

Comparison of Efficacy of Synthetic Pesticides with Botanical Extracts under Field Condition on Cabbage White Butterfly (*Pieris brassicae*)

Aneela Kanwal¹, Mehboob Ahmad^{2*}, Isma Khurshid¹, Muhammad Pervaiz Khan², Shitab Khan², Imran Ullah², Farkhanda Khan², Muhammad Shahid³, Shoaibullah Bashir², Mah Rukh⁴

¹Hazara agricultural research station, Abbottabad, Pakistan

²Agricultural Research Institute, D. I. Khan, Pakistan

³Agricultural Research Station, Chitral, Pakistan

⁴Baacha Khan University, Charsadda, Pakistan

Email: *mehboobalazarwi@gmail.com

How to cite this paper: Kanwal, A., Ahmad, M., Khurshid, I., Khan, M.P., Khan, S., Ullah, I., Khan, F., Shahid, M., Bashir, S. and Rukh, M. (2021) Comparison of Efficacy of Synthetic Pesticides with Botanical Extracts under Field Condition on Cabbage White Butterfly (*Pieris brassicae*). *Advances in Entomology*, 9, 44-48.

<https://doi.org/10.4236/ae.2021.91004>

Received: November 18, 2020

Accepted: January 10, 2021

Published: January 13, 2021

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Abstract

Cabbage white butterfly (*Pieris brassicae*) is one of the important insect pests of cabbage crop which causes remarkable quantitative or qualitative crop losses. The research was conducted at Hazara Agricultural research station, Abbottabad (Pakistan) to study the effect of different new chemical insecticides, botanical oil and neem seed oil (*Azadirachta indica* A. Juss.) on the population density of *P. brassicae*. The study showed that neem oil had a significant effect on population of *P. brassicae* in comparison to control treatment. So, neem oil alone or in combination with insecticides can be used for control of *P. brassicae* in vegetable crops for a safer food supply.

Keywords

Botanical Extracts, Efficacy, Cabbage, White Butterfly

1. Introduction

Cabbage is one of the most nutritious leafy vegetables and is an excellent source of vitamin C and vitamin K. A 100 g edible portion of cabbage contains 1.8 g protein, 0.1 g fat, 4.6 g carbohydrate, 0.6 g mineral, 29 mg Ca, 0.8 mg Fe and 14.1 mg sodium [1] [2]. The production of cabbage was recorded to be 4210 tons in year 2017-2018 in Khyber Pakhtunkhwa (minfir).

The cabbage white butterfly (*Pieris brassicae*) is an important pest of cauliflower and cabbage in our region [3] as well as world [4]. 74 to 80 cm² leaf area is

consumed by the single larvae [5]. 40 percent yield loss was recorded annually in cruciferous vegetables due to this pest [6]. As a result of feeding, the plants either fail to form compact cabbage heads or produce deformed heads [7].

Keeping in view the problems caused by synthetic pesticides and their residues, need is being felt for effective biodegradable pesticides with greater selectivity. Alternative strategies have included the search for new types of pesticides which are often effective against a limited number of specific target species, are biodegradable into nontoxic products and are suitable for use in integrated pest management programs. This criterion is met by the natural plant products derived from plants and has enormous capability to replace the modern agrochemical research. When extracted from plants, these chemicals are referred to as botanicals. The use of botanical pesticides has proved to be one of the prime means to protect crops and their products and the environment from pesticide pollution. Botanicals extract has ability to degrade more rapidly than most chemical pesticides, and is, therefore, considered relatively environment friendly and less likely to kill beneficial pests than synthetic pesticides with longer environmental retention. Most of the botanical pesticides generally degrade within a few days and sometimes within a few hours [8].

Insect repellent and anti-feedant properties have been found in plants such as neem, *Azadirachta indica* A. Juss, chinaberry, *Melia azedarach* L., and *Warburgia* spp. [9]. Botanical insecticides affect only target insects and do not destroy beneficial natural enemies and provide residue-free food and safe environment. Therefore present research has been proposed on use of botanical insecticides as an integrated insect management program which can greatly reduce the use of synthetic pesticide.

2. Materials and Methods

The experiment was conducted at Hazara Agriculture Research Station Abbotabad during March-July 2019 and Cabbage seed Variety green light was sown in January and nursery was transplanted on 20th march in the field in randomized complete block design with 3 replications. Each treatment was replicated three times in a subplot size of 3 × 2 m. Row to row distance was kept 75 cm, while plant to plant distance was 45 cm. There were 4 rows in each plot and each row had 10 plants.

Two insecticidal formulations including control were tested details of which are given in **Table 1**. Fertilizer, irrigation and all other agronomic practices were carried out in the experimental field when needed. All inputs for example fertilizer application, irrigation, hoeing and other agronomic practices remained same for all cultivars. Observation on population dynamics of insect pests started as soon as their infestation was noticed. Population density was determined on randomly selected plants at weekly interval.

Observations on the *P. brassicae* population from the selected plants were recorded before spray and after 1, 3, 7 days of spray. The population density of the insect was recorded on three randomly selected plants on the basis of

Table 1. Details of products used in the experiment.

treatment	Trade name	Active ingredient	Recommended dose
T1 (synthetic pesticide)	Nova Star	Bifenthrin and abamectin	2.5 ml/litre of water
T3 (synthetic pesticide)	Range star	Lambda cyhalothrin	2.5 ml/litre of water
T2 (botanical oil)	Neem oil Purchase from local market		2 ml/litre of water

number of larvae per plant. All the open leaves and heads of the selected plants were observed thoroughly and the number of larvae found were recorded. Data obtained were analysed statistically and the efficacy of the insecticides and botanical oils were worked out.

3. Results and Discussion

1) Seasonal Incidence of *P. brassicae* larvae on cabbage

It was observed that the larvae first appeared on cabbage in the 3rd week of April, and the population peaked during the 3rd week of May 2019, and remained active up to June. In the present investigation, the number of larvae per plant ranged from 0.66 - 7.53 (Table 2). It was found that the 3rd and 4th week after transplantation is sensitive to attack of cabbage butterfly so suitable control measures should be done on this stage.

2) Population dynamics of the Cabbage butterfly on green light variety under different treatments

Population dynamics of the Cabbage butterfly on green light variety under different treatments were recorded.

Efficacy of the insecticides revealed that all the treatments at 1, 3, 7 day after spray were superior to control (Table 2). There was no significant difference between the treatments one day before spray.

The observations recorded on 1st day after spray revealed that all the treatments proved significantly superior over control. Neem seed oil T2 was found to be most effective by (1.5 larvae/plant), followed by nova star *i.e.* bifenthrin (2.83 larvae/plant) where as T3 was found to be least effective (Table 2).

After 3 days of application all the treatments proved significantly superior over control. Neem oil (2.50 larvae/plant) was found to be most effective treatment while T3 was found to be least effective having 3.667 larvae per plant.

7th day after spray revealed that all the treatments proved significantly superior over control. While neem oil (0.6 larvae/plant) was found to be the most effective treatment in reducing the larval population followed by range star and nova star showing 2 and 1.07 larvae per plant.

The relative efficacy of insecticides against the cabbage white butterfly (*P. brassicae*) showed that Neem oil had higher efficacy against *P. brassicae* in reducing pest population. Mean population of *P. brassicae* after two sprays revealed that Neem oil was effective and superior. The bifenthrin was found to be ineffective.

Table 2. Mean number of larvae under different treatments.

Treatments	Pre spray data	1 day after spray	3 rd day after spray	7 th day after spray	Means
T1 Novastar (Bifinthrine + Abamectin)	3.5	2.83de	3.167d	2e	2.66B
T2 Neem oil	3.6	1.5e	2.50de	0.667f	1.55A
T3 Range star (Lamba cyhalothrin)	3.5	3.1667d	3.667d	1.667e	2.7B
T4 (control)	3.7	4.1667c	5.83b	7.500a	5.833C
LSD value	N.S	3.700A	2.958B	2.916B	

Table 3. Yield (kg/plot) under different treatments.

S. No	Techniques	Yield (kg/plot)
1	(T1) Nova star.	26.5B
2	(T2) Neem oil	42A
3	(T3) Range star.	27B
4	(T4) control	19.5C

3) Yield

The highest yield (42 kg/plot) was noted in T2 and the lowest yield was noted in T4 (19.5 kg/plot) as presented in **Table 3**.

Our results matched with the findings of [10] who observed the repellent effect of neem (*Azadirachta indica*) against 2nd and 3rd instar larvae of *Pieris brassicae* on cabbages. All concentrations of seed kernel suspension and oil emulsion and 2% leaf water extract had a significant anti-feedant effect, reducing the mean leaf area consumed by 40% - 50%.

[11] conducted field trials in Himachal Pradesh and evaluated 8 different pyrethroids insecticides in which cypermethrin, decamethrin and fenvalerate gave complete protection to Brassica crop against *Pieris brassicae*. His study showed same result as our work explained that lambda cyhalothrine (pyrethroids) shows effectiveness to control cabbage butterfly larvae.

[12] studied the effects of Neem EC (1% azadirachtin) on the cabbage white butterfly which is major pest of cruciferous plants and found that neem extract also induced high mortality by causing lethal failures of larval-larval and larval-pupalecdysis, which were typical for insecticides possessing morphogenetic activity commonly referred to as IGR activity. His findings matches to finding of our experiment and revealed that Neem EC had toxic and antifeedant/deterrent effects but also acted as a growth regulator for *P. brassicae* larvae.

4. Conclusion

Useful insecticidal and repellent of neem oil extracts can be used to suppress the cabbage white butterfly caterpillars in food crops. In addition, insecticide-botanical combinations can provide cost-effective solutions for crop problems and can be used as an important part of integrated pest management strategies. However,

achieving more acute interactions, the synergistic mechanism between insecticides and the botanicals should be the focus in future research.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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