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Effect of botanical extracts, biological and chemical control against *Spilosoma oblique* on cabbage (*Brassica oleracea*)

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Abstract
The laboratory experiment was carried out during March to April of 2014 in the laboratory of entomology, Sam Higginbottom Institute of Agriculture Allahabad, India. The botanical extracts that include Neem, Sarifa and bioagent *Beauveria bassiana* and Insecticide (Cypermethrin 0.07%) with treatment of Control in a randomized block design (RBD) were tested against caterpillars of *Spilosoma obliqua* on cabbage leaves in plastic jars. Cypermethrin significantly increased population reduction of *Spilosoma obliqua* (100%) followed by leaf extracts of Neem (90.00%), Sarifa (83.33%) and *Beauveria bassiana* (73.33%) as compared with Control (0.00%), pupae did not appear during treatment of Cypermethrin 0.00% with significantly reduced from other treatments Neem 10.00%, Sarifa 16.67%, *B. bassiana* 26.66% and Control 100.00% at 10% concentrations after 35 days.

Keywords: *Spilosoma obliqua*, Cabbage, Insecticide, Neem, Sarifa and *Beauveria bassiana.*

1. Introduction
Brassica oleracea (Cabbage) is an introduced vegetable crop in India, but it has adapted itself well and is grown all over the country. Sowing time in India is different to regions, in Northern and eastern regions, for cool season October – November, for Hot weather July - Aug; Jan – Feb. and Southern and western regions sowing round the year [2]. *Spilosoma oblique* is a serious pest in Bihar, Uttar Pradesh, Punjab, Madhya Pradesh, Manipur and some other states. The third and onward instar larvae cause serious damage and significant reduction in yield [7, 6]. It is known fact that the Bihar hairy caterpillar showed certain levels of behavioral resistance to different class of insecticides, hence successful control of this pest is to some extent difficult [5]. The use of botanical resources for agrochemical purpose is one of the important alternatives to manage insect-pests in place of synthetic insecticides. The activity of crude plant extracts is often attributed to the complex mixture of active compounds that alter the behavioral and physiological aspects of insects which reduces the potential chances of insect resistance to the natural complex [11]. In fact, botanical pesticides are in use in Indian agriculture for over a century to minimize losses caused by pests and diseases [10]. Botanical pesticides are less expensive and easily available because of their natural occurrence especially in oriental countries. Some of the botanical like neem, bel, senwar, pyrethrum, tobacco, karanj, mahua and sweet flag *etc*. have already attained the status of potential pesticides of plant origin to be used in IPM of crop field insects as well as in storage ecosystems [9]. Biological control of Pests using antagonistic fungal and bacterial strains is gaining increasing importance. Soil has untapped potential and contains several potential biocontrol agents (BCAs) such as *Beauveria bassiana.* So, our present work was carried out to investigate the effect of botanical extracts, biological and chemical control on survival and feeding of *S. oblique* larvae under laboratory conditions.

2. Materials and Methods
2.1 Collection of *Spilosoma obliqua*
The eggs of *S. obliqua* were collected from infested leaves from central research field, Sam Higginbottom Institute of Agriculture on 14 February 2014. The eggs were incubated in the laboratory on cabbage leaves (*Brassica oleracea*) in plastic jars (30 cm dia. X 15 cm ht.) until emergence of caterpillars after 7 days.

2.2 Preparation 20% concentration of botanical extracts (Neem, Sarifa) and *Beauveria bassiana*

Every botanical extracts prepared from fresh leaves of Neem and Sarifa by crushing the leaves with the amount of fresh water and grinded, after well grind sieved through a piece of cloth and then water was poured into the resultant sieved solution. These solutions were used for the treatment applications as the stock solutions. Prepared 20 percent concentration of required spray 20 ml of leaf extracts (Neem and Sarifa) / 80 ml in water and applied. *B. bassiana* were cultivated and maintained on potato dextrose agar (PDA) medium. For conducting various experiments, 2-3 weeks old fungal culture was used. Conidia with mycelia were harvested by scraping the surface of culture with a sterile loop in distilled water and prepared concentration were 20%.

2.3 The treatment details

The experiment was included five treatments such as Neem, Sarifa, *Beauveria bassiana*, Cypermethrin (0.07%) and Control Used with three replicates, 8 days old caterpillars were added per replicate to all treatments in plastic jars (8 cm dia. X 15 cm ht.) covered with muslin clothes with 1-2 leaves of cabbage under ambient conditions (temperature 26 ± 2 ^{0}C).

2.4 Statistical analysis

The experiment was conducted in completely randomized block design (RBD) and the data was analyzed by one way Analysis of Variance (ANOVA).

2.5 Recording observations

Cabbage leaves (*Brassica oleracea*) treated with Neem, Sarifa, *Beauveria bassiana* (20%) and Cypermethrin (0.07%) in plastic jars, the percent mortality of larva was calculated the Abbott's formula [1] after 7,14,21,28 and 35 days and calculated of pupae.

$$\text{Corrected \%} = \left(1 - \frac{\text{n in T after treatment}}{\text{n in Co after treatment}}\right) \times 100$$

Where: n = Insect population, T = treated, Co = control

3. Results and discussion

3.1 Effect of various treatments on the larval population of *Spilosoma obliqua* after 7, 14, 21, 28 and 35 days

After 7 and 14 days the results revealed that maximum significantly increased in reduction the larval population of *Spilosoma oblique* in T_1 (Cypermethrin) 100% to all times Followed by T_3 (Sarifa) 6.67,10.00%, respectively, and T_2 (Neem) 3.33% as compared with T_0 (Control) and T_4 (*B. bassiana*) 0.00% in Table.1 and Fig. 1.

After 21 and 28 days the data shown maximum increased in reduction the larval population in T_2 (Neem) 56.67, 73.33%, T_4 (*B. bassiana*) 30.00, 73.33% and T_3 (Sarifa) 23.33, 46.67% respectively as compared with T_0 (Control) 0.00%.

After 35 days the results shown maximum increased in reduction the larval population in T_2 (Neem) 90.00%, T3 (Sarifa) 83.33% and T_4 (*B. bassiana*) 73.33% which were found non-significant from each-other as compared with T_0 (Control) 0.00% that recorded a minimum reduction the larval population.

3.2 Effect of various treatments on pupal emergence of *Spilosoma oblique* after 7, 14, 21, 28 and 35 days

The results of Table. 2 and Fig. 2 revealed that did not appear pupae % after 7, 14 and 21 days in all treatments while T_1 (Insecticide) and T_2 (Neem) recorded 0.00% followed by T_4 (*B. bassiana*) 16.67%, T_3 (Sarifa) 3.33% and T_0 (control) 40.00% which were found significant from each-other after 28 days. After 35 days the results shown minimum emergence of pupae % in (Insecticide) 0.00% followed by T_2 (Neem) 10.00%, T_3 (Sarifa) 16.67% and T_4 (*B. bassiana*) 26.66% and T_0 (Control) 100.00% that the recorded maximum emergence of pupae % which were found significant from each-other.

The results are in agreement with Nagia DK *et al.* 1990 [8] that tested the efficiency of 9 insecticides against 4th- and 5th-instar larvae of *Spilosoma oblique*, Good results were achieved with deltamethrin, cypermethrin and fenvalerate at 0.016% a.i. Srimannarayana G *et al.* [12] that tested the effectiveness of (*Annona squamosa*) against Bihar hairy caterpillar (*Spilosoma obliqua*). Annona oil-based formulations were found to be the best antifeedants followed by Annona seed extracts and leaf-based formulations. Compared with a neem-based pesticides, the antifeedant Annona products were more effective against silkworm than against Bihar hairy caterpillar at the same concentration.

Bhardwaj DK *et al.* [3] Reported that the maximum effect was shown as azadirachtin 1 per cent > azadirachtin 0.03 per cent > azadirachtin 0.3 per cent > azadirachtin 0.15 per cent against IInd instar larvae of *Spilosoma obliqua* (Wlk). The best treatment to check the population of *S. obliqua* were azadirachtin 1 per cent, azadirachtin 0.03 per cent, azadirachtin 0.3 percent @0.4 to 0.8 percent.

[4] *B. bassiana* has already been reported to be pathogenic on bihar hairy caterpillar (*Spilosoma obliqua*).

Table 1: Effect of various treatments on the larval population of *Spilosoma obliqua* after 7, 14, 21,28 and 35 days

Treatments		7 Days	14 days	21 days	28 days	35 days
T_0	Control	0.00	0.00	0.00	0.00	0.00
T_1	Cypermethrin	100.00	100.00	100.00	100.00	100.00
T_2	Neem	3.33	3.33	56.67	73.33	90.00
T_3	Sarifa	6.67	10.00	23.33	46.67	83.33
T_4	*B. bassiana*	0.00	0.00	30.00	73.33	73.33
F- test		S	S	S	S	S
S. Ed. (±)		2.789	3.651	9.369	10.593	7.888
C. D. (P = 0.05)		5.912	7.741	19.862	22.458	16.723

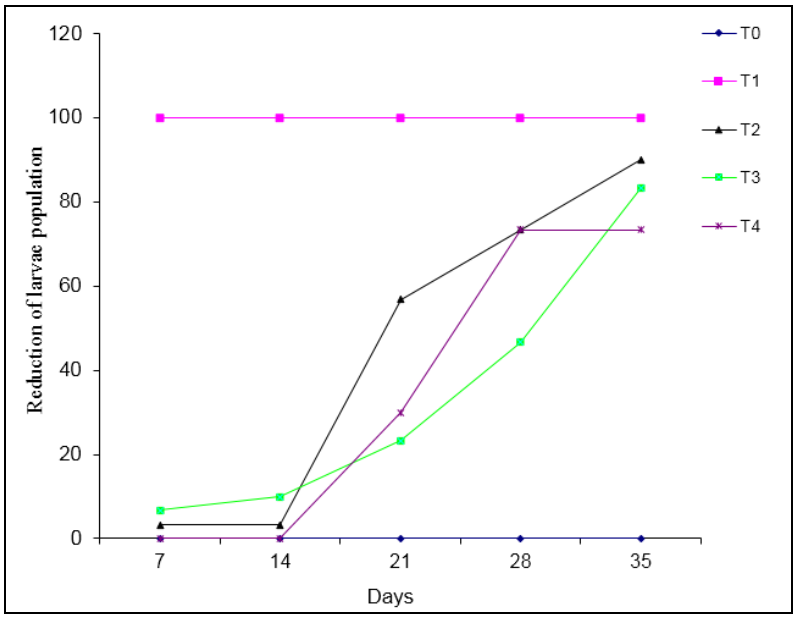

Fig 1: Effect of various treatments on the reduction in larval population of *Spilosoma oblique* after 7, 14, 21,28 and 35 days.

T_0 - Control
T_1 –Insecticide
T_2 –Neem
T_3-Sarifa
T_4- *B. bassiana*

Table 2: Effect of various treatments on pupal emergence of *Spilosoma oblique* after 7, 14, 21, 28 and 35 days

Treatments		7 Days	14 days	21 days	28 days	35 days
T_0	**Control**	0.00	0.00	0.00	40.00	100.00
T_1	**Cypermethrin**	0.00	0.00	0.00	0.00	0.00
T_2	**Neem**	0.00	0.00	0.00	0.00	10.00
T_3	**Sarifa**	0.00	0.00	0.00	3.33	16.67
T_4	***B. bassiana***	0.00	0.00	0.00	16.67	26.66
F- test		-	-	-	S	S
S. Ed. (±)		-	-	-	4.216	4.216
C. D. (P = 0.05)		-	-	-	8.939	8.939

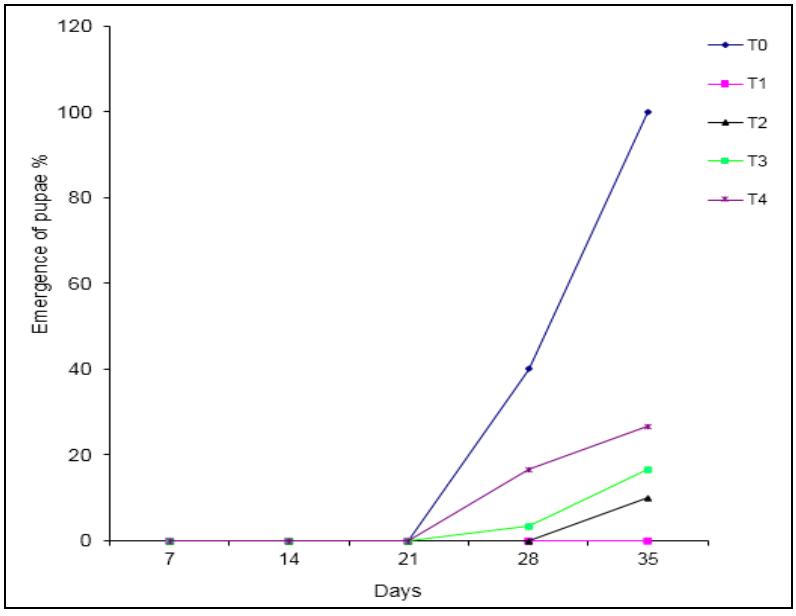

Fig 2: Effect of various treatments on pupal emergence of *Spilosoma oblique* after 7, 14, 21,28 and 35 days

T_0 - Control
T_1 -Insecticide
T_2 -Neem
T_3- Sarifa
T_4- *B. bassiana*

Fig 3: Plastic jars to test caterpillars of *Spilosoma oblique*

Fig 4: caterpillar of *Spilosoma obliqua*.

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