

***ECO-FRIENDLY MANAGEMENT OF CABBAGE BUTTERFLY LARVAE (*P. brassicae*) AND ITS EFFECT ON YIELD***

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**Abstract:** Cabbage (*Brassica oleracea*) is a vital crop globally, both economically and nutritionally, providing income for farmers and serving as a dietary staple. Many insects' pests attack on cabbage crop but cabbage butterfly larvae (*Pieris brassicae*) is one of the most destructive insects. The experiment was conducted in farmer field during 2023, aimed to assess the effectiveness of botanical extracts *viz*, Tobacco fresh leaves, Chinaberry leaves, Parthenium leaves, and Green Chili extract against cabbage butterfly larvae and their influence on cabbage yield. The experiment was randomized complete block design (RCBD) with three replications and a total of two sprays was applied at 14 days interval. The results showed that Green Chili Extract was the most effective, achieving (83.70%) reduction in larval populations, followed by Chinaberry Leaves Extract (77.50%) reduction, while lowest was recorded in Tobacco Fresh Leaf Extract (69.54%) and Parthenium Leaves Extract (65.12%) had mean percent reduction respectively which was statistically non-significant. The highest yield was observed in plot treated with Green Chili Extract (784.67 kg $ha^{-1}$ ), followed by Chinaberry Leaves Extract (631.67 kg $ha^{-1}$ ), statistically significant, while Tobacco Fresh Leaf Extract (568.67 kg $ha^{-1}$ ) and Parthenium Leaves Extract (573.33 kg $ha^{-1}$ ) was statistically non-significant. Lowest yield was observed in control plot

(433.67 kg ha<sup>-1</sup>). The highest CBR was recorded in plot treated with Green Chili Extract (5.11), followed by Chinaberry (3.01), Tobacco extracts (2.95), while lowest was recorded in plot treated with Parthenium leaves (2.12). It is concluded from the study that all the botanical extracts were most effective against cabbage butterfly larvae management. It is recommended that the green chili extract showed best results among all botanical extracts. Further research is needed to explore these botanical extracts for used against different insect pests of other crops.

**Keywords:** *Cabbage butterfly, Botanical extracts, Yield and CBR*

### **Introduction**

Cabbage (*Brassica oleracea*) is a vital vegetable crop cultivated globally, but it faces substantial yield losses due to insect pests, particularly the cabbage butterfly (*Pieris brassicae*). The larvae of *P. brassicae* are notorious for their destructive feeding on cabbage leaves, leading to reduced quality and significant economic losses for farmers (Sarfranz *et al.*, 2006). Traditionally, chemical pesticides have been the primary tool for managing this pest; however, their extensive use poses serious concerns, including pesticide resistance, environmental contamination, negative impacts on non-target species, and health risks to humans (Isman, 2006).

The growing awareness of these issues has led to an increased emphasis on eco-friendly pest management strategies. These sustainable methods involve the use of botanical insecticides, biological control agents, and cultural practices that provide effective pest control with minimal environmental and human health risks. Botanical extracts such as neem (*Azadirachta indica*), tobacco (*Nicotiana tabacum*), and Chinaberry (*Melia azedarach*) are gaining popularity due to their biodegradable nature, selective toxicity, and lower risk of developing resistance in pests (Regnault-Roger *et al.*, 2012). In addition, these plant-based insecticides are often safe for beneficial insects, promoting a balanced ecosystem within agricultural fields (Dubey *et al.*, 2011).

The integration of biological control, including the use of parasitoids and predators like *Coccinella septempunctata* and *Chrysoperla carnea*, has proven to be a sustainable approach in naturally regulating pest populations (Kumar & Singh, 2018). Furthermore, cultural practices such as crop rotation, intercropping, and habitat management are crucial components of Integrated Pest Management (IPM) strategies that reduce pest pressure while maintaining environmental integrity (Pimentel, 2009). Combining these eco-friendly approaches not only provides a more resilient

method of controlling pests like the cabbage butterfly but also contributes to sustainable farming practices.

This study aims to evaluate the effectiveness of various eco-friendly management strategies for controlling cabbage butterfly larvae under field conditions. By exploring the efficacy of botanical extracts and other sustainable pest control methods, this research seeks to promote the adoption of environmentally safe pest management practices, reduce reliance on chemical insecticides, and contribute to sustainable agriculture.

## **Materials and Methods**

### **Study Area and Design**

The field experiment was conducted in the summer season at a local farmer's field in District, Loralia, Village Oryagai Kakaran, Pakistan. The experiment was Randomized Complete Block Design (RCBD) with five treatments, replicated three times. The treatments included botanical extracts from Tobacco fresh leaves, Parthenium leaves, Chinaberry leaves, and Green chili, with an untreated plot serving as the control.

### **Botanical Extracts Preparation**

**Tobacco Fresh Leaf Extract:** Fresh tobacco leaves were collected, washed, and crushed to prepare a 10% (w/v) solution by soaking 100 grams of crushed leaves in 1 liter of water for 24 hours. The mixture was then filtered through muslin cloth before application.

**Parthenium Leaves Extract:** Parthenium leaves were prepared similarly, using a 10% (w/v) concentration.

**Chinaberry Leaves Extract:** Chinaberry leaves were crushed, soaked, and filtered, following the same method as tobacco.

**Green Chili Extract:** Fresh green chili was blended, and a 5% (w/v) solution was prepared, filtered, and diluted in water before field application.

### **Application and Data Collection**

**Treatment Application:** The botanical extracts were sprayed two times on the cabbage plants at a 14-days interval using a knapsack sprayer, with the first application conducted when the cabbage larvae population was initially detected.

**Cabbage Larvae Population Monitoring:** Larvae counts were recorded at weekly intervals after treatment application. Five plants per plot were randomly selected, and the larvae on three leaves (upper, middle, and lower) were counted.

$$\text{Percent reduction} = \frac{\text{No. insects in control} - \text{No. insects in treatment}}{\text{No. insects in control}} \times 100$$

**Yield Parameters:** At harvest, yield parameters such as the number of marketable heads and total yield per hectare were recorded to assess the impact of botanical extracts on cabbage production.

$$\text{Yield (kg/ha)} = \frac{\text{Weight of fruits (kg/ plot)} \times 10000}{\text{Area of plot (m}^2\text{)}}$$

### **Statistical Analysis**

Significant differences among treatments were evaluated using the least significant difference (LSD) test at a 5% probability level.

### **Results**

The results presented in Table 1 demonstrate significant differences in the percent reduction of cabbage butterfly larval populations across the various treatments after both the first and second spray applications. Green Chili Extract was the most effective, achieving reductions of 73.70% and 76.23% in the first week and 88.59% and 96.30% in the second week, resulting in an overall mean reduction of 83.70%. This was significantly higher compared to other treatments ( $p < 0.05$ ). Chinaberry Leaves Extract also showed strong efficacy with mean reductions of 77.50%, indicating its effectiveness in managing larvae as well. In contrast, Tobacco Fresh Leaf Extract and Parthenium Leaves Extract had mean reductions of 69.54% and 65.12%, respectively, which were significantly lower than those of Green Chili and Chinaberry extracts ( $p < 0.05$ ). The statistical analysis highlights the superior performance of Green Chili and Chinaberry extracts in reducing larval populations compared to the other treatments.

### **Yield Kg/ha**

The yield results for different treatments against cabbage larvae indicated significant variations among the botanical extracts (Table. 2). Green Chili Extract produced the highest yield of 784.67 kg/ha, significantly outperforming all other treatments ( $p < 0.05$ ). This was followed by

Chinaberry Leaves Extract, which yielded 631.67 kg/ha, showing a statistically significant difference compared to the lower yields of Tobacco Fresh Leaf Extract (568.67 kg/ha) and Parthenium Leaves Extract (573.33 kg/ha). Both treatments yielded similar results and were statistically comparable to each other. The Control group had the lowest yield 433.67 kg/ha, which was significantly lower than all the treatments with botanical extracts, underscoring the effectiveness of these extracts in enhancing cabbage crop yield.

### **CBR ratios**

The cost-benefit ratios (CBR) for different botanical extracts applied against cabbage larvae revealed varying levels of economic viability (Table. 3). Green Chili Extract demonstrated the highest CBR 5.11, indicating it was the most economically effective treatment for managing cabbage larvae. This was followed by Chinaberry Leaves Extract with a CBR of 3.01 and Tobacco Fresh Leaf Extract 2.95, both of which also showed favorable economic returns. In contrast, Parthenium Leaves Extract had a lower CBR of 2.12, reflecting lesser economic efficiency compared to the other treatments. The control group served as a baseline and did not yield a CBR value, highlighting the economic advantages of using botanical extracts in pest management.

**Table.1. Effect of different treatments on the percent reduction of larval population of cabbage butterfly after 1<sup>st</sup> and 2<sup>nd</sup> spray application.**

Treatments	Percent reduction				
	1 <sup>st</sup> spray		2 <sup>nd</sup> spray		
	1 <sup>st</sup> week	2 <sup>nd</sup> week	1 <sup>st</sup> week	2 <sup>nd</sup> week	Means
Tobacco Fresh Leaf Extract	57.66 <sup>b</sup>	60.80 <sup>b</sup>	77.53 <sup>ab</sup>	82.18 <sup>ab</sup>	69.54 <sup>bc</sup>
Parthenium Leaves Extract	59.94 <sup>b</sup>	62.47 <sup>b</sup>	66.56 <sup>b</sup>	71.54 <sup>b</sup>	65.12 <sup>c</sup>
Chinaberry Leaves Extract	61.75 <sup>b</sup>	68.35 <sup>ab</sup>	85.40 <sup>a</sup>	94.51 <sup>a</sup>	77.50 <sup>a</sup>
Green Chili Extract	73.70 <sup>a</sup>	76.23 <sup>a</sup>	88.59 <sup>a</sup>	96.30 <sup>a</sup>	83.70 <sup>ab</sup>
<b>CV</b>	7.67	9.20	9.60	12.34	7.07

Significant at 5% level of significance compared with control

**Table.2. Yield Kg/ha in different treatments.**

Treatments	Yield Kg/ha
Tobacco Fresh Leaf Extract	568.67 <sup>c</sup>
Parthenium Leaves Extract	573.33 <sup>c</sup>
Chinaberry Leaves Extract	631.67 <sup>b</sup>
Green Chili Extract	784.67 <sup>a</sup>
Control	433.67 <sup>d</sup>
CV	5.09

Significant at 5% level of significance compared with control

**Table 3. The cost benefit ratio of different botanical applied against cabbage larvae.**

Treatments	Yield kg/ha	Gross income Rs.	Cost of control	Return over Control	Estimated net Benefit. (Rs. ha <sup>-1</sup> )	C: B
	A	B	C	D	E=(D-C)	F=(E/C)
<b>Tobacco Fresh Leaf Extract</b>	568.67	39806.90	3205.00	9450.00	6245.00	2.95
<b>Parthenium Leaves Extract</b>	573.33	40133.10	4605.00	9776.20	5171.20	2.12
<b>Chinaberry Leaves Extract</b>	631.67	44216.90	4605.00	13860.00	9255.00	3.01
<b>Green Chili Extract</b>	784.67	54926.90	4805.00	24570.00	19765.00	5.11
<b>Control</b>	433.67	30356.90	-----	-----	-----	-----

Average Kg=Rs.70

### Discussion

The present experiment was conducted Eco-friendly Management of Cabbage Butterfly Larvae (*P. brassicae*) under field Condition in District, Loralia, Village Oryagai Kakaran, Pakistan. The current study showed significant effect of different plant extracts to management against Cabbage Butterfly Larvae (*P. brassicae*).

Different plant extracts *viz.*, Tobacco fresh leaves, Chinaberry leaves, Parthenium leaves, and Green Chili extract. Green Chili Extract emerged as the most potent option, achieving an overall mean reduction of 83.70% in larval populations. This aligns with previous research highlighting the efficacy of Capsicum species in pest management, showcasing their potential as natural insecticides (González-Mas *et al.*, 2021). The increasing larval reduction observed with Chinaberry Leaves Extract (mean reduction of 77.50%) supports findings by Kumar *et al.* (2022), which noted that *Melia azedarach* exhibits larvicidal properties against various pest species.

In contrast, Tobacco Fresh Leaf Extract and Parthenium Leaves Extract showed lower mean reductions of 69.54% and 65.12%, respectively. This finding is consistent with studies indicating that while these extracts can provide some pest control, their efficacy is often surpassed by other botanical options (Singh & Kumar, 2020) and Hussain *et al.*, (2022).

Moreover, the yield results further emphasize the benefits of botanical treatments. Green Chili Extract yielded 784.67 kg/ha, significantly outperforming all other treatments, which corroborates findings by Rahman *et al.* (2023) on the positive impact of effective pest management on crop yield. The economic analysis revealed that Green Chili Extract also provided the highest cost-benefit ratio (CBR) of 5.11, indicating its economic viability as a pest management strategy, which is supported by the work of Duran *et al.* (2022), who found that integrating botanical extracts can enhance economic returns in agricultural practices.

In conclusion, the study highlights the potential of botanical extracts, particularly Green Chili and Chinaberry, as effective and economically viable alternatives for managing cabbage butterfly larvae. These findings encourage further research into optimizing these extracts for broader agricultural applications.

### **Conclusion and Recommendations**

The study confirmed that botanical extracts, particularly Green Chili and Chinaberry, effectively manage cabbage butterfly larvae and enhance cabbage yield. Green Chili Extract emerged as the most effective treatment, offering significant economic viability.

Farmers should adopt Green Chili and Chinaberry extracts for effective cabbage butterfly management, while further research is needed to explore their long-term efficacy and potential

combinations with other pest management practices. Training programs on the preparation and application of these extracts can enhance their utilization.

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