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Assessment of certain plant extracts as insecticides against cabbage butterfly, *Pieris brassicae* Linn. (Lepidoptera: Pieridae)

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*(** A part of Ph.D. thesis)

Abstract

In the present investigation alcoholic extract of ten indigenous plant extracts viz., *Acorus calamus* Linn., *Adhatoda vasica* Nees. *Allium sativum* Linn.,*Cleome monophylla* Linn., *Curcuma domestica* Val. *Lantana camara* Linn., *Momordica charantia* Linn., *Nigella sativa* Linn., *Ricinus communis* Linn.and *Vitex nugendo* Linn. (leaves,bark, seeds, aerial parts etc.) with control (benzene + emulsified water) were prepared with the help of the soxhlet apparatus under the laboratory conditions. These extracts were tested to find out insecticidal effects against third instar larvae of cabbage butterfly, *Pieris brassicae* Linn. The data depicted from results that *Acorus calamus* gave the maximum mortality. It killed 80.87 per cent *Pieris brassicae* larvae followed by *Vitex negundo* (72.83 per cent) > *Adhatoda vasica* (67.90 per cent) > *Momordica charantia* (66.80 per cent) >*Lantana camara* (66.35 per cent) > *Ricinus communis* (65.70 per cent) > *Curcuma domestica* (64.82 per cent) > *Allium sativum* (64.16 per cent) > *Nigella sativa* (62.62 per cent) >*Cleome monophylla* (62.13 per cent), respectively.

Key Words: Pieris brassicae, Vitex negundo, Acorus calamus, Adhatoda vasica

1. INTRODUCTION:

A large number of insect-pests as, cabbage butterfly, *Pieries brassicae* Linn., tobacco caterpillar, *Spodoptera litura* Fabr., Bihar hairy caterpillar, *Spilosoma oblique* Walk., cabbage borer, *Hellula undalis* Fabr., mustard sawfly, *Athalia proxima* Klug., cabbage semilooper, *Trichoplusia ni* Hub. and cabbage leaf webber *Crocidolomia binotalis*

Zell. are limiting factors of crops and vegetables.(Antonius and Hagazy 1987, Weaver *et al.* 1991, Krishnarajah, *et al.* 1985, Ahmed and Eapen 1986, , Mehta. and Sandhu 1992, Mwangi *et al.*1992) Among them, larvae of cabbage butterfly, *Pieries brassicae* Linn. are the most damaging to the vegetable and crops.(Turowski 1963).

Among above mentioned insect pests, cabbage butterfly, *Pieries brassicae* Linn. (Lepidoptera: Pieridae) is a sporadic in nature has been in regular occurrence in northern Indo- Gangatic reigion, causing considerable damage to cruciferous crop, vegetables, pulses, cereals, oil seeds, fiber crops and other plants of economic importance in our country (Deshpande and Tipnis 1977, Golob and Webley 1980, Meisner *et al.* 1981, Bekele, *et al.*1996, Abe and Matsuda 2000, Chandel *et al.* 2004, Dubey *et al.* 2004). The larvae feed and causing enormous destruction by making holes in the leaves (Srivastava and Awasthi 1958, Paul *et al*. 1965, Sahoo and Senapathi, 2000 Chandel *et al.* 2001, Chalapathi Rao, *et al.* 2002). In nature, there are so many plant species, which are not even touched by the insets to feed. It means, such plants must have some to deterring chemicals, which exhibit their feeding. Such plants are being utilized for insect pest management.

Therefore, the need for the alternative pest control has been device,which have insecticidal properties to combat the cabbage butterfly, *Pieries brassicae* Linn.destructions.

2. MATERIALS AND METHODS

2.1: Procurement of raw plant materials: After preliminary experiment of aqueous extract on different aspects mention already in above, the regular experiments of selected 10 asteraceous botanical soxhlet extractives regarding insecticidal efficacy were conducted under laboratory conditions. The plants parts used for extracts were collected mainly from wasteland and wild areas and some plants were collected from cultivated fields of the farmers. The investigations on the screening of various available indigenous naturally occurring plant extracts on viz., *Acorus calamus* Linn., *Adhatoda vasica* Nees. *Allium sativum* Linn.,*Cleome monophylla* Linn., *Curcuma domestica* Val. *Lantana camara* Linn., *Momordica charantia* Linn., *Nigella sativa* Linn., *Ricinus communis* Linn.and *Vitex nugendo* Linn. (leaves,bark, seeds, aerial parts etc.) were screened for their bioefficacy insecticidal against against third instar larvae of cabbage butterfly, *Pieris brassicae* Linn. in laboratory.

2.2: Preparation of powder: Fresh collected green plant parts (leaves, Flowers and seeds, rhizomes etc) were washed with distilled water and kept in the laboratory for 7 days for air drying followed by one day sun 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 (Chayengia *et al*. 2010).

2.3: Preparation of botanical extracts: For the extraction, Soxhlet Apparatus was used about 20g powder of each category of powder were extracted with 300 ml of different solvents (n-hexane, acetone, methanol, petroleum ether and distilled water). Extraction 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 with rotary evaporator 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:Apparatus used for experiment: Small plastic jars (capacity 50 ml) were used for the experiment; there was one set of two jars joined by clear plastic pipe of 1cm diameter at an angle of 180 degree for each replication. One jar of each set was provided with 10 g of grains given the name 'A' while the other jar was kept empty and given the name **'**B**'**. In jar 'A**'**, the grains treated with extracts were placed, while the jar B remained empty. The jars used for experiment were disinfected with alcohol.

2.5: Preparation of Stock Solution: For stock solution, 50ml. extract in each case was taken into reagent bottles and 50ml. benzene was added in it to dissolve the constituents of the materials. The mouth of the bottles were stopper with airtight corks after which, these bottles containing the solutions were kept in refrigerator.

2.6: The Insecticidal Formulations: Five concentrations (0.5,1.0, 2.0 percent) were used for experiments on insecticidal tests in the laboratory conditions. However, only three concentrations (0.5,1.0 and 2.0 percent) were used for insecticidal test in the laboratory experiment. 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.

2.7: Experimental Protocol:

For testing the insecticidal bio-efficacy, mustard leaves as food were taken in a plastic container (300 ml) were used as food sprayed with different concentrations (0.5, 1.0 and 2.0 percent) of each extract and then air dried for 30 minutes to farm a dry film on treated leaves. Five pairs of newly emerged one day old adult beetles were released in each plastic container and the mouth was closed with its lid. Each treatment was replicated thrice including control. All treated containers were kept at ambient room temperature (27-30^{o}C) in the laboratory for mortality. After 6,12 and 24 hours, dead and alive beetles were counted and removed from each container. The efficacy of plant materials as insecticides against third instar larvae of cabbage butterfly, *Pieris brassicae* Linn. was assessed considering mortality percentage. Thus data was collected on the number of larvae of *Pieris brassicae* Linn. were died on

treated food and mortality over control was recorded. The data were arranged in tabulated form and graph formats. The mortality (%) was corrected by Abbots's formula (Abbott, W.S. 1925)[1]

3. RESULTS AND DISCUSSIONS:

The data depicted in table 1 and figure 1 indicated that the plant extract of *Acorus calamus* gave the maximum mortality. It killed 80.87 per cent *Pieris brassicae* larvae followed by *Vitex negundo* (72.83 per cent) > *Adhatoda vasica* (67.90 per cent) > *Momordica charantia* (66.80 per cent) >*Lantana camara* (66.35 per cent) > *Ricinus communis* (65.70 per cent) > *Curcuma domestica* (64.82 per cent) > *Allium sativum* (64.16 per cent) > *Nigella sativa* (62.62 per cent) >*Cleome monophylla* (62.13 per cent), respectively. The plant extract of *Acorus calamus* differed significantly from remaining once except *V. negundo* and *Adhatoda vasica* from which it does not differs significantly to one another. The table 2 and figure 2 reveals that the plant extract of *A. calamus* gave the maximum mortality. It killed 97.5 per cent larvae of *Pieris brassicae* followed by *V. negundo* (91.3 per cent), *A. vasica* (85.9 per cent), *M. charantia* (84.5 per cent), *L. camara* (84.00 per cent) etc. The plant extract of *A. calamus* differed significantly from remaining once except *V. negundo*, *A. vasica* , *M. charantia* and *L. camara,* from which it does not differs significantly to one another.

Table 3 and figure 3 indicates that 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 *P. brassicae* larvae kill in concentration 2.0 per cent and 1.0 per cent is greater than the difference in concentration to kill the grubs in 1.0 per cent and 0.5 per cent in all the three periods. Similarly the difference in percentage mortality of *Pieris brassicae* larvae in 24 hours (97.97 per cent)) and 12 hours (78.7 per cent) is greater than the difference in percentage mortality in the period of 12 hours (78.7 per cent) and 6 hours (59.81 per cent).The Table 4 and figure 4 indicates that the maximum percentage of *Pieris brassicae* larval mortality after 24 hrs. (88.9 per cent) and minimum after 6 hrs (73.7 per cent). The period of 24 hrs. is significantly superior to period of 12 hrs. (82.3 per cent) and 12 hrs. (73.7 per cent) in both control and treated. The overall effect of all the treatments in killing the larvae is greater than that of control in all the three periods.

Finally, it can be concluded on the basis of Table 28 that all the ten plant extracts are toxic to *Pieris brassicae* larvae. Among all the thirteen plant extracts, *A. calamus* is most toxic and placed at the top and *C. monophylla* is least toxic and placed at the bottom of merit of selected bio-insecticides.

Table 1: Mean mortality percentage of *Pieris brassicae* Linn. in case of different combination in laboratory condition

Treatment	**Con.**	**mortality percent After Mean**					
		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.$_3$**
A. calamus	0.5	59.01	73.5	63.44	80.0	83.85	98.9
A. calamus	1.0	71.56	90.0	90.00	100.0	90.00	100.0
A. calamus	2.0	90.00	100.0	90.00	100.0	90.00	100.0
A. vasica	0.5	43.08	46.6	46.92	53.4	50.77	60.0
A. vasica	1.0	66.15	83.6	68.85	87.0	71.56	90.0
A. vasica	2.0	83.85	98.9	90.00	100.0	90.00	100.0
R. communis	0.5	48.85	56.7	48.85	56.7	54.78	66.7
R. communis	1.0	54.78	66.7	56.79	70.0	63.44	80.0
R. communis	2.0	83.85	98.9	90.00	100.0	90.00	100.0
L. camara	0.5	46.92	53.4	50.77	60.0	52.78	63.3
L. camara	1.0	52.78	63.3	63.93	80.7	66.15	83.6
L. camara	2.0	83.85	98.9	90.00	100.0	90.00	100.0
A. sativum	0.5	41.15	43.3	46.92	53.4	52.8	46.95
A. sativum	1.0	54.78	66.7	56.79	70.0	61.22	76.7
A. sativum	2.0	83.85	98.9	90.00	100.0	90.00	100.0
M. charantia	0.5	48.85	56.7	52.78	63.4	61.22	76.2
M. charantia	1.0	56.79	70.0	63.93	80.7	68.85	87.0
M. charantia	2.0	68.85	87.0	90.00	100.0	90.00	100.0
N. sativa	0.5	46.92	53.4	48.85	56.7	54.78	63.3
N. sativa	1.0	54.78	63.3	59.01	73.6	68.85	87.0
N. sativa	2.0	68.85	87.0	71.56	90.0	90.00	100.0
C. monophylla	0.5	39.23	40.0	45.00	50.0	59.01	73.5
C. monophylla	1.0	54.78	66.7	63.44	80.0	77.71	95.5
C. monophylla	2.0	61.22	76.8	75.00	93.3	83.85	98.9
C. domestica	0.5	43.08	46.6	46.92	53.4	56.79	70.0
C. domestica	1.0	54.78	66.7	56.79	70.0	61.22	76.8
C. domestica	2.0	83.85	90.0	90.00	100.0	90.00	100.0
V. negundo	0.5	48.93	56.8	61.22	76.8	68.85	87.0
V. negundo	1.0	68.85	87.0	68.85	87.0	83.85	98.9
V. negundo	2.0	75.00	93.3	90.00	100.0	90.00	100.0
Contor	0.00	0.00	18.44	10.00	18.44	10.00	0.00

(Figures within parenthesis represent mean percentage transformed back values.)

C.D. for the treatment combination means = 0.147

The analysis of variance in table1 shows that the main effect of insecticides, concentration, period as well as first order and second order interaction are highly significant “insecticide x concentration”, which is non significant. The effect of “Control x Treatment"

Table 2: Mean mortality percentage of *Pieris brassicae* in exposure periods irrespective of concentration laboratory condition.

Treatments (Plant extracts)	**Mean mortality percent After**						**Mean % Mortality**	
	6 hrs.		**12 Hrs.**		**24 hrs.**			
	T_1	**TBV_1**	**T_2**	**TBV_2**	**T_3**	**TBV_3**	**G.T.**	**TBV**
A. calamus	73.52	91.2	81.14	97.1	87.95	99.8	80.87	97.5
A. vasica	64.35	81.3	68.59	86.7	70.77	89.2	67.90	85.9
R. communis.	62.49	78.7	65.21	82.4	69.40	87.6	65.7	82.3
L. camara	61.18	76.6	68.23	86.2	69.64	87.9	66.35	84.0
A. sativum	59.93	74.9	64.57	81.6	68.00	86.0	64.16	81.0
M. charantia	58.16	72.2	68.90	87.0	73.35	91.8	66.80	84.5
N. sativa	56.85	70.1	59.80	74.1	71.21	89.6	62.62	78.9
C. monophylla	51.74	61.6	61.14	76.7	73.52	91.9	62.13	78.2
C. domestica	60.57	76.7	64.57	81.6	69.33	87.5	64.82	81.9
V. negundo	64.26	81.1	73.35	91.8	80.90	97.5	72.83	91.3
Control (Benzene+ H_2O)	0.00	0.00	18.44	10.00	18.44	10.0	12.26	4.25

(Figure within parenthesis represent mean percentage transformed back value)

C.D. for treatment x period means = 0.075

C.D. for treatment means(plant extract) = 0.032

C.D. for treatment means (control) = 0.160

Table 3: Mean mortality percentage of *Pieris brassicae* larvae in concentrations irrespective of treatments under the laboratory condition

Concen-trations	**Mean mortality percent after**						**Mean %**	
	6 hrs.		**12 hrs.**		**24 hrs.**			
	T_1	**TBV_1**	**T_2**	**TBV_2**	**T_3**	**TBV_3**	**G.T.**	**TBV**
0.5	45.19	50.4	49.74	58.2	57.09	70.5	50.67	59.8
1.0	56.96	70.3	62.23	78.3	68.38	87.0	62.50	78.7
2.0	75.25	93.5	83.32	98.7	80.06	97.1	81.54	97.9

(Figure within parenthesis represent mean percentage transformed back value)

C.D. for treatment x period means = 0.080

C.D. for treatment means(plant extract) = 0.045

C.D. for treatment means (control) = 0.139

Table 4: Mean mortality percentage of *Pieris brassicae* Linn.in different exposure periods irrespective of treatments in laboratory condition

Treatments	**Mean mortality percent after**						**Mean Mor-Tality**	**(%)**
	6 hrs.		**12 hrs.**		**24 hrs.**			
	T_1	**TBV_1**	**T_2**	**TBV_2**	**T_3**	**TBV_3**	**G.T.**	**TBV**
Plant Extracts	59.13	**73.7**	65.09	**82.3**	70.49	**88.9**	64.91	**82.0**
Control	00.00	**0.00**	18.44	**10.00**	18.44	**10.00**	12.26	**4.25**
Mean values	29.56	**24.4**	74.31	**92.7**	79.71	**96.9**	71.04	**89.5**

(Figures within parenthesis represent mean percentage transformed back values)

C.D. for period means (extracts) = 0.027

C.D. for period means (Control) = 0.193

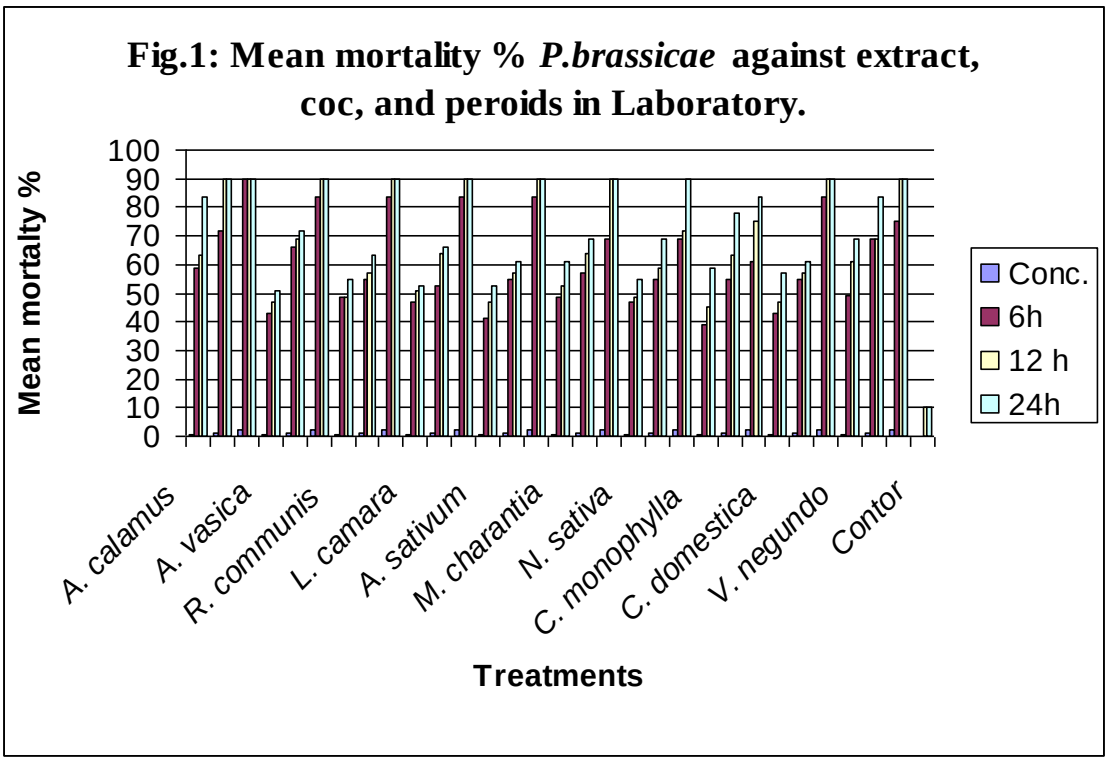
Fig.1: Mean mortality % P.brassicae against extract, coc, and peroids in Laboratory.
Mean mortalty %
100
90
80
70
60
50
40
30
20
10
0
A. calamus
A. vasica
R. communis
L. camara
A. sativum
M. charantia
N. sativa
C. monophylla
C. domestica
V. negundo
Contor
Treatments
Conc.
6h
12 h
24h

.

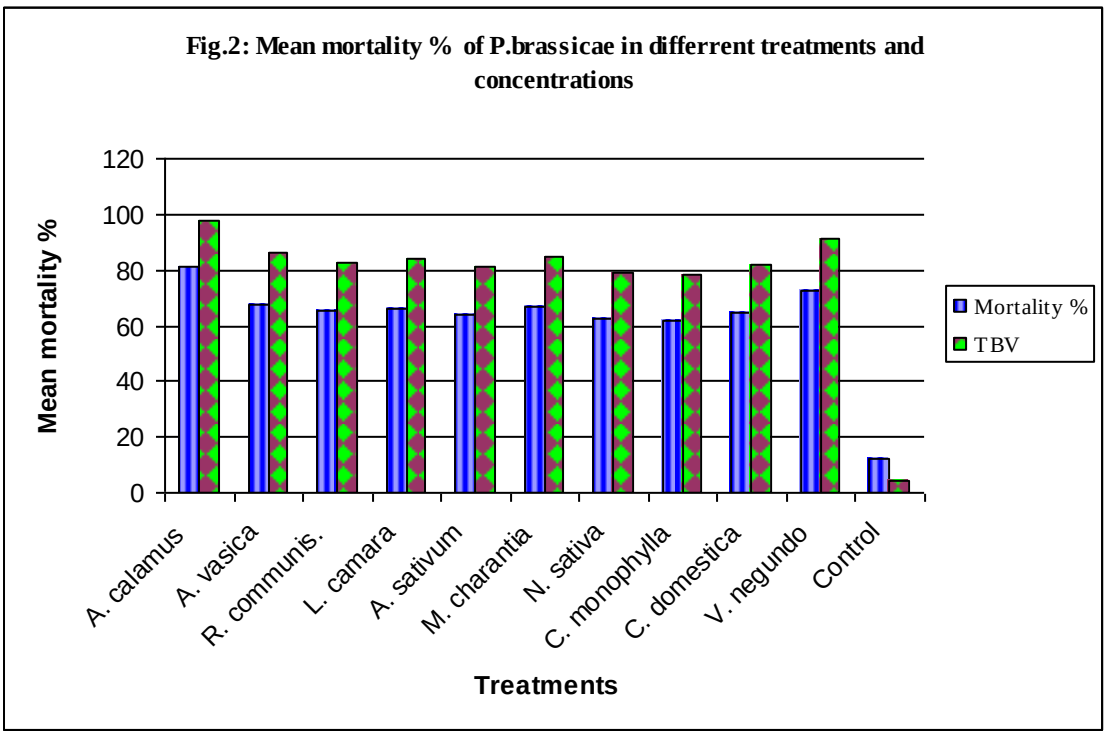
Fig.2: Mean mortality % of P.brassicae in differrent treatments and concentrations
Mean mortality %
120
100
80
60
40
20
0
A. calamus
A. vasica
R. communis.
L. camara
A. sativum
M. charantia
N. sativa
C. monophylla
C. domestica
V. negundo
Control
Treatments
Mortality %
TBV

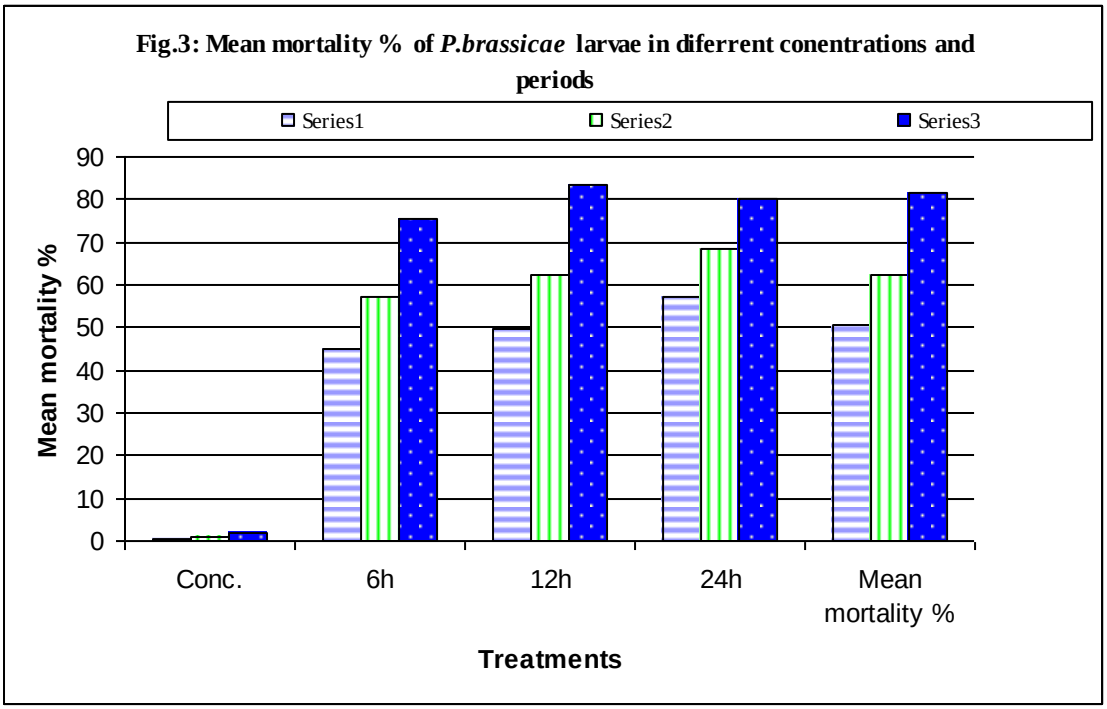

Fig.3: Mean mortality % of *P.brassicae* larvae in diferrent conentrations and periods

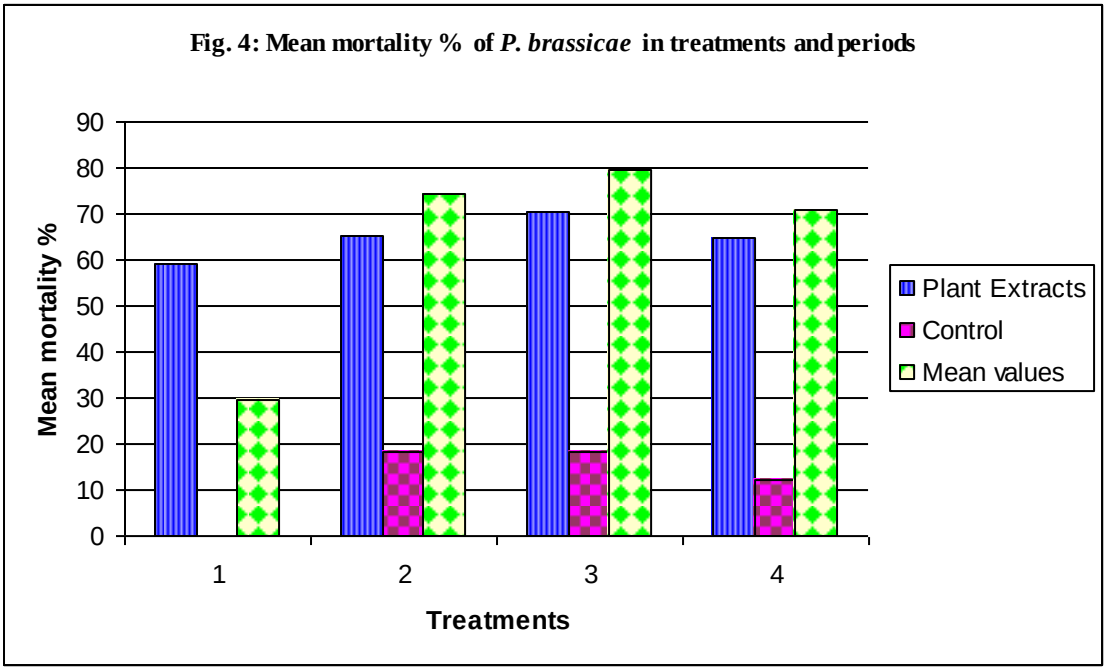

Fig. 4: Mean mortality % of *P. brassicae* in treatments and periods

The present findings to the inconformity with those workers who has done works on use of ecofriendly naturally occurring indigenous plant origin insecticides against various insect pest of crop and vegetable (Yadav,1971, Roomi and Ariquiddin 1977,

Sighamony *et al*. 1984, Krishnarajah *et al*. 1985, Chander *et al*. 1990, Kurnar *et al*. 1990, Jilani and Saxena 1990, Risha *et al*. 1990, Chitra *et al.* 1993, Schmidt and Streloke 1994, Sahayaraj and Paulraj, 1999, Gahukar,2000, Chandel *et al.* 2002, Sahoo and Senapathi, 2000, Misra, 2002, Chalapathi *et al.* 2002, Rao *et al.* 2002, Dwivedi. and Garg 2003, Tandon *et al.* 2004).

Abe and Matsuda (2000) tested *Momordica charantia* leaves ethnol extract at 120-ug/fifth instar caused 51.8 per cent *S. litura* larval mortality. Gautam and Chauhan (2003) tested insecticidal properties of 24 asteraceous plants against *S. obliqua* Walk. and observed that 1000 $ugml^{-1}$ abstract of *S. lappa* was most effective (65.3% mortality) followed by *Cichorium intybus* (54.6%) and *Vernonia cinera* (38.6%) as compared to extracts of other species. Singh and Kanaujia, (2003) evaluated certain biopesticides against third instar larvae of *Spilosoma obliqua* Walk. on castor. Out of which NSKE (5.0 per cent) exhibited 1.44 per cent residual toxicity and have third position of relative toxicity i.e. 158.84 Pt values. Panicer *et al.* 2003 also worked on insecticidal efficacy of various plant materials and reported significant responses. Seenivasan et al. (2004) tested the efficacy of new insecticides against citrus leaf miner, *Phyllocnistis citrella* Stainton and compared with commonly used insecticides along with neem- based formulations. Among different inseciticides evaluated neem formulations viz., neem seed kernel, azadirachtin were found in causing high mortality of leaf minor larvae. Michaelraj and Sharma (2006) tested castor, corn and karanj vegetable oils as grain protectant against *Sitophilus oryzae* Linn. and *R. dominica* Fabr.in stored maize. Karanj oil was most effective against *Sitophilus oryzae* with the lowest LD50 and LD95 of 0 .0 433 and 0.0674 ul/cm2 , respectively.followed by corn (0.0494 and 0.0978)and castor oil (0.4037 and 0.9080) in film method.

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Fig 1 : Mean mortality % of *P. brassicae* **in case of different combination and peroides**

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Treatments	Conc.	6h	12 h	24h
A. calamus	**0.5**	**59.01**	**63.44**	**83.85**
A. calamus	**1.0**	**71.56**	**90.00**	**90.00**
A. calamus	**2.0**	**90.00**	**90.00**	**90.00**
A. vasica	**0.5**	**43.08**	**46.92**	**50.77**
A. vasica	**1.0**	**66.15**	**68.85**	**71.56**
A. vasica	**2.0**	**83.85**	**90.00**	**90.00**
R. communis	**0.5**	**48.85**	**48.85**	**54.78**
R. communis	**1.0**	**54.78**	**56.79**	**63.44**
R. communis	**2.0**	**83.85**	**90.00**	**90.00**
L. camara	**0.5**	**46.92**	**50.77**	**52.78**
L. camara	**1.0**	**52.78**	**63.93**	**66.15**
L. camara	**2.0**	**83.85**	**90.00**	**90.00**
A. sativum	**0.5**	**41.15**	**46.92**	**52.8**
A. sativum	**1.0**	**54.78**	**56.79**	**61.22**
A. sativum	**2.0**	**83.85**	**90.00**	**90.00**
M. charantia	**0.5**	**48.85**	**52.78**	**61.22**
M. charantia	**1.0**	**56.79**	**63.93**	**68.85**
M. charantia	**2.0**	**68.85**	**90.00**	**90.00**
N. sativa	**0.5**	**46.92**	**48.85**	**54.78**
N. sativa	**1.0**	**54.78**	**59.01**	**68.85**
N. sativa	**2.0**	**68.85**	**71.56**	**90.00**
C. monophylla	**0.5**	**39.23**	**45.00**	**59.01**
C. monophylla	**1.0**	**54.78**	**63.44**	**77.71**
C. monophylla	**2.0**	**61.22**	**75.00**	**83.85**
C. domestica	**0.5**	**43.08**	**46.92**	**56.79**
C. domestica	**1.0**	**54.78**	**56.79**	**61.22**
C. domestica	**2.0**	**83.85**	**90.00**	**90.00**
V. negundo	**0.5**	**48.93**	**61.22**	**68.85**
V. negundo	**1.0**	**68.85**	**68.85**	**83.85**
V. negundo	**2.0**	**75.00**	**90.00**	**90.00**
Contor	**0.00**	**0.00**	**10.00**	**10.00**

Fig.2 : Mean mortality % of *P. brassicae* mortality in deferent periods.

Treatments	Mortality %	TBV
A. calamus	**80.87**	**97.5**
A. vasica	**67.90**	**85.9**
***R. communis*.**	**65.7**	**82.3**
L. camara	**66.35**	**84.0**
A. sativum	**64.16**	**81.0**
M. charantia	**66.80**	**84.5**
N. sativa	**62.62**	**78.9**
C. monophylla	**62.13**	**78.2**
C. domestica	**64.82**	**81.9**
V. negundo	**72.83**	**91.3**
Control	**12.26**	**4.25**

Fig.3 : Mean mortality % of *P. brassicae* Concan.& periods.

Conc.	6h	12h	24h	Mean mortality %
0.5	45.19	49.74	57.09	50.67
1.0	56.96	62.23	68.38	62.50
2.0	75.25	83.32	80.06	81.54

Fig. 4 : Mean mortality % of *P. brassicae* Extracts .& periods.

Treatments	**Mean**	**mortality**	**percent**	**after**		**Mean**	**Mor-**
	6	**hrs.**	**12**	**hrs.**	**24**	**hrs.**	**Tality**	**(%)**
	T_1	**TBV_1**	**T_2**	**TBV_2**	**T_3**	**TBV_3**	**G.T.**	**TBV**
Plant Extracts	59.13	**73.7**	65.09	**82.3**	70.49	**88.9**	64.91	**82.0**
Control	00.00	**0.00**	18.44	**10.00**	18.44	**10.00**	12.26	**4.25**
Mean values	29.56	**24.4**	74.31	**92.7**	79.71	**96.9**	71.04	**89.5**

Plant Extracts	59.13	65.09	70.49	64.91
Control	00.00	18.44	18.44	12.26
Mean values	29.56	74.31	79.71	71.04