**ABSTRACT**

Cabbage white butterfly, *Pieris brassicae* (L., 1758) (Lepidoptera: Pieridae), is one of the important insect pest of cabbage crop which causes remarkable quantitative or qualitative crop losses. The effect of different new chemical insecticides and one botanical oil, neem seed oil (*Azadirachta indica* A. Juss.) on the population density of *P. brassicae* was studied at Hazara Agricultural research station, Abbottabad (Pakistan). 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 could be used for control of *P. brassicae* in vegetable crops for a safer food supply.

**Keywords:** Botanical extracts, white fly, efficacy

1. **INTRODUCTION**

Cabbage is one of the most nutritious leafy vegetable 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 (Ojetayo et al. 2011). In Khyber Pakhtunkhwa production of cabbage was 4210 tons in year 2017-18.

The cabbage white butterfly (*Pieris brassicae* (Linnaeus) (Lepidoptera: Pieridae)), is a serious pest of cauliflower and cabbage in our region (Shankar et al., 2016) as well as world (Hasan, 2008). A single larva can consume about 74 to 80 cm2 leaf area (Younas et al., 2004). In cruciferous vegetables, this pest alone causes 40 percent yield loss annually (Hasan and Ansari, 2010). As a result of feeding, the plants either fail to form compact cabbage heads or produce deformed heads (Uddin et al., 2007).

The problems caused by synthetic pesticides and their residues have increased the need 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. The natural plant products derived from plants effectively meet this criterion and have enormous potential to influence modern agrochemical research. When extracted from plants, these chemicals are referred to as botanicals. The use of botanical pesticides is now emerging as one of the prime means to protect crops and their products and the environment from pesticide pollution. Botanicals degrade more rapidly than most chemical pesticides, and are, 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 few days and sometimes within a few hours, (Guleria and Tiku, 2009).

Plants such as neem, *Azadirachta indica* A. Juss, chinaberry, *Melia azedarach* L., and *Warburgia* spp., have been known for insect repellent and anti-feedant properties in addition to other plants possessing insecticidal and growth regulating properties. Saxena, R. (1987). Botanical insecticides affect only target insects, 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 Abbottabad 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 3x2 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 (Table-1). Standard agronomic practices were carried out as per recommendations. Observations 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 after spray. The population density of the insect was recorded on three randomly selected plants on the basis of number of larvae per plant. All open leaves and heads of the selected plants were observed thoroughly and the number of larvae found were recorded. Data obtained were analyzed statistically and the efficacy of the insecticides and botanical oils were worked out.

3. RESULTS AND DISCUSSION

3.1 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 3rd and 4th week after transplantation is sensitive to attack of cabbage butterfly so suitable control measures should be done onstage.

3.2 Population dynamics of 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 insecticides revealed that all the treatments at 1, 3, 7 days 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) whereas T3 was found to be least effective (Table-2).

Table: 1. Details of products used in the experiment

| Treatment                  | Trade name          | Active ingredient         | Recommended dose   |
|----------------------------|---------------------|---------------------------|--------------------|
| T1(synthetic pesticide)   | Nova Star           | Bifenthrin and abamectine | 2.5ml/liter of water |
| T3(synthetic pesticide)   | Range star          | Lambda cahaloyhrine       | 2.5ml/liter of water |
| T2(botanical oil)          | Neem oil Purchased from local market | 2ml/liter of water |

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.

3.3 YIELD

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

Table 2: Mean number of larvae per plant under different treatments

| Treatments                  | Pre spray data | 1 day after spray | 3rd day after spray | 7th day after spray | Means   |
|-----------------------------|----------------|-------------------|---------------------|--------------------|---------|
| T1(Bifenthine+abamectine)   | 3.5            | 2.83de            | 3.167d              | 2e                 | 2.66B   |
| (novastar)                  |                |                   |                     |                    |         |
| T2 Neem oil                 | 3.6            | 1.5e              | 2.50de              | 0.667f             | 1.55A   |
| T3 (lambda cyhalothrine)    | 3.5            | 3.1667d           | 3.667d              | 1.667e             | 2.7B    |
| (range star)                |                |                   |                     |                    |         |
| T4(control)                 | 3.7            | 4.1667c           | 5.83b               | 7.500a             | 5.833C  |
| Lsd value                   | N.S            | 3.700A            | 2.958B              | 2.916B             |         |

Our results matched with the findings of Singh et al. (1987) who observed the repellent effect of neem (*Azadirachta indica*) against 2nd and 3rd instar larvae of *Pieris brassicae* on cabbage. 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%.

Thakur and Parmar (2000) conducted field trials in Himachal Pradesh and evaluated 8 different pyrithriod 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 cahylothrin (synthetic pyrithriod) shows effectiveness to control cabbage butterfly larvae.

Grisakova et al. (2006) 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-pupal ecdisis, 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. CONCLUSIONS
Useful insecticidal and repellent properties of neem oil extracts have been shown in the study, which indicates it 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.

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