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Eco-friendly Management of Garlic Thrips (*Thrips tabaci*) (Thysanoptera: Thripidae) through different Herbal Pesticides

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ABSTRACT

Garlic (Allium sativum) is the most important vegetable crop in Pakistan. Many insect pests attack the garlic crop, but thrips are the most important one. The experiment was conducted in a local farmer field at District Swat and randomized complete block design was followed with three replications. The plant extracts were used were viz., Tobacco leaves Extract 50%, Neem leaves Extract 50%, and Parthenium leaves Extract 50%, and Chinaberry fruit extract 50% respectively. The lowest means percent infestation (6.53, 2.03) and highest % reduction (87.20, 96.23) after both spray application was recorded in plots treated with chinaberry fruit extract. The plot treated with Neem leaves extract and Tobacco leaves was found least effective with maximum percent infestation (8.27, 4.23) (8.83, 3.93) and minimum reduction (78.07, 88.80) (76.23, 88.60) in thrips population and was found similar to each other. The untreated plot had the highest rate of infestation (26.4). It is concluded from the current study that all the botanical extracts gave a significant result against garlic thrips. But botanical extracts of Chinaberry fruit extract gave best results as compared to other plant extracts.

INTRODUCTION

Garlic (*Allium sativum*) is economically one the most important vegetable crop grown in Pakistan. Pakistan's local production of garlic meets only two-thirds of its domestic needs. For that reason, Pakistan imported 61,688 tonnes of garlic worth $68.7 million (Rs11 billion) in 2021, whereas the import value was even higher in 2020, standing at $102m, according to International Trade Centre data Garlic is cultivated on 13,347 hectares, primarily in Punjab and Khyber Pakhtunkhwa, with a production volume of 127,463 tonnes (2020-2021) (FAO 2021). With a current yield of 9.55 tonnes per hectare, Pakistan only needs an additional 6,460 hectares to bridge the current demand gap. This target is achievable as there are at least 15 districts in Pakistan where garlic is cultivated on a significant area. Garlic consumption has been significantly increasing

worldwide because of certain health benefits (Havey *et al.*, 2004; CSA, 2012).

Several sucking insect pests are responsible for garlic damage. The most damaging insect to garlic is *Thrips tabaci* (Thysanoptera: Thripidae), which is detrimental in both nymph and adult stages (Atwal, 1976). The infected leaves progressively get wrinkled, curled, and dried out. Heavy infection causes the plant to cease bulb growth and prevents the generation of flowers and seeds (Atwal, 1976). Thrips cause production losses of up to 59 percent and are widespread in all onion-growing regions (Waiganjo *et al.*, 2008).

Throughout the growing season, farmers use many pesticides for thrips management. The insect is prevalent on the plant's inner leaves and pupates in the soil, rendering the use of pesticides ineffective. Moreover, the pest has several generations that overlap (Alimousavil et al 2007; Nault and Shelton, 2010; Shelton *et al.*, 2006). Additionally, *Thrips tabaci* has exhibited resistance to several commonly used insecticides (Martin *et al.*, 2003). The excessive use of pesticides results in pesticide residues, pest resurgence, and pest resistance, which cause environmental contamination and the extinction of beneficial insects (Adilakshmi *et al.*, 2008).

For safe application, it is necessary to combine this pesticide with other control measures, such as plant extracts. Numerous plant extracts have shown broad-spectrum action and may thus replace commercial pesticides. Botanicals are effective and environmentally benign; thus, these botanicals should be used to combat issues caused by other pesticides (Sohail et al., 2015). Botanicals and novel pesticides might be conveniently used to manage the pest at a low cost. Keeping in mind the significance of onion thrips, the purpose of this study was to assess the efficacy of botanicals and recently developed chemicals for the control of garlic thrips.

MATERIAL AND METHODS

Garlic thrips, *Thrips tabaci*, Lind were the focus of the experiment conducted in 2021-22 at farmer field in Malam Jaba Swat. The aim was to modify eco-friendly management of garlic Thrips (Thysanoptera: Thripidae). The seedlings of Chinese · MJ-84 variety were purchased from local market and was planted in the selected area.

Botanicals Extracts

The extracts were prepared by crushing the leaves and fruits of the plants (500 g/L water) and were sprayed to minimize the pest infestation.

Table 1

S. No.	Treatments	Concentrations
1	Tobacco leaves Extract 50%	500 gm/ l of water
2	Neem leaves Extract 50%	500 gm/ l of water
3	Parthenium leaves Extract 50%	500g/l of Water
4	Chinaberry fruit extract 50%	500g/l of Water
5	Control	————

Experimental Design

The research trial was replicated three times using a Randomized Complete Block Design (RCBD) with nine treatments, including the control. Row-to-row spacing was maintained at 50cm, while plant-to-plant spacing was maintained at 10cm.

Frequency of Spraying Botanical extracts in the Field

During the plant's growth stage, the prepared botanical and synthetic pesticides were sprayed three times. Each spray was applied every two weeks on the field keeping in view the ETL of the pest.

Data Collection

To compare the population of garlic thrips before and after spraying, 5 plants were chosen randomly, and the population was recorded at regular intervals. The pre-spray data were collected 24 hours prior to spraying and then after weekly interval. The thrips were counted, and their mean was calculated. When the thrips population per plant reached 15-20, plant extracts and pesticides were applied. To determine the efficacy of each pesticide and plant extract, the number of thrips on five randomly chosen plants from each replication was recorded.

Data Analysis

Statistical software (Statistix 8.1) was used to examine the data collected. ANOVA (Analysis of Variance) was created to test the significance of difference between variables means were separated by LSD (Least Significance Difference) test at 5% significance level. Shiberu and Negeri, (2014) reported the efficacy percentages by using the following formulas:

$$\text{Efficacy (\%)} = \frac{\text{Pre spray count} - \text{Post spray count}}{\text{Pre spray count}} \times 100$$

$$\text{Reduction efficacy\%} = \frac{\text{Control count} - \text{Post spray count}}{\text{Control count}} \times 100$$

RESULTS

Mean infestation of garlic thrips/plant after 1st spray

Thrips are a constant problem in all onion-growing regions. In Table 2, the mean % infection of garlic thrips plant^{-1} 24 hours before spray application was statistically insignificant. After 7 days of spray, the plots treated with chinaberry fruit extract had the lowest mean percent infestation (5.90), which was statistically similar with plot treated with parthenium leaves extract (6.80) followed by Neem leaves extract (8.10) and Tobacco leaves extract (8.20) which was in line with each other. The untreated plot exhibited highest rate of thrips infestation (26.20).

After 14 days of spray, similar trend was observed. The plot treated with Chinaberry fruit extract had the lowest percent infestation (3.20), significantly non-significant with plot treated with parthenium leaves extract (4.20) followed by Neem leaves extract (5.60) and Tobacco leaves extract (6.20), which was statistically similar to each other. The average rate of infestation was highest in the control group (27.40).

After 21 days of spray, the plot treated with Chinaberry fruit extract had the lowest percent thrips infestation (1.10), followed by Parthenium leaves extract (2.20) while the highest infestation was noted in control plot (27.07). The plots treated with Neem leaves extract (3.87) and Tobacco leaves extract (4.67) showed statistically similar thrips infestation.

Mean data after 3 weeks of spray indicated that the lowest means percent infestation was recorded in plot treated with Chinaberry fruit extract (6.53) followed by Parthenium leaves extract (7.20). The percentage of thrips infection was recorded higher in the untreated plot (24.30). The plots treated with Neem leaves extract (8.27) and Tobacco leaves extract (8.83) showed statistically similar thrips infestation.

Table 2

Means population of thrips per plant after 1st spray application at different days interval during 2021-22

Treatment	Means population of thrips per plant				
	24BSA	7DAS	14DAS	21DAS	Means
Tobacco leaves Extract	16.30^{a}	8.20^{b}	6.20^{b}	4.67^{b}	8.83^{b}
Neem leaves Extract	15.60^{a}	8.10^{b}	5.60^{b}	3.87^{b}	8.27^{b}
Parthenium leaves Extract	15.70^{a}	6.80^{c}	4.20^{c}	2.20^{c}	7.20^{c}
Chinaberry fruits extract	15.80^{a}	5.90^{c}	3.20^{c}	1.10^{d}	6.53^{d}
Control	16.50^{a}	26.20^{a}	27.40^{a}	27.07^{a}	24.30^{a}
CV	6.26	5.57	7.37	6.15	5.45

Different letters indicates that the treatments are significant at P value (0.05)

Mean Infestation of Garlic Thrips/plant after 2nd Spray

Table 3 indicated that the mean % infection of garlic thrips plant^{-1} 24 hours before 2nd spray application was statistically significant. The lowest mean infestation was recorded in Chinaberry fruit extract (4.83), which were statistically insignificant with Parthenium leaves Extract (5.47) and Tobacco leaves Extract (6.13), followed by Neem leaves Extract (7.27). The untreated patch exhibited highest rate of infestation (27.37).

After 7 days of spray, the plot treated with chinaberry fruit extract demonstrated the lowest mean percent infestation (1.77), which statistically in line with plot treated with parthenium leaves extract (2.67), followed by Neem leaves extract (3.73) and Tobacco leaves extract (4.30) which was found non-significant with each other. The untreated patch noted highest rate of infestation (28.07).

After 14 days of spray, the plot treated with Chinaberry fruit extract had the lowest percent infestation (1.00), followed by plot treated with parthenium leaves extract (1.73). The average rate of infestation was highest in the control group (28.10). The plots sprayed with Tobacco leaves extract (3.20) and Neem leaves extract (3.37) showed statistically similar infestation.

After 21 days of spray, the plot treated with Chinaberry fruit extract had the lowest percent infestation of thrips (0.47), which was significantly insignificant with plot treated with Parthenium leaves extract (1.13) followed by Tobacco leaves extract (2.23). The percentage of thrips infection was higher in the untreated plot (30.13).

Mean data after 3 weeks indicated that the lowest means percent infestation was recorded in plot treated with Chinaberry fruit extract (2.03) followed by Parthenium leaves extract (2.77). The percentage of thrips infection was higher in the untreated plot (28.40). The plots treated with Tobacco leaves extract (3.93) and Neem leaves extract (4.23) showed similar pest infestation statistically.

Table 3

Means population of thrips per plant after 2nd spray application at different days interval during 2021-22

Treatment	Means population of thrips per plant				
	24BSA	7DAS	14DAS	21DAS	Means
Tobacco leaves Extract	6.13^{c}	4.30^{b}	3.20^{b}	2.23^{bc}	3.93^{b}
Neem leaves Extract	7.27^{b}	3.73^{b}	3.37^{b}	2.50^{b}	4.23^{b}
Parthenium leaves Extract	5.47^{c}	2.67^{c}	1.73^{c}	1.13^{cd}	2.77^{c}
Chinaberry fruits extract	4.83^{c}	1.77^{c}	1.00^{d}	0.47^{d}	2.03^{d}
Control	27.37^{a}	28.07^{a}	28.10^{a}	30.13^{a}	28.40^{a}
CV	5.09	6.09	5.09	7.05	5.18

Different letters indicates that the treatments are significant at P value (0.05)

Percent reduction in thrips population plant^{-1} after 1st Spray

The mean percent reduction in Garlic thrips population plant^{-1} at weekly intervals is shown in Table 4. After 7 days of spray, the thrips population was reduced by the greatest margin (77.33 percent) in plot treated with Chinaberry fruit extract which was found in line with Parthenium leaves Extract (74.13 percent) followed by Neem leaves Extract (68.97 percent). The lowest percent reduction was noted in Tobacco leaves Extract (68.47 percent).

After 14 days of spray, the Chinaberry fruits extract -treated plot showed the highest percentage reduction (88.33) followed by Parthenium leaves Extract (84.77). The lowest percent reduction was noted in Neem leaves Extract -treated and Tobacco leaves Extract plots (79.60 and 77.33, respectively), which was found statistically similar with each other.

After 21 days of spray, similar trend was observed. The thrips population per treated plot was reduced by the greatest margin (95.97 percent) in Chinaberry fruit extract followed by Parthenium leaves Extract (91.87 percent). Neem leaves Extract (85.67 percent) and Tobacco leaves Extract (82.83 percent) noted lowest percent infestation and was statistically non-significant with each other.

The mean percent reduction after 3 weeks of spray indicated the dominance of Chinaberry fruit extract having maximum percent reduction (87.20) followed by Parthenium leaves Extract (83.60 percent). Neem leaves Extract (78.07 percent), and Tobacco leaves Extract (76.23 percent), showed the lowest percentage reduction and was in line with each other.

Table 4

Means % reduction of thrips per plant after 1st spray application

Treatment	% reduction of thrips per plant			
	7DAS	14DAS	21DAS	Over all Means
Tobacco leaves Extract	68.47^{c}	77.33^{c}	82.83^{c}	76.23^{d}
Neem leaves Extract	68.97^{bc}	79.60^{c}	85.67^{c}	78.07^{c}
Parthenium leaves Extract	74.13^{ab}	84.77^{b}	91.87^{b}	83.60^{b}
Chinaberry fruits extract	77.33^{a}	88.33^{a}	95.97^{a}	87.20^{a}
CV	5.45	6.12	5.75	5.15

Same letters indicates that the treatments are non-significant at P value (0.05)

% Reduction of Thrips Population after 2nd Spray Application

In Table 5, the mean percentage reduction in Garlic thrips population plant^{-1} at 2nd spray application. After 7 days of spray, the thrips population per treated plot was reduced by the greatest margin (93.83 percent) in Chinaberry fruit extract, which was statistically in line with Parthenium leaves Extract (90.53 percent) followed by Neem leaves Extract (86.73 percent). The lowest percent reduction was noted in Tobacco leaves Extract (84.63 percent).

After 14 days of spray, Chinaberry demonstrated highest percent reduction (96.33) followed by Parthenium leaves extract (93.80). The plot treated with Neem leaves extract exhibited lowest percent reduction (88.07) which was statistically similar with Tobacco leaves extract (88.60).

After 21 days of spray, similar trend was noted. Chinaberry demonstrated highest percent reduction (98.43) followed by Parthenium leaves extract (96.20). The plot treated with Neem leaves extract exhibited lowest percent reduction (91.76) which was statistically similar with Tobacco leaves extract (92.67).

Overall mean data presented that Chinaberry was found more fruitful with maximum percent reduction in thrips population (96.23) followed by Parthenium leaves extract (93.50). The lowest mean percent reduction was noted in Tobacco leaves extract (88.60) and Neem leaves extract (88.80) which was statistically in line with each other.

Table 5

Mean % reduction of thrips per plant after 2nd spray application

Treatment	% reduction of thrips per plant			
	7DAS	14DAS	21DAS	Overall Means
Tobacco leaves Extract	84.63^{c}	88.60^{c}	92.60^{c}	88.60^{c}
Neem leaves Extract	86.73^{bc}	88.07^{c}	91.67^{c}	88.80^{c}
Parthenium leaves Extract	90.53^{ab}	93.80^{b}	96.20^{b}	93.50^{b}
Chinaberry fruits extract	93.83^{a}	96.33^{a}	98.43^{a}	96.23^{a}
CV	5.93	6.01	5.75	5.45

Same letters indicates that the treatments are non-significant at P value (0.05)

DISCUSSION

The study was conducted to find out the effectiveness of different botanical insecticides against garlic thrips during 2020. The experiment was randomized complete block design with replications. Total 5 plants were selected randomly selected in each row. During growing period of crop 4 sprayed were applied at 14 days interval. The spraying application was started when the thrips population reached ETL. Before spray application the pest population in all treatments was nonsignificant. These findings are same as the finding of Hussain *et al.*, (2022). The population of thrips build up in month of February and during April it reached to its peck. Similar finding was also reported by Hussain *et al.* (1997). Sudden reduction in the population of thrips due to crop maturation, leaf hardening and migration of thrips to other crops. Hussain *et al.* (1997), Hyder *et al*., (1987) and Ihsan *et al*. (2022) also reported similar findings.

Similarly, *P. hysterophorus* extract can dissolved in different solvent showed different efficacy against insect pests. These reports are similar to the report of Rizvi *et al.*, (2012) and Koubala *et al.*, (2013). Some botanical extracts have active ingredients in different extraction solvents that may have different dissolving nature and may revealed the synergistic effect with a particular solvent against a specific pest (Oyedokun *et al.*, 2011). The similar finding was also recorded that Chinaberry extract was most effective against major insect pests of pea crop (Hussain *et al.*, 2022).

The present experiment with the botanical extract of chinaberry *Melia azedarach* L. most effective to reduce the population of cabbage *P. brassicae*. These results are similar to the results of Przybyszewski, (1993), Khan and Siddiqui (1994), Grisakova *et al.*, (2006), Sharma & Gupta, (2009), and Hussain *et al*., 2022).

The neem leaf extract at 10% gave significant mortality of *P. brassicae* as well as feeding

disturbances to the caterpillars and reducing the growth and development of insect larvae. The aqueous extracts of *M. azedarach* and *A. indica* as antifeeding activity and growth inhibitors for the larvae of *Plutella xylostella* L. was also reported Amin *et al.*, (2014).

The infestation of onion thrips is difficult to control because the mobile stages are mainly found in inner leaves where difficult to reach the residues of the chemicals. Keeping in view the above facts that the present research review was initiated to review the past research work was not solved the challenges. Still now the problem of this insect pest is existing. Therefore, it needs to focus on the future the management aspects of onion thrips are need attention to the researchers.

CONCLUSION AND RECOMMENDATION

All the combination of botanical extracts gave a significant result to reduce the infestation of onion thrips. Among various combination of botanical extracts, Chinaberry and Parthenium leaves Extract superior infestation reduction and production as compared to other extracts. It is therefore recommended that the combination of Chinaberry and Parthenium leaves Extract as significantly minimize the infestation of onion thrips. In future we study different concentration of these botanical extracts against other insect pests of agricultural crops.

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