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Efficacy of Botanical Extracts and a Synthetic Insecticide against Tomato Leaf Miner (*Tuta Absoluta*) (Meyrick) (Lepidoptera: Gelechiidae) on Tomato

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ABSTRACT

Tomato is the most important crop all over the world. Due to several factors to minimize the production of the crops. Large number of insect pests attack from vegetative to reproductive growth of the plant. The present experiment was conducted to evaluate the efficacy of different plant extracts and chemical insecticide against tomato leaf miner (*Tuta absoluta*)during 2021 at the Agriculture Research Institute (ARI), Mingora Swat. The insecticides used with concentration i.e.Eucalyptus leaves extract (10%), Tobacco leaves extract (10%), Onion bulb extract (20%), Garlic cloves extract (10%), Neem leaves extract (10%) and a synthetic insecticide Lambda cyhalothrin (2.5% EC) were spraying three times at 14 days interval. The experiment was Randomized complete block design (RCBD) with three replicates. The minimum mean percent damage was recorded in plot treated with lambda cyhalothrin (5.56), followed by neem leaves extract (9.73), Onion bulb (12.80), Eucalyptus leaves (13.25), Tobacco leaves (13.56) and Garlic bulb (13.61)respectively. The maximum mean percent damage was observed in untreated plot (37.02). The highest yield and CBR was reported in plot treated with lambdacyhalothrin (2761.7 kg ha^{-1}, 1: 5.93) and followed by Neem extract (2279 $kgha^{-1}$, 1: 4.55). All the insecticides reduce the percent damage of tomato leaves but chemical insecticides Lambda cyhalothrin gave better result as the rest of the other botanical extracts against tomato leaf miner. The insecticides Lambda cyhalothrin is recommended for quicker action while botanical extracts are recommended for safe control of tomato leaf miner and

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environment.

Key Words: Tomato, Chemical, Plant Extracts, Leaf miner, Swat.

INTRODUCTION

Tomato belong to the family Solanaceae is an important vegetable ranked 3rd after potato. It is highly nutritious, edible and used in many products via cooking purposes, as salad and as ketchup after processing (Akhtar *et al.,* 2010; Saeed *et al.,* 2007). Tomato is healthy and balanced food with high minerals, vitamins, dietary fibers, sugar contents and essential amino acids. It is rich source of phosphorous, iron, vitamin A, B and C. Lycopene act as an antioxidant are present mostly in red tomato provide protection against carcinogenic substances (Khokhar *et al.,* 2013).

The optimum temperature requirements for tomato ranges from 21-24°C, hence grown in wide range of climatic and environmental conditions (Naika *et al.,* 2005). The total production of tomato in Pakistan was 561293 tons cultivated with an area of 101577hectare(FAO, 2019). In Punjab, tomato is cultivated on 6556 ha area with production of 86269 tons. In KPK, 5812 ha area is under cultivation with production of 66420 tons. The total production of Baluchistan is 87753 tons from 6609 ha land while the total production of Sindh is 73275 tons cultivated in an area of 3542 ha (MNFSR 2018-019).

The production of tomato in Pakistan is comparatively very lowdue to certain factors including insect pests. The pest infest different growth stages and reduce the tomato production considerably (Hoffmann *et al.,* 2007). The pest not only damage fruit but also attack on flowers, leaves and stem. The fruit borer cause highest economic damage, leaf miner, lead footed bugs, stink bug and aphids also to contribute to less yield. Leaf miner (*Tuta absoluta,* Meyrick) is an emerging issue to tomato that cause up to 50-80% damage (Haque, 2015).

Tomato leaf miner is an oligophagous insect not only damage tomato but also infest potato, pepper and eggplant in greenhouses (Suinaga et al., 1999; Notz, 1992). In Southern America the pest cause up to 80-100% destruction when left untreated (Swathi *et al.,* 2017; Brevault *et al.,*

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2014;Desneux *et al.*, 2010).

Different control measures including physical, biological, chemical and cultural method are used for management of tomato pests (Bajwaand Kogan, 2004). Chemical insecticides are extensively used lead to development of resistance in pest causes food loss. Plant extracts showed alternative of chemical insecticide (Sithisut *et al.,* 2011). The attack of pest cause losses of billions of dollars annually (Pereira *et al.,* 2006).The insecticides show multiple resistance in insects like neurotoxic, teratogenic and mutagenic and deplete ozone layer (Regnault *et al.,* 2012). Botanical extracts are friendly to the environment and are less injurious compared to insecticides thus comes under the category of green insecticides. About 2400 bioactive plants species have been identified having pesticide properties (Karunamoorthi, 2012).

Keeping in view the importance of the destructive pest, the study wasplannedwith the primary goalto evaluate the efficacy of 5 botanical insecticides along with a synthetic insecticide against *T. absoluta* in tomato crop.

MATERIALS AND METHODS

The research was carried out at Agriculture Research Institute, Swat during 2021 to study the efficiency of botanical extracts and a synthetic insecticide against tomato leaf miner (*T. absoluta*) in tomato.

Experimental Design

Randomized complete block design (RCBD) was used with 7 treatments including control replicated 3 times. The nursery wasgrown in March, 2021 for F1 hybrid (1359) variety of tomato and plantation was done in May, 2021. Row to Row distance was kept 3ft and plant to plant distance was kept 1.5ft followed by uniform agronomic practices in each and every treatment. Randomly 5 plants were selected from each replication which were divided into top, middke and bottom portions to record number of larvae of tomato leaf miner damaged the leaves. The data were then converted into percent damage. The yield of each treatment was taken separately to estimate the yield from initial to final picking for comparison.

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Preparation of Botanical extracts

Garlic Bulb Extract

The garlic bulb extracts was prepared by crushing 20gm of dried bulb. The crushed bulb were added to 100ml of water for 24hrs and filtered by using muslin cloth to prepare 1 liter stock solution.

Tobacco Extract

Tobacco extracts were obtained by crushing 30gm dried tobacco leaves and added to 150ml of water for 24hrs. The solution were then filtered through muslin cloth to get field solution at @ of 6 ml in one liter of water, (Sohail *et al.*, 2012).

Neem Leaves Extract

To get neem extracts 50gm of dried leaves were taken and added to 500ml of water. The solution were then filtered by muslin cloth through Whatman No.1 (Hany and Yehia, 2016).

***Eucalyptus* leaves extract**

The collected leaves were dried for 2 days in shady place and chopped into powder. The dried powder (6g) were kept in 60ml of water for 24hrs and filtered through Whatman No. 1 filter paper to get the field solution.

Onion Bulb Extract

To get onion bulb extracts, 20gm of onion bulbs were collected and rinsed with distal water. The onion were cut into pieces and grinded with juicer. The onion were then mixed with 200ml of water for 48hrs. The solution were then filtered through fine muslin cloth and added with 1 liter of water for field application.

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Table 1. Treatments with recommended dose and concentrations against tomato leaf miner

S.No.	Treatments	Scientific Name	DOSE ml/l	Concentration
1	Eucalyptus leaves extract	*Eucalyptus globulus*	100ml/liter	10%
2	Tobacco leaves extract	*Nicotiana tabacum*	60ml/liter	10%
3	Onion bulb extract	*Allium cepa*	200ml/liter	20%
4	Garlic cloves extract	*Allium sativum*	100ml/liter	10%
5	Neem leaves extract	*Azadirachta indica*	100ml/liter	10%
6	Synthetic insecticide	Lambda cyhlothrin	2ml/liter	2.5% EC
7	Control		-	-

CBR and Yield kg ha^{-1}

The method of Hussain *et al.* (2022) was followed to find the best treatment in term of CBR. The yield was calculated after each picking by the following formula:

$$\text{Yield kg per ha}^{-1} = \frac{\text{Yield weight}}{\text{Area harvested } (m^2)} \times 10000$$

Statistical Analysis

The data was analyzed by STATISTIX 8.1 and means were separated by LSD test at 5% level of significance.

RESULTS

The data recorded of tomato leaf miner before spray application was non-significant in all the treatments among untreated plots.

After 7th DAS (Table .2) of first spray application the reported showed that the least percent damage was observed in treated plot lambda cyhalothrin (4.21), followed by neem extract (10.41), onion extract (16.66), tobacco extract (17.60), eucalyptus extract (18.10) and garlic extract (22.03) respectively. Plots treated with eucalyptus and tobacco extract was non-

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significant to each other. Untreated plot (34.26) showed that maximum percent infestation was reported as compared the treated plots.

After 14DAS application the least percent damage was reported in plot treated in lambda cyhalothrin (2.71) and followed by neem extract (8.08), tobacco extract (10.93), eucalyptus extract (12.43), onion extract (13.00) and garlic extract (13.43) respectively while highest percent damage was recorded in untreated plot (39.10). The result showed that tobacco extract eucalyptus extract onion extract and garlic extract was non-significant to each other as the rest of other treatments.

After 21DAS application the least percent damage was reported in plot treated with lambda cyhalothrin (1.32), followed by neem extract (5.45), garlic extract (9.05), eucalyptus extract (9.38), tobacco extract (9.60) and onion extract (10.44) respectively. While highest percent damage was observed in untreated (40.96).The treated plot of lambdacyhalothrin and neem extract showed significant effect at the rest of the other treatments.

After 28DAS application the least percent damage was reported in plot treated with lambda cyhalothrin (1.18), followed by neem extract (5.06), garlic extract (7.72), eucalyptus extract (8.05), onion extract (8.13) and tobacco extract (10.52) respectively. While highest percent damage was reported in untreated plot(42.66).Results showed that the botanical extracts of garlic extract eucalyptus extract onion extract and tobacco extract was non-significant each other. While chemical insecticides lambda cyhalothrin treated plot and botanical extract of neem extract are significant from each other.

After 35DAS application the results revealed that the least percent leaf damage was reported in plot treated with Lambda cyhalothrin(1.047), followed by neem extract (6.83), garlic extract (8.22), onion extract (8.42), tobacco extract (9.66) and eucalyptus extract (9.91) respectively. While in untreated plot the highest percent leaf damage was recorded in(35.80). The botanical extracts treated plots i.e.Neem extract, Garlic extract, Onion extract, Tobacco extract, Eucalyptus extract was non-significant to each other.

After 42DAS application results showed that the least percent damage of tomato leaf miner was reported in plot treated with Lambda cyhalothrin (0.88), followed by neem extract (4.55), garlic

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extract (5.48), onion extract (5.61), eucalyptus extract (6.39) and tobacco extract (6.44) respectively. While in untreated plot (35.80) the highest percent damage of tomato leaf miner was observed. All the botanical extracts treated plots was non-significant.

The overall means of tomato leaf miner percent leaf damage infestation results revealed in afterdifferent weeks of spray application. The least means percent damage reported in plot treated with lambda cyhalothrin (5.56), followed by neem extract (9.73),Onion bulb (12.80), eucalyptus extract (13.25), tobacco extract (13.53) and Garlic bulb (13.61) respectively. The highest percent leaf damage was observed inuntreated plot (37.02). The botanical extracts onion extract, eucalyptus extract and tobacco extract and garlic extract treated plot were non-significant.The chemical insecticides lambda cyhalothrin and botanical extract of neemwas significantresults from each other.

Yield of tomato crop (kg ha^{-1}) and CBR

The maximum yield of tomato crop (Table 3) was reported in plot treated with lambda cyhalothrin (2761.7 kg ha^{-1}), followed by neem extract (2279.3 kg ha^{-1}), onion extract (2079.0 kg ha^{-1}), garlic extract (2061.7 kg ha^{-1}), tobacco extract (1970.0 kg ha^{-1}) and eucalyptus extract (1968.0 kg ha^{-1}) respectively, The botanical extracts of neem extract, onion extract, garlic extract, tobacco extract, eucalyptus extract wasnon-significant. While minimum yield was reported in untreated plot (1577.7 kg ha^{-1}). Theeconomics of different botanical extracts and a synthetic insecticide is presented in table (4). The highest CBR was reported in plot treated with Lambda cyhalothrin (1:5.93), followed by neem extract (1:4.55), onion extract (1:4.03), tobacco extract (1:3.93), garlic extract (1:3.74) and eucalyptus extract (1:2.23) respectively.

DISSCUSION

The experiment was conducted ‘To evaluatethe efficacy of different botanical extracts and a synthetic insecticide against tomato leaf miner (*T. absoluta*) tomato in district Swat Khyber Pakhtunkhwa Pakistan 2021.

The dataof tomato leaf miner was recorded one day before treatment application and then after 7day, 14days, 21days, 28days, 35 days and 42 days after spray application. Before spray

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application of different treatments are non-significant. This resultis similar to the result of Hussain *et al*. (2022). After 1st application the least percent damage was observed in Lambda cyhalothrin treated plot.While maximum percent damage was observed in untreated plot. Same results were reported in 2nd and 3rd spray application. The findings are similar to the finding of Bughdady *et al*, (2020) Nesreen *et al.* (2020), Kar (2017) and Bala *et al.* (2019) who also reported that lambda cyhlothrin used against tomato leaf miner as most effective. Same results were also found by Alam *et al*, (2019) and Illakwahhi *et al*, (2017). That neem leaf extract was most effective against tomato leaf minor in all the tested botanicals insecticides which is at par with findings of the current study.

The chemical insecticides and botanical extracts wereaffected the yield of the crop. The maximum yield was observed in plot treated with lambda cyhalothrin (2761.7kg ha^{-1}) followed by neem extract (2279.3 kg ha^{-1}), onion extract (2079.0 kg ha^{-1}), garlic extract (2061.5 kg ha^{-1}), tobacco extract (1970.0 kg ha^{-1}) and eucalyptus extract (1968.0 kg ha^{-1}) respectively. While minimum yield 1577.7 kg ha^{1} was noted in untreated plot. These finding are similar to the findings of Floret *et al* (2019), Noor *et al*, (2015), Badii *et al* (2015) and Singh *et al*, (2005) who reported that lambda cyhalothrin gives maximum production in tomato crop. Usman *et al*, (2012) also recorded that neem leaf extract application provided maximum yield of tomato. CBR of different treatments was checked. The chemical insecticides lambda cyhalothrin showed least cost of control and gave maximum yield at the rest of the other treatments. Highest CBR was reported Lambda cyhalothrin (1: 5.93) and followed by Neem extract (1: 4.55).

CONCLUSION AND RECOMMENDATIONs

All the insecticides showed to reduce the pest infestation. But chemical insecticides Lambda cyhalothrin showed better results as compared to botanical extracts against tomato leaf miner. Highest yield and highest CBR was also reported in plot treated with Lambda cyhalothrin. The botanical extracts is recommended because environment friendly and avoid food poisoning in daily life.

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Table 2. Percent leaf damage of tomato leaf miner (*Tuta absoluta*) infestation treated with botanicals extracts and Synthetic insecticide at different week's interval during 2021 at Swat.

Treatment	24hrs BSA	% Damage of tomato leaf miner after Spray						
		7DAS	14DAS	21DAS	28DAS	35DAS	42DAS	Means
Eucalyptus leaves	28.85a	18.10 bc	12.43 b	9.38 b	8.05 c	9.91 b	6.39 b	13.25b
Tobacco leaves	29.96a	17.60 bc	10.93 bc	9.60 b	10.52 b	9.66 b	6.44 b	13.53b
Onion bulb extract	28.05a	16.66 c	13.00 b	9.74 b	8.13 bc	8.42 bc	5.61 bc	12.80b
Garlic cloves extract	29.31a	22.03 b	13.43 b	9.05 b	7.72 c	8.22 bc	5.48 bc	13.61b
Neem leaves extract	27.75a	10.41 d	8.08 c	5.45 c	5.06 d	6.83 c	4.55 c	9.73c
Lambda cyhalothrin	27.55a	4.21 e	2.71 d	1.32 d	1.18 e	1.04 d	0.88 d	5.56d
Control	29.75a	34.26 a	39.00 a	41.79 a	42.66 a	35.80 a	35.80 a	37.02a
LSD value	5.35	5.11	3.12	3.31	2.45	1.95	1.50	1.53

Any two means having similar letters in a column are significantly not different on 5% level of significance

Table 3. Mean yield (kg ha^{-1}) of tomato (*Lycopersicon esculentum*) after treated with different botanical extracts and synthetic insecticide against tomato leaf miner (*Tuta absoluta*).

S.NO.	Treatments	Yield (kg ha $^{-1}$)
1	Eucalyptus leaves extract	1792.0 d
2	Tobacco leaves extract	1970.0 cd
3	Onion bulb extract	2079.0 bc
4	Garlic cloves extract	2061.7 c
5	Neem leaves extract	2279.3 b
6	Lambda cyhalothrin	2761.7 a
7	Control	1577.7 d
	LSD value	203.84

Means of different letters indicates in each column are statistically significant to each other at

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5% level of significance ANOVA followed by LSD Test.

Table 4. Cost benefit ratio of Different Botanical extracts and Synthetic Insecticide against Tomato leaf miner (*Tuta absoluta*) in district Swat 2021.

Treatments	Marketable Yield (kg ha^{-1})	Gross Income	Cost of Control	Return Over Control	Net Increase Over Control	CBR
	A	B	C	D=B-C	E=D-C	F=D/C
Eucalyptus leaves extract	1792	85560	15345	70215	54870	2.76
Tobacco leaves extract	1970	88650	14943	73707	58764	3.93
Onion bulb extract	2079	93555	15520	78035	62515	4.03
Garlic cloves extract	2061	92745	16150	76595	60445	3.74
Neem leaves extract	2279	102555	15650	86905	71255	4.55
Lambda cyhalothrin	2761	124245	15660	108585	92925	5.93
Control	1544	69480				

Authors' Contributions
Afsar Ali: Conducted research work.
Syed Fahad Shah: Main Supervisor.
Tahir Zaman and Riaz Hussain: Wrote the Article.
Muhammad Kiramat Shah, Sanaullah Khan and Muhammad Adnan Khan: Proof reading.
Muhammad Amin: Co-Supervisor
Muhammad Usman: Financial Support.

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