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ECO-FRIENDLY MANAGEMENT OF SQUASH LEAF MINER LIRIOMYZA HUIDOBRENSIS (Diptera : Agromyzidae) THROUGH HERBAL INSECTICIDES

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Abstract

A field study was conducted in Loralai during spring 2023 evaluated the efficacy of botanical insecticides against leaf miner infestations in squash. Using a Randomized Complete Block Design (RCBD) with five treatments (Neem oil 5%, Tobacco extract 2%, Chili extract 5%, Chinaberry extract 10%, and along with control), each treatment with replicated three times, the experiment assessed infestation levels over five weeks. Chinaberry extract proved the most effective, reducing mean leaf miner populations to (7.43), followed by Tobacco extract (12.42), Chili extract (13.36), and Neem oil extract (13.88). The control had the highest infestation rate (27.23). It is concluded from the study that all the botanical extracts showed best results against squash leaf miner, but botanical extract of Chinaberry extract superior efficacy against squash leaf miners. It is recommended that botanical extract of Chinaberry is batter control against leaf miner.

Key words: *Botanical extracts, Squash and Loralai*

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Introduction

Squash (*Cucurbita spp*.) refers to several species within the genus Cucurbita, including *C. maxima*, *C. mixta, C. moschata*, and *C. pepo*, which are widely cultivated for their edible fruits, vegetables, and as livestock feed. These herbaceous annual plants exhibit either trailing vine or bush-like growth forms. Vining varieties are characterized by large, lobed leaves and long stems that can climb by attaching tendrils to surrounding structures, while bush varieties occupy less space and may have prickly leaves. Squash plants produce yellow or orange flowers, and their fruits vary in color (green, white, or yellow), shape, and size, with either smooth or ridged skin. The edible fruits are commonly cooked as vegetables, and both the seeds and blossoms are also consumed (Marr *et al.,* 2004).

The Cucurbita spp. is collectively ranked among the 12 leading vegetable crops worldwide. China and India are the world leading producers. China's total squash and pumpkin production is 7.155.250 tonnes in 387.705 hectares, while India’s production is 4.900.000 tonnes in 510.000 hectares. In Pakistan, squash is cultivated on 5.86 thousand hectares which produced 57.67 thousand tones with an average production of 9839 kg per hectare Zvalo *et al.,* (2007).

Squash is attacked by many insect pests including Leaf miner, Cucumber Beetle, Squash Vine Borer, Stink Bug, Aphids and Cutworms. Leaf miners are tiny greyish black flies about 2 mm long, whose larvae (grubs) feed under the surface of leaves. Feeding causes loss of healthy leaf tissue, so the plant can't capture enough sunlight and often becomes infected with disease. Plants often fail to grow or produce crops. Leaf minor damage is caused by the larvae of some moths, flies, sawflies, or beetles. As mentioned above, the adults lay eggs on the underside of leaves. The leaf miner larvae eat the chlorophyll in the plant when they hatch from the eggs Faostat (2015).

Botanical extracts are very useful for the initial stages of the insect pest, as botanical extracts have advantage to less harmful for human health, ecofriendly, safe natural enemies and other animals. It is good alternative to chemicals pesticides and most of botanical extracts have low toxicity to mammalian (Rizvi *et al* 2016).

MATERIALS AND METHODS

A study on "Eco-friendly of management strategies for leaf miner infestation in squashes" was initiated at the farmers field in Loralai during spring season of year 2023. Squash seeds were purchased from local market of Loralai and sown into prepared field during last week of February. The Experiment was carried out in RCBD with 5 treatments including control. Each plot size was kept 8m x 3.5m with plant-to-plant distance 50cm. Each treatment was replicated three times. All treatments including generic, and an insecticide were applied through Knapsack sprayer. The control plot was left untreated.

Table 1: Detail of bio pesticides

Treatments		Scientific Name	Concentration (%)
T1	Neem oil		5
T2	Tobacco	*Nicotiana tabacum*	2
T3	Chili extract	C*apsicum spp*	5
T4	Chinaberry	*Melia azedarach*	10
T5	Control	-	-

Preparation of Plant Extract: -

Field solution of Chili was prepared by following method of Reddy and Sasikala, 2013 and Fatima *et al*., 2015. Neem oil and Tobacco was obtained by the method develop by Sohail *et al.,* 2012. Field solution of Chinaberry was prepared by the following procedure of Hussain *et al.,* 2022, Jazzar *et al* 2003, Hammad *et al* 2000 and Banchio *et al.,* 2003.

Parameter

Population of Leaf miner: Mean number of leaf miner population was recorded on 3 randomly selected plants from each experimental plot. From each selected plants 3 leaves were randomly selected, and leaf miner numbers were counted. Data were recorded 1day before spray and at the frequency of 1day, (1, 2,3,4, 5) weeks after spray respectively.

Statistical Analysis: Data on the above parameters were analyzed through STATISTIX 8.1 and means were separated by using LSD test at P=0.05%.

Results

The experiment evaluated the effectiveness of various botanical insecticides on leaf miner infestation in squash plants over a five-week period. The treatments included neem oil extract, tobacco extract, chili extract, and chinaberry extract, with an untreated control for comparison.

At baseline, Neem oil extract had an infestation of leaf miner per plant 19.33, tobacco extract 16.02, chili extract 16.23, chinaberry extract 15.33, and control 13.33 respectively. One week after treatment, Chinaberry extract showed the lowest infestation rate per plant 7.03, followed by Chili extract at 8.34, Tobacco extract 9.02, and neem oil extract 10.23. The control group had the highest infestation rate 18.66. This trend continued over the subsequent weeks. By the second week, Chinaberry extract maintained the lowest infestation rate per plant 5.12, significantly outperforming all other treatments. Neem oil extract and Chili extract had moderate rates of 10.35 and 9.01, respectively, while the control group's infestation rate increased to 24.25.

In the third week, Chinaberry extract continued to show the lowest infestation rate at 4.13, while Neem oil extract and Chili extract showed moderate effectiveness with rates of 14.12 and 12.47, respectively. The control group’s infestation rate rose further to 30.25. In the fourth week, Chinaberry extract remained the most effective with an infestation rate of 3.65. Neem oil and Chili extracts had rates of 16.12 and 17.46, respectively, showing moderate effectiveness. Tobacco extract showed a higher rate of infestation per plant 15.65 compared to its earlier performance. The control group had the highest infestation rate 35.64.

By the fifth week, Neem oil extract, Chili extract, and Chinaberry extract continued to perform better than the control, with infestation rates of 13.12, 16.65, and 9.33, respectively. Tobacco extract showed a significant drop in effectiveness with an infestation rate per plant 6.46. The control group's infestation rate peaked 41.25. Overall, Chinaberry extract had the lowest mean infestation rate of 7.43, followed by Tobacco extract at 12.42, Neem oil extract at 13.88, and Chili extract at 13.36. The control group had the highest mean infestation rate at 27.23.

In conclusion, Chinaberry extract proved to be the most effective botanical insecticide against leaf miners in squash, demonstrating the lowest mean infestation rate of 7.43. Neem oil extract, Chili extract, and Tobacco extract also showed effectiveness with mean rates of 13.88, 13.36, and 12.42, respectively. The untreated control group had the highest mean infestation rate of 27.23, underscoring the importance of these treatments in managing leaf miner infestations.

Table 1: Effect of chemicals and botanical insecticides against on leaf miner in squash before and after different spray application in different week interval.

Treatments	BSD	1week	2week	3week	4week	5week	Mean
Neem oil extract	19.33 a	10.23 b	10.35 b	14.12 a	16.12b	13.12b	13.88 b
Tobacco extract	16.02 a	9.02 ab	11.04 b	16.35 b	15.65a	6.46c	12.42b
Chili extract	16.23 a	8.34 c	9.01 b	12.47 a	17.46 b	16.65 b	13.36 b
Chinaberry extract	15.33 a	7.03 c	5.12 c	4.13 bc	3.65bc	9.33c	7.43 b
Control	13.33 a	18.66 a	24.25 a	30.25 a	35.64 a	41.25a	27.23 a
LSD	NS	10.07	13.136	11.45	13.51	14.15	14.86

Means followed by same letters within a column are not significantly different at 5% level of significance (LSD test).

Discussion

Recent studies continue to explore the efficacy of botanical insecticides in managing leaf miner infestations, reflecting advancements in understanding their modes of action and environmental impact. The baseline infestation levels in this study were consistent across treatments and the control group, providing a reliable starting point for evaluating treatment effectiveness.

Chinaberry extract emerged as the most effective treatment, consistently reducing leaf miner infestation rates over the five-week period. This aligns with recent research highlighting the potent insecticidal properties of Chinaberry extracts, attributed to compounds like azadirachtin and salannin, which disrupt insect growth and development effectively (Isman, 2020) and Hussain *et al* (2022). These natural compounds offer a promising alternative to synthetic pesticides, potentially reducing environmental impact and promoting sustainable pest management practices.

Neem oil extract also demonstrated moderate effectiveness throughout the study period, corroborating findings from recent studies that emphasize its ability to disrupt insect growth and development through multiple mechanisms, including antifeedant and growth regulatory effects (Isman, 2019). The consistent reduction in infestation rates with neem oil extract underscores its potential as a key component in integrated pest management strategies.

Chili extract, known for its active ingredient capsaicin, showed varying effectiveness but generally maintained lower infestation rates compared to the control group. Recent studies suggest capsaicin's role in deterring and repelling pests, highlighting its potential as a natural insecticide (Govindarajan *et al.,* 2020). However, its efficacy can be influenced by environmental conditions and concentration used in formulations.

Tobacco extract exhibited initial efficacy but experienced decreased effectiveness by the fifth week, which may be attributed to factors such as rapid degradation of active compounds or potential development of resistance in pest populations (Duan *et al.,* 2021). Further research into optimizing formulation and application techniques could enhance its long-term efficacy in pest management.

The control group consistently showed the highest infestation rates, emphasizing the urgent need for effective pest control measures in agricultural settings. The untreated plants' escalating infestation rates underscore the rapid reproductive potential of leaf miners in the absence of intervention, highlighting the economic and ecological importance of implementing effective pest management strategies.

Conclusion and Recommendation

Chinaberry extract was the most effective botanical insecticide for managing squash leaf miner infestations. Neem, chili, and tobacco extracts also showed potential. The control group’s high infestation highlights the value of botanical insecticides. Chinaberry extract is recommended for squash leaf miner control, with other extracts as secondary options depending on application methods.

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Novelty Statement

The study is novel in describing the use of plant extracts as an alternative to pesticides which are friendly to environment, human health and biocontrol.

Conflict of interest

The authors have declared no conflict of interest.

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