laboratory experiments.

Over all the mean mortality percentage of larvae of of *Eucosma critica* of all the plant extracts at their mean concentration 0.2 percent, 1.0 per cent and 0.5 percent are differ significantly to one another.

In the conformity of above findings many workers as [Chandel *et al.* 2001, Dubey, *et al.* 2004, koul. 2004, Bajpaiand Chandel, 2009, Trivedi and Chandel, 2010) reported contact toxicity of many botanicals exihibiting condiderable insect toxicity [27, 28, 20, 30, 31]. Evaluation reported potential insecticidal bioefficacy of neem, *Azadirachta indica*, *Argemone mexicana* towards stored grain insect pest, house hold and crop pest reported by Majeed and Abidunnisa, 2011 on *Tribolium castaneum* and *Sitophilus oryzae* [32]. Kangade and Zambare 2013 reported insecticidal effectiveness of leaves extract of *Argemone mexicana* in the management of Corcyra cephalonica (Stainton) grain under stored condition [33]. Similarly, Zeinab and Abou, 2015 found strong larvicidal properties of *Argemone mexicana* L. against *Culex pipiens* and *Aedes aegypti* [34].

5. Conclusions

Finally, it can be concluded that *Ageratum conyzoides* plant extracts and one synthetic insecticide are highly toxic to third instar larvae leaf webber, *Eucosma critica*. Among all the three plant extracts, rhizome extract of *Ageratum conyzoides* is the most toxic to the third instar larvae of *Eucosma critica* and placed at the top of the merit, whereas *Arachis hypogea* extracts placed at the bottom of the merit of the insecticidal effectiveness all selected plant extracts. These plant origin insecticides are very cheap easily, available, safe and negligible hazardous to the human being.

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