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Laboratory assessment of *Annona reticulata* Linn. (Annonaceae), *Pongamia glabra* Vent. (Fabaceae) and *Piper nigrum* Linn. (Piperaceae) against Bihar hairy caterpillars, *Spilarctia obliqua* Walker (Lepidoptera: Arciitidae)

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Abstract
Labiratory experiment was conducted to evaluate comparative bio-efficy of certain naturally occurring indigenous plant extracts against destruction of Bihar hairy caterpillars, *Spilarctia obliqua* Walker (Lepidoptera: Arctiidae) under mustard agroecosystem. The unripe fruits of *Annona retoculata* Linn. (Annonaceae), leaves of *Pongamia glabra* Vent.(Fabaceae), arial parts of *Lantana camara* Linn. (Fabaceae), leaves of *Piper nigrum* Linn (Piperaceae) were collected from Kanpur region. The collected plant materials were dried in shade, make them powder farm and extracted them with the help of soxhlet apparatus using alcohol as solvent. From stock solution different concentrations (0.5, 1.0 and 2.0 per cent) were prepared from each plant extract. Three treatments were used and each treatment with three replication were introduced. The data were dipected from results that unripe fruits extract of *Annona reticulata* showed maximum larval mortality 67.90 per cent and placed at top followed by *l*eaves of *Pongamia glabra* 66.80 per cent, leaves extract of *Piper nigrum* Linn 62.62 per cent larval moratality, whereas extract of *Lantana camara* gave only 50.57 per cent larval mortality to the Bihar hairy caterpillars, *Spilarctia oblique* Walker under laboratory conditions.

Keywords: *Spilarctia oblique, Annona reticulata, Pongamia glabra, Piper nigrum*

1. Introduction
Rapeseed-mustard (Brassica sp.) is a major group of oilseed crop of the world being grown in 53 countries across the six continents, with India being the third largest producer after China and Canada (FAO 2009) [1]. It is also important rabi oilseed crop of West Bengal cultivated in about 410.793 thousand ha with total production of about 419.58 thousand tones and average productivity of 1021 kg/ha (Anon 2011) [2]. Among various biotic factors responsible for reducing the yield of rapeseed-mustard, insect pests are the major one. Thirty eight insect pests are known to be associated with rapeseed-mustard crop in India (Bakhetia & Sekhon 1989) [3].

Among them mustard aphid, Lipaphis erysimi (Kalt.) is the key pest in all the mustard growing regions of the country. The Bihar hairy caterpillars, *Spilarctia obliqua* Linn. Eat the leaves resulting into very poor yield. Lipaphis erysimi causes 35.4 to 96 % yield loss, 30.9 per cent seed weight loss and 2.75 per cent oil loss (Bakhetia and Sekhon 1989, Singh and Premchand 1995) [4, 5, 6]. In view of combating the notorious pest, the present investigation was undertaken to study the incidence and management of mustard aphid (Awasthi, 2002) [7].

Mustard belongs to the family of Brassica. Mustard is a tall Mediterranean plant that can grow 5- to 6 1/2-foot tall. Mustard are very widely cultivated throughout the world. Mustard seed is the third leading source of vegetable oil in the world after Soya bean oil and palm oil. It is world's second-leading source of protein meal after soybean meal. Mustard seeds oil content varies from 33% to 46% and average oil recovery is around 32% to 38%. After oil extraction, the remaining part of the seed is used to produce a rapeseed/mustard meal, an important source of cattle and poultry feed.

In India, and asian countries, mustard is popularly used in Indian cooking. India is number one in production of mustard oil mustard gives edible oil which is used as cooking in world over mustard seed is used as condiment in the preparation of vegetable and curries. India mustard varieties grown in India, world mustard seed production is about 530000 metric tons per year. Most of this production is destined as condiment and spice trade while Canada is the largest producer and also the biggest exporter of seeds.Trade in mustard seeds represent 0.0015% of total world trade. mustard seeds are a part of other oily seeds. exports in 2021 the top exporters of mustard seeds were canada ($95 m), russia ($71.5 m), germany ($31.1m), india ($28.2 m), and poland ($15.2 m).

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A large number of insect-pests as Bihar hairy caterpillar *Spilarctia obliqua* Walk [8, 9, 10]. cabbage butterfly, *Pieris brassicae* Linn. tobacco caterpillar, *Spodoptera litura* Fabr., mustard aphid, *Lipaphis erysimi* Kalt. [11], painted bug, *Bagrada cruciferarum* Kirk. Diamond backmoth, *Plutella xyllostella* Linn. [12], mustard sawfly, *Athalia proxima* Klug., cabbage borer, *Hellula undalis* Fabr., cabbage semilooper, *Trichoplusia ni* Hub., cabbage semilooper, *Trichoplusia ni* Hub., cabbage semilooper, *Trichoplusia ni* Hub., mustard aphid, (*Lipaphis erysimi* Kalt., *Brevicoryne brassicae* Linn. and *Myzus persicae* Sulzer) and cabbage leaf webber *Crocidolomia binotalis* Zell. are limiting factors of crops and vegetables [13, 14]. Among them, Bihar hairy caterpillar, *Spilarctia obliqua* Walk.) (Lepidoptera: Arctiidae) is the most damaging pest of vegetable and crops [15, 16].

The insect-pests destroy more than one-third of the world's mustard production and this heavy crop losses global level can be successfully dealt with only through the intensive use of the pesticides (Butani and Verma 1976, Butani *et al.*`1977, [17, 18]. If pesticides are not used, the graph of the crop losses may rise to 50.0 per cent and even more in the developing countries (Golob and Webley 1980,) [19]. In India, in inflicts huge losses to early and late sown cauliflower and mustard. The pest is distractive in its larval stage (Chen and Chang, 1996) [20].

The synthetic insecticides are employed in the management of insect-pest on crops bearing direct hazardous adverse effects on humans, wildlife, aquatic life and the environment at large. However, there are concerns about the use of pesticides, because of their negative effects on the environment and human health (Yuan *et al.*, 2014) [21].

Biorational herbal extractives are currently recognized as biodegradable, systemic, eco-friendly and nontoxic to mammals and are thus considered as safe alternatives (Ali *et al.*1983, Pascual *et al.*1990, Sarup, and Srivastava 2001) [22, 23, 24].

Insecticidal activities of certain neem, *Azadirachta indica* A. Juss extractives, products and derivatives on larvae of E. vittella was reported (Sharma *et.al.*1980, Raghuraman and Singh 1999, El and El, 2000,) [25, 26, 27]. Oil extracted from various materials was used in the tropics as a dressing for livestock to control blowfly. Biopotency of plant extracts were reported by Gahukar, 2000 [28].

However, in his study, plant extracts taken like *Annona reticulata* Linn. (Annonaceae), *Pongamia glabra* Vent. (Fabaceae), *Lantana camara* Linn. (Fabaceae), and *Piper nigrum* Linn (Piperaceae for study were not tested against third instars larvae of *S. obliqua*. Hence, the present studies were undertaken in the field trials to study, the relative insecticidal efficacy of three plant extracts, one synthetic chemical (endosufan0 against third instar larvae of Bihar hairy caterpillar, *Spilarctia obliqua* Walker on mustard under laboratory condition.

2. Materials and Method

2.1 Plant Materials collection and powder preparations: The collected plant parts from cultivated fields of the farmers and wild areas from Kanpur region. The laboratory processing take place at the Zoology, D.B.S. College affiliated to C.S.J.M. University, Kanpur. The collected four types plant materials like unripe fruits of custard apple, *Annona reticulate* Linn. (Annonaceae), Karanj, *l*eaves of *Pongamia glabra* Vent. (Fabaceae), arial parts of ariappl, *Lantana camara* Linn. (Verbanaceae), leaves of Black Pepper, *Piper nigrum* Linn (Piperaceae) were shade dried and make them powder.

2**.2 Extraction Process**: The powder were passed through a 30-mesh sieve and kept in polythene bags at room temperature and properly sealed to prevent quality loss. For the extraction, Soxhlet Apparatus was used; about 20g powder of each category was extracted with 300ml of alcohol and distilled water). Extractions of each category of powder were done in about 12 hrs. 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. 2.4 Preparation of Stock Solution and

2.3. Formulations

50ml. extract in each case was taken into reagent bottles and 50ml. benzene was added in it to dissolve the constituents of the selected plant materials. The mouth of the bottles were stopper with airtight corks after which, these bottles containing the solutions were kept in refrigerator. The alcoholic extracts of Aforementioned were tested under laboratory against third instar larvae of D. obliqua, which is noxious insect pest of okra vegetables and crop. Three concentrations of plant extractives (0.5, 1.0, and 2.0 percent) were used for experiments on insecticidal tests in the field conditions. The different concentrations of the herbal extracts were prepared from the stock solution using benzene as solvent and Triton X-100 as emulsifier. The level of solvent and emulsifier were kept constant. 2.5 Apparatus used for experiment: More than one hundred glass petridishes (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 petridishes.

2.4 **Collection of Bihar hairy caterpillar and rearing** Bihar hairy caterpillar, *Spilarctia obliqua* Walker were obtained from the mustard experimental farmers' fields of ekghra village, Kanpur Nagar and maintained in the laboratory on natural diets. The collected larvae were kept for at least 2 days in the laboratory to check, whether or not, there are any other infections before using them for experiments. *Spilarctia obliqua* required for the study were mass reared on cruciferous leaves in the laboratory. The mass culturing was initiated by confining 10 larvae of *Spilarctia obliqua* 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 D. obliqua larvae was done at 28±2 ºC temperature in the plastic container and observed daily.

3. Experimental Protocol

Laboratory experiment was conducted to the insecticidal effect of four extractives *viz*; *A. squamosa P. glabra L. camara P. nigrum* against third instars larvae of *Spilarctia obliqua*, which are noxious insect pest of mustard vegetables and crop. For testing the insecticidal effect the mustard leaves were used as food against the third instar larvae of *Spilarctia obliqua* treated with different concentrations of four selected extractives insecticides under laboratory trials. The treated foods per perti-dish was covered with muslin cloths. Then 10 third instar, 24 hours starved larvae of *S. obliqua* were released in each set of extract and one control was introduced under laboratory trials. For control set the leaves were sprayed with Benzene + emulsified water only. After 6hrs, 12hrs.and 24hrs. hours of the release of larvae, the data was taken on the number of larvae dead at each treated set of perti-dish. Three replication of treatment were made. The insecticidal effect of each the plant extractives was judged by counting the mortality of larvae after 6, 12 and 24 hours and the larval mortality percentage were adjudged over control. All the values were calculated as per Abbott formula (Abbott 1925) [29].

Table 1: List of selected botanicals for experimentation under laboratory conditions

Scientific Name	Family	Common Name	Parts Used
Annona reticulata Linn.	Annonaceae	Custard apple	Unripe fruits
Lantana camara Linn.	Verbanaceae	Ariapple	Arial parts
Pongamia glabra Vent.	Fabaceae	Karanj	Leaves
Piper nigrum Linn.	Piperaceae	Black Pepper	Unripe fruits

Table 2: Mean mortality % of Bihar hairy caterpillar, *Spilactia obliqua* using botanicals

Treatment	Con.	Lab.	Mean	Mortality	%	After	
		6	Hrs.	12	Hrs.	24	Hrs.
(Plant extracts)	(%)	T_1	T.B.V.$_1$	T_2	T.B.V.$_2$	T_3	T.B.V.$_3$
Annona reticulata	0.5	43.08	46.6	46.92	53.4	50.77	60.0
Annona reticulata	1.0	66.15	83.6	68.85	87.0	71.56	90.0
Annona reticulata	2.0	83.85	98.9	90.00	100.0	90.00	100.0
Lantana camara	0.5	37.22	36.6	43.08	46.6	48.85	56.7
Lantana camara	1.0	45.00	50.0	48.85	56.7	52.78	63.4
Lantana camara	2.0	54.78	66.7	61.22	76.7	63.44	80.0
Pongamia glabra	0.5	43.08	46.6	46.92	53.4	48.85	56.7
Pongamia glabra	1.0	54.78	66.7	59.01	73.5	63.63	80.7
Pongamia glabra	2.0	68.85	87.0	71.56	90.0	77.71	95.5
Piper nigrum	0.5	48.85	56.7	52.78	63.4	61.22	76.2
Piper nigrum	1.0	56.79	70.0	63.93	80.7	68.85	87.0
Piper nigrum	2.0	68.85	87.0	90.00	100.0	90.00	100.0
Control	0.00	0.00	18.44	10.00	18.44	10.00	12.26

(T1, T2, T3 = Treatments and TBV.1, TBV.2, TBV.3= Transformed Back Values)
C.D. for the treatment combination means = 0.175

The analysis of variance in table 2 and figure 1 to four shows that the main effect of insecticide, concentrations and periods as well as “Control versus treated” in first order and periods, concentrations in 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 ercent level of significance.

Table 3 and figure 5 indicated that extract of *Annona reticulata* Linn., *Pongamia glabra* Vent., *Lantana camara* Linn.and *Piper nigrum* Linn and their formulation (0.5,1.0 and 2.0 per cent) tested under lab. trials. The data depicted from results that the extract of custard apple, *Annona reticulata* Linn. showed maximum larval mortality 67.90 per cent and placed at top followed by Karanj, leaves extract of *Pongamia glabra* Vent.(66.80 per cent), leaves of black Pepper, *Piper nigrum* Linn (62.62 per cent) larval mortality, whereas ariapple, *Lantana camara* Linn. gave only 50.57 per cent larval mortality to the caterpillars of *Spilarctia obliqua* Walker under laboratory trials. Similarly, all the three concentration differed significantly to one another. The concentration 2.0 per cent is superior to concentration 1.0 and 0.5 per cent. It is observe that the difference in the percentage larvae of hairy caterpillar, *Spilarctia obliqua* Walker kill in concentration 2.0 per cent and 1.0 per cent is greater than the difference in concentration to kill the larvae in 1.0 per cent and 0.5 per cent in all the three periods.

Our findings are in conformity with the findings of Chitra *et al.* (1993) evaluated insecticidal efficacy of certain plant products against *H. Vigintioctopunctata.* Petroleum ether leaves extract of *Argemone maxicana* gave (76.18 per cent) mortality followed by *A. indica* leaves extract 0.1 per cent showed 71.75 per cent mortality, respectively [30]. Pandey and Raju, (2003) tested different ecofriendly insecticides against *Plutella xylostella* larvae among them NSKE 2.00 per cent gave considerable mortality to the second instar larvae of *Plutella xylostella* [31].

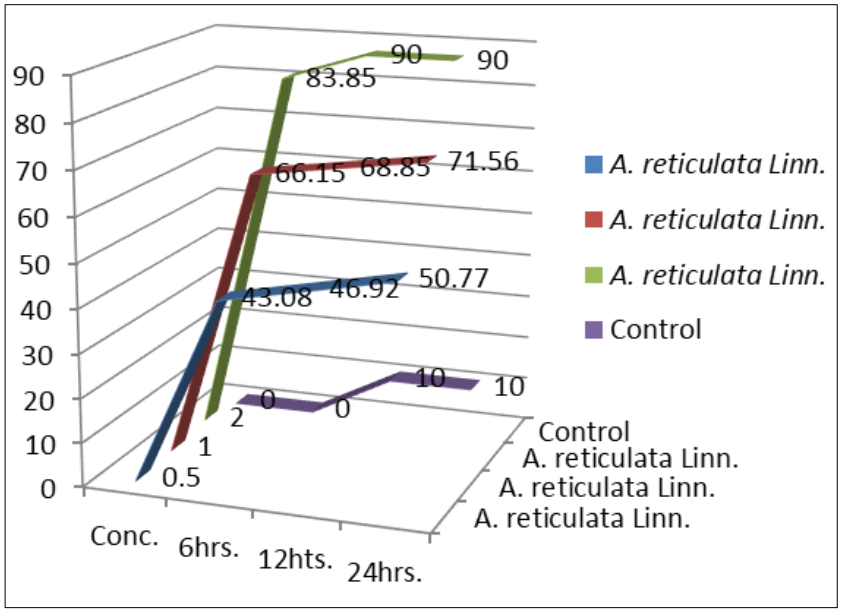

Fig 1: Mean mortality per cent of Bihar hairy caterpillar, *Spilactia obliqua* using. *reticulara*

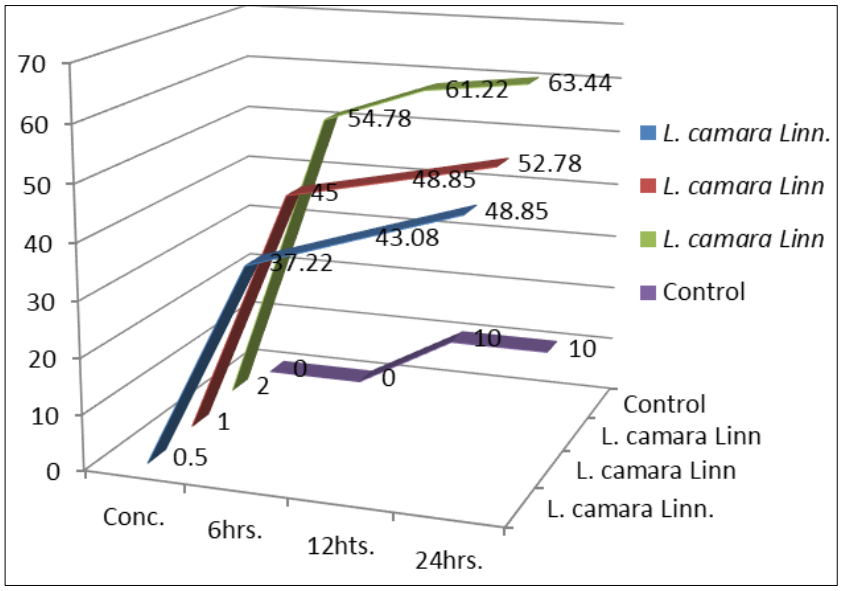

Fig 2: Mean mortality per cent of Bihar hairy caterpillar, *Spilactia obliqua* using *L. camara*

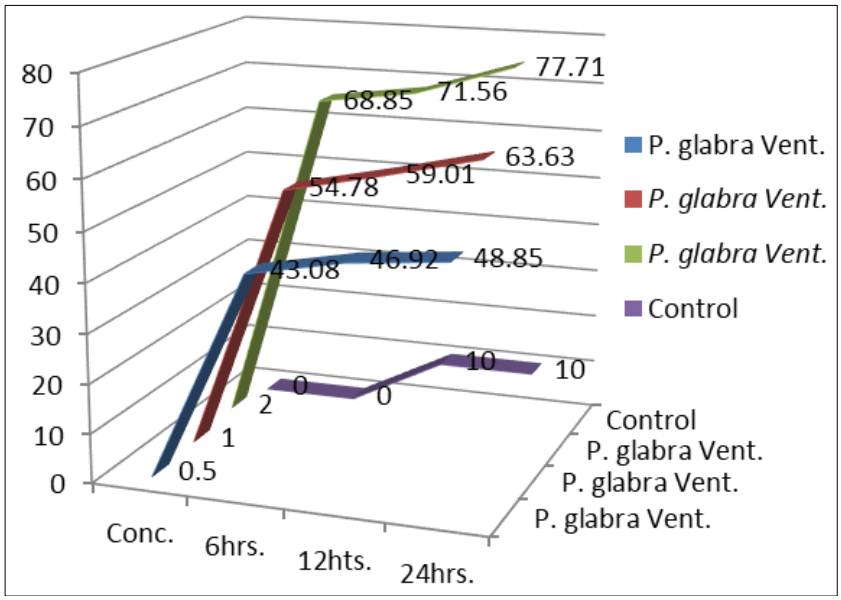

Fig 3: Mean mortality per cent of Bihar hairy caterpillar, *Spilactia obliqua* using *P. glabra*

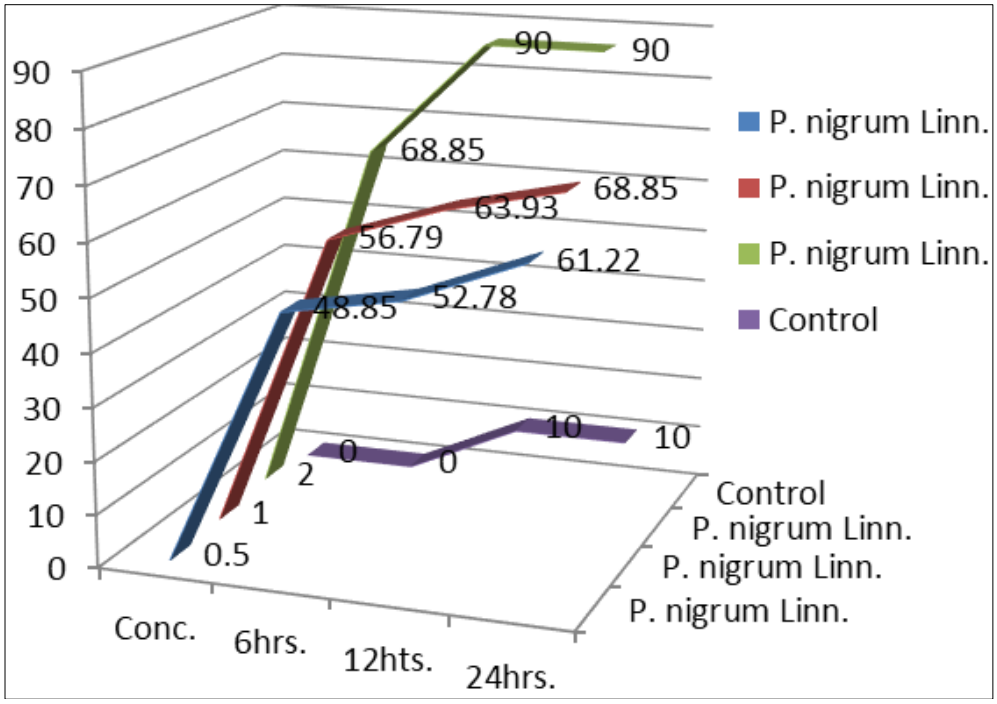

Fig 4: Mean mortality per cent of Bihar hairy caterpillar, *Spilactia obliqua* using *P. nigrum*

Table 3: Mean mortality % of *S. obliqua* in exposure periods irrespective of concentration

Treatment	Lab.	Mean	Mortality	%	after		Mean	mortality
	6	Hrs.	12	Hrs.	24	Hrs.	%	
Botanicals	**T_1**	**TBV_1**	**T_2**	**TBV_2**	**T_3**	**TBV_3**	**G.T.**	**TBV**
A. reticulata	64.35	81.3	68.59	86.7	70.77	89.2	67.90	85.9
L. *camara.*	45.66	51.1	51.04	60.4	55.02	67.1	50.57	59.7
P. glabra	58.16	72.2	68.90	87.0	73.35	91.8	66.80	84.5
P. nigrum	56.85	70.1	59.80	74.1	71.21	89.6	62.62	78.9
Control	0.00	0.00	18.44	10.00	18.44	10.00	12.26	4.25

(T1, T2, T3 = Treatments and TBV.1, TBV.2, TBV.3= Transformed Back Values) C.D. for the treatment combination means = 0.147

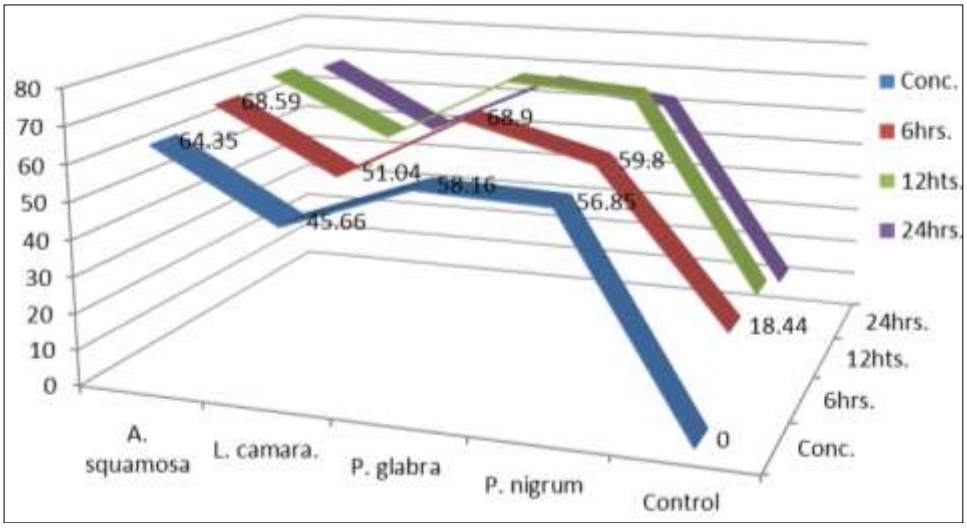

Fig 5: Mean mortality per cent of *S. obliqua* in exposure periods irrespective of concentration

5. Conclusion

Conclusively, the present investigation revealed that The data depicted from results that the extract of custard apple, *Annona reticulata* Linn. showed maximum larval mortality 67.90 per cent and placed at top followed by Karanj, leaves extract of *Pongamia glabra* Vent.(66.80 per cent), leaves of black Pepper, *Piper nigrum* Linn (62.62 per cent) larval mortality, whereas ariapple, *Lantana camara* Linn. gave only 50.57 per cent per cent larval mortality to the Bihar hairy caterpillars, *Spilarctia obliqua* Walker under mustard agro- ecosystem.

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