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Najeebullah Khoso
Department of Plant Protection, Faculty of Crop Protection, Sindh Agriculture University Tando Jam, Pakistan

Jan Muhammad Marri
Department of Plant Protection, Faculty of Crop Protection, Sindh Agriculture University Tando Jam, Pakistan

Fahad Nazir Khoso
Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University Tando Jam, Pakistan

Bhai Khan Solangi
Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University Tando Jam, Pakistan

Agha Mushtaque Ahmed
Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University Tando Jam, Pakistan

Yasir Iftikhar
Department of Plant Pathology, University College of Agriculture, University of Sargodha, Pakistan

Anseer Ali
Department of Zoology, Mirpur University of Science and Technology, Azad Jammu Kashmir, Pakistan

Jamal U Din Hajano
Department of Plant Pathology, Faculty of Crop Protection, Sindh Agriculture University Tando Jam, Pakistan

Muneer Ahmed
School of Biological Sciences, University of Punjab, Quaid-e-Azam Campus, Lahore, Pakistan

Kirshan Chand
Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University Tando Jam, Pakistan

Taimur Ur Rehman
Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University Tando Jam, Pakistan

Correspondence
Fahad Nazir Khoso
Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University Tando Jam, Pakistan

Assessment of botanical insecticides against onion thrips, *Thrips tabaci* (L.) (Thysanoptera: Thripidae)

Najeebullah Khoso, Jan Muhammad Marri, Fahad Nazir Khoso, Bhai Khan Solangi, Agha Mushtaque Ahmed, Yasir Iftikhar, Anseer Ali, Jamal U Din Hajano, Muneer Ahmed, Kirshan Chand and Taimur Ur Rehman

Abstract
Replacement of chemical insecticides with bio pesticides is a common mission for researchers and a lot of work is being carried out to achieve this goal. The use of non-synthetic pesticides is not a new approach but still is under the evaluation for anticipated results. Likewise, this work was designed at Agriculture Research Institute Tandojam during summer 2016 to assess the efficacy of different bio-extract locally available in the area of study in comparison with insecticide locally available in the market. The tobacco, neem oil, Datura leaves extracts were used as bio-pesticides whereas, Carbosulfan was used as control treatment. After 1st spray, the lowest population among the bio-pesticide treated plots was observed at Neem treated plots (4.15±1.81) and highest population was recorded at plot treated with Datura extract (9.60±1.95). The highest mortality percentage was also observed on the 7th day of spray. The highest mortality was found on Carbosulfan followed by Neem, Tobacco and Datura, whereas, the percentages were 89.34%, 83.30%, 73.84% and 61.37%, respectively. After 2nd spray, the overall mean population thrip at each treated plot is given. The result revealed that the highest mean population of the pest was at untreated (control) plot which was 71.85±0.21 followed by Datura (14.50±0.23), Tobacco (7.10±0.21), Carbosulfan (6.17±0.23) and Neem (5.83±0.18). The statistical results showed significant difference between Neem treated and Carbosulfan treated plot, although both were significantly different ($p < 0.01$) from plot sprayed with remaining plots. In terms of mortality, data indicates that the highest mortality was observed on 14th day of spray in plot treated with Cabosulfan (97.79%). In plots treated with different bio pesticides, the highest mortality of the pest was recorded on the 7th day of second spray which was 94.26%, 96.48% and 85.63% on Tobacco, Neem and Datura treated plot, respectively.

Keywords: bio-pesticides, neem, tobacco, Datura, mortality

Introduction
Onion (*Allium cepa* L.) is an important commonly grown vegetable in kitchen gardens and for commercial purpose throughout the globe. In Pakistan, it is ranked as the most important vegetable crop and produced at huge scale. This vegetable is herbaceous and biennial crop having a diploid (2n=16) number of chromosome [1]. It is named after the founder's name ("Onia") of the city built in 1703 BC near the Gulf of Suez [2].

Like other crops, onion is also a victim of many pests including insects, microbial agents such as bacteria and fungi [3]. During the past two decades, among the insect pests, thrips (*Thrips tabaci*) is considered as universal pest and treated as a global pest issue of many crops; most prominently, onion and cotton [4]. Onion thrip is a broad-based pest and measured as a major pest of garlic, cotton and onion.

Thrip tabaci itself feed on leaves of onion in both adult and nymphal stages and may cause reduction about 50% in yield of fruit [5]. The adults and nymphs feed with the help of their rasping and sucking mouth parts [6]. They are slender yellowish brown insects and approximately 1mm in size in their adult stage. The female thrips have a life span of 2-4 weeks and lays about 50-60 eggs, that hatch in 4-9 days. The nymphs, right after hatching, start feeding on plant sap. In dry seasons, the infestation of *T. tabaci* becomes worse and can frequently lead to demolition of the entire crop. After an attack of thrips, the leaves become wrinkled, curled, and slowly dried off. The formation of flowers and bulbs retarded in heavily infested plants and they could produce the seeds [6].

In some studies it is reported that the infestation of onion thrip is round about 34–43% which created other problem like viral attack eventually created heavy losses yield of the crop [7].

A wide range of host plants is reported to attack by thrips which cause approximately 50% yield losses. Not only this, but it is involved in transmission of most destructive plant viruses such as Iris yellow spot virus (IYSV) and tomato spotted wilt virus (TSWV) [8, 9]. In recent times, different parts of the world; Arizona, Colorado, California, New Mexico, Idaho, Utah, and Washington face Iris Yellow Spot Viral disease that affected the onion leaves and bulb result in heavy losses [10].

The control of thrips is a challenging job and difficult due to its small size and ambiguous habits as they feed while hiding in the crannies of flowers and sheaths of leaves. The application of synthetic pesticides to control various pests and diseases is not recommended due to their carcinogenicity, adverse effects on food, human and environment [7]. The introduction of bio pesticides is an alternative measure to the conventional pest control methods. These bio pesticides are extracted from living organisms using various processes that do not alter their chemical compositions [11]. Farmers are using synthetic insecticides for controlling the pest on crops. However, repeated applications could lead to the development of insecticide resistance [12]. Keeping in view the importance of onion and related crops and the damage caused by the insect pests of these economically important crops, the current study was designed to compare the effectiveness of a bio pesticide tobacco extract with synthetic pesticide Carbosulfan (Advantage 20EC) against onion thrips.

Materials and Methods

The experiment was conducted during summer season 2016 on experimental field of Oil Seed Section, Agriculture Research Institute, Tandojam. The variety of onion Phulkara was sown in a Randomized Complete Block Design. After the appearance of thrips, the tobacco, neem oil, Datura leaves extracts were applied during the cropping season. For positive control carbosulfin was applied, whereas, the negative control plot was also sown. Twenty plants from each treatment were randomly selected and observed to record the population of thrips on onion crop. The data were collected at 24 hours before and 24, 48, 72 hours 7 and 14 days after application of insecticides. Finally, the data were statistically analysed in Statix 8.1 software for ANOVA and LSD tests.

Result

The efficacy of three bio-pesticides and one synthetic insecticide was determined on onion thrips at Agriculture Research Institute Tandojam during summer 2016. The results of this study demonstrate the mean population and mortality percentage of thrips after treatment of biopesticiedes i.e. Tobacco, Neem and Datura extracts. The negative control was Carbosulfan whereas; the positive control was untreated plot.

First spray on onion

Results demonstrated in Table 1 reveal that the population of thrip started to decline after 24 hours of spray and the effect was seen until the 7th day after spray. The mean population of thrip 24 hours after spray was 12.10±1.62, 13.20±2.02, 15.45±1.90, 10.30±2.00 and 23.9±1.97 on Tobacco, Neem, Datura, Carbosulfan and Control, respectively. The lowest mean population on the entire treated plot was observed after 7 days of spray. The least mean number of thrips was found on plots treated with Carbosulfan (2.65±0.93) followed by Neem (4.15±1.81), Tobacco (6.50±2.03), and Datura (9.60±1.95). The statistical analysis showed the significant difference between all treated plot except Neem and Carbosulfan. The highest mortality percentage was also observed at 7th day of spray. The highest mortality was found on Carbosulfan followed by Neem, Tobacco and Datura, whereas, the percentages were 89.34%, 83.30%, 73.84% and 61.37%, respectively.

The overall mean population of thrips on plots treated with different biopesticides, synthetic insecticide and untreated plot is illustrated in figure 1. The outcomes of the study displayed that the highest mean population of thrip was noted at untreated plot with mean population of 30.40±0.18 and the lowest mean population was at plot treated with chemical insecticide (Carbosulfan) that was 8.90±0.20. The results are significantly different form each other with p value <0.0001. The mean population on plots treated with Neem, Tobacco and Datura was 9.70±0.12, 10.15±0.24 and 13.45±0.18, respectively. There was no significant difference observed between Neem treated and Tobacco treated plot, although both were significantly different ($p < 0.001$) from plot sprayed with Datura extract.

Second spray on onion

Before second spray of treatments, the thrip population noted on plots assigned for Tobacco, Neem, Datura, Carbosulfan and Control was 9.30±3.01, 10.20±1.96, 17.60±2.83, 13.60±2.87 and 61.70±2.22, respectively (Table 2). Data recorded over 24 hours of spray demonstrated that the population begins to decreased in all the treated plots whereas, on untreated plot the population was raising simultaneously. The mean population noted after 24 hours was 8.35±2.83 (Tobacco), 7.30±1.34 (Neem), 16.00±2.42 (Datura), 6.30±2.47 (Carbosulfan) and 66.75±1.91. There was highest significant ($p <0.0001$) between untreated and all the treated plots. The slight difference ($p < 0.05$) was observed between the Carbosulfan treat plot and plots treated with bio pesticides. The highest mean population of thrip after 48 hrs, 72 hrs, 7 days and 14 days on the untreated plot was 71.15±2.58, 75.95±2.43, 72.35±2.60 and 83.25±1.86, respectively. On contrary, the lowest mean population was 4.20±2.01, 2.95±1.79, 1.60±1.04, and 8.40±3.06 after 48 hrs, 72 hrs, 7 days and 14 days, respectively. In terms of mortality, data indicates that the highest mortality was observed on the 14th day of spray in plot treated with Cabosulfan (97.79%). In plots treated with different bio pesticides, the highest mortality of the pest was recorded on the 7th day of second spray which was 94.26%, 96.48% and 85.63% on Tobacco, Neem and Datura treated plot, respectively.

In figure 2, the overall mean population thrip at each treated plot is given. The result revealed that the highest mean population of the pest was at untreated (control) plot which was 71.85±0.21 followed by Datura (14.50±0.23), Tobacco (7.10±0.21), Carbosulfan (6.17±0.23) and Neem (5.83±0.18). The statistical results showed significant differences between Neem treated and Carbosulfan treated plot, although both were significantly different ($p < 0.01$) from plot sprayed with remaining plots.

Discussion

Diversion from the application of synthetic insecticide is well focused by the researchers and also demanded by society members to mitigate the risk of pesticide residues in vegetable and fruits. A number of strategies have been planned and executed to evaluate the performance of these approaches.

The use of bio-pesticides is not a new strategy but still is under the trials for desired results. In continuation with the use of bio-pesticides, this work was designed to assess the efficacy of different bio-extract locally available in the area of study in comparison with insecticide locally available in the market.

The assumptions set before the experiments are very much near to the results. In the light of literature available in the same pattern it is evident that the bio-pesticides are effective at some extend. Several researchers had reported that the botanical insecticides have potential to control the onion thrip [13-15]. The result of Neem extracts is in agreement with those of [16] in which Neem extract was ranked more efficient than the Datura extracts. The study conducted by Malik [17] also concluded that the Datura was least efficient against onion thrip as compare to *Calotropis procera* and *Citrullus colocythus* extracts. Khaliq and co-workers [18] also worked with the bio products and reported that the (neem, datura and bitter apple) caused significant reductions (45-70%) in thrips populations. Same as Hazara along with team [16] found neem seed extract and neem oil efficiently controlled onion thrip. Tadele allied researchers [15] also found Neem influence on onion thrips population to reduce their population. Neem pesticides if followed by different type of microbial pesticides like Bt give highly effective result against thrips

It is observed in this study that the best results were obtained from carbosulfan followed by Neem, Tobacco and Datura. Carbosulfan had rate of highest mortality. Nouroz and co-workers [19], the follow same pattern but they found that the lower mortality rate of carbosulfan and much fluctuation among the treatments due to some environmental conditions this result is a little bit different from our result.

Table 1: Mean population and percentage mortality of onion thrip after 1st application of different treatments.

Treatments	Before Treatment	After treatment					Mortality Percentage after treatment				
	24 hrs	24 hrs	48 hrs	72 hrs	7 Days	14 Days	24 hrs	48 hrs	72 hrs	7 Days	14 Days
Tobacco	$14.95^{b}\pm1.95$	$12.1^{c}\pm1.62$	$9.70^{c}\pm1.62$	$8.15^{c}\pm1.90$	$6.50^{c}\pm2.03$	$9.10^{cd}\pm1.68$	49.37	64.47	74.17	73.84	83.87
Neem	$16.25^{ab}\pm1.86$	$13.2^{c}\pm2.02$	$8.35^{cd}\pm2.05$	$7.20^{c}\pm2.10$	$4.15^{d}\pm1.81$	$8.10^{d}\pm1.65$	44.77	69.41	77.18	83.30	85.64
Datura	$16.15^{ab}\pm2.89$	$15.45^{b}\pm1.90$	$13.20^{b}\pm1.64$	$11.05^{b}\pm2.16$	$9.60^{b}\pm1.95$	$14.55^{b}\pm1.73$	35.36	51.65	64.98	61.37	74.20
Carbosulfan	$15.15^{b}\pm1.84$	$10.3^{d}\pm2.00$	$7.60^{d}\pm0.99$	$6.50^{c}\pm1.10$	$2.65^{d}\pm0.93$	$10.25^{c}\pm1.80$	56.90	72.16	79.40	89.34	81.83
Control	$17.65^{a}\pm1.39$	$23.9^{a}\pm1.97$	$27.30^{a}\pm1.62$	$31.55^{a}\pm2.40$	$24.85^{a}\pm2.20$	$56.4^{a}\pm1.90$	N/A	N/A	N/A	N/A	N/A

Note: Results with same donated by same alphabets are not significantly different

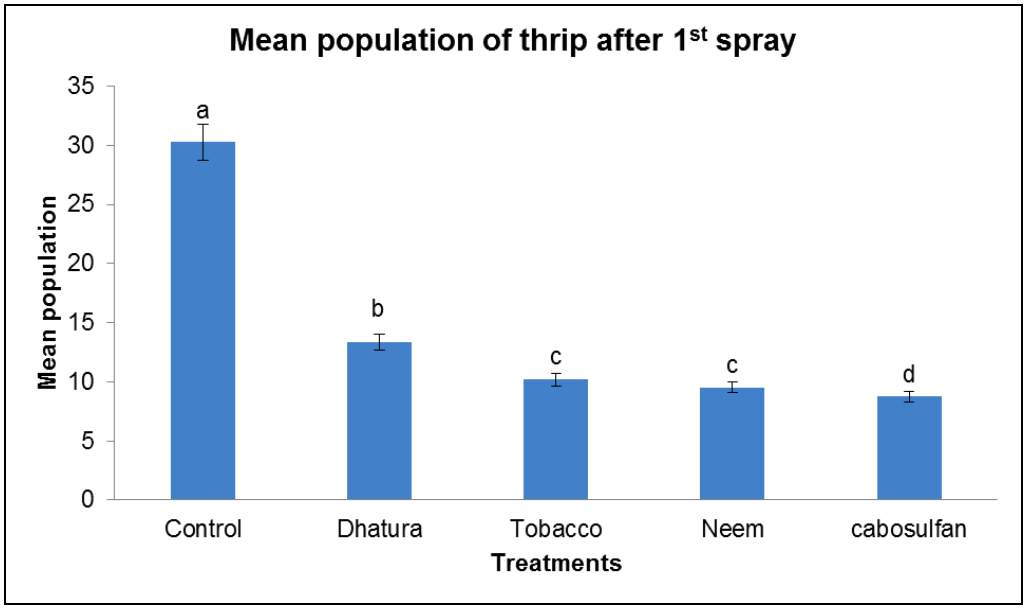

Fig 1: Mean population thrips at each plot after first spray

Treatments	Before Treatment	After treatment					Mortality Percentage after treatment				
	24 hrs	24 hrs	48 hrs	72 hrs	7 Days	14 Days	24 hrs	48 hrs	72 hrs	7 Days	14 Days
Tobacco	$9.30^{d}\pm3.01$	$8.35^{d}\pm2.83$	$7.45^{d}\pm3.18$	$5.75^{c}\pm1.74$	$4.15^{c}\pm1.56$	$7.60^{c}\pm1.98$	87.49	89.53	92.43	94.26	90.87
Neem	$10.20^{d}\pm1.96$	$7.30^{cd}\pm1.34$	$5.85^{cd}\pm1.78$	$3.9^{d}\pm0.97$	$2.55^{d}\pm1.70$	$5.20^{d}\pm2.37$	89.06	91.78	94.87	96.48	93.75
Datura	$17.60^{b}\pm2.83$	$16.00^{c}\pm2.42$	$14.85^{b}\pm2.00$	$12.25^{b}\pm1.45$	$10.40^{c}\pm1.63$	$15.95^{b}\pm2.08$	76.03	79.13	83.87	85.63	80.84
Carbosulfan	$13.60^{c}\pm2.87$	$6.30^{b}\pm2.47$	$4.20^{d}\pm2.01$	$2.95^{d}\pm1.79$	$1.60^{d}\pm1.04$	$8.40^{c}\pm3.06$	77.96	90.56	94.10	96.12	97.79
Control	$61.70^{a}\pm2.22$	$66.75^{a}\pm1.91$	$71.15^{a}\pm2.58$	$75.95^{a}\pm2.43$	$72.35^{a}\pm2.60$	$83.25^{a}\pm1.86$	N/A	N/A	N/A	N/A	N/A

Note: Results with same donated by same alphabets are not significantly different.

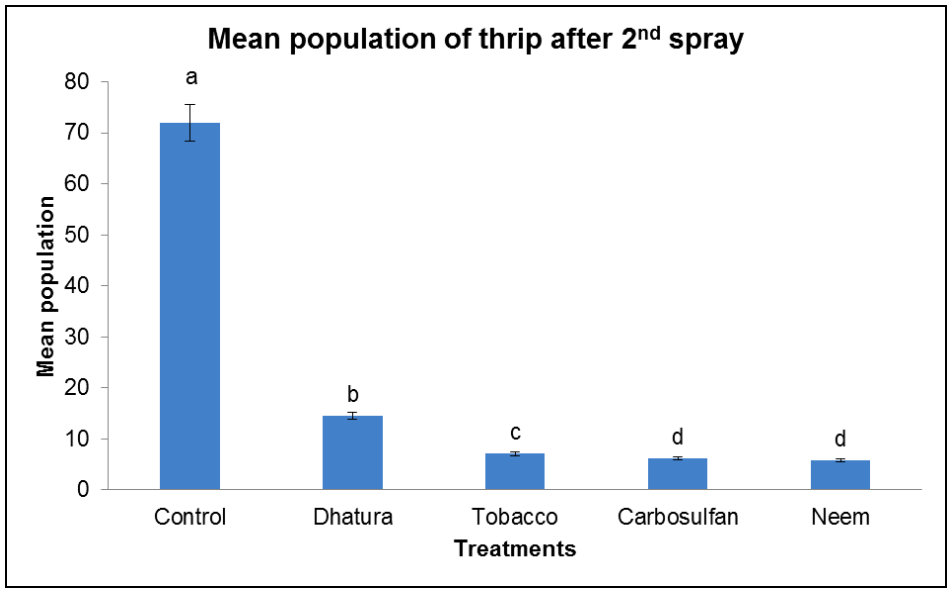

Fig 2: Mean population thrips at each plot after second spray.

Conclusion

Findings of this study established that the use of bio-pesticides; especially, Neem can be used as front line management tool for controlling thrips at early stage. Additionally, it is also proved that the use of synthetic insecticide can be reduced with the application of botanical insecticides. For future research, the compendium of all botanical insecticides used in this study may be tried to evaluate the efficacy against thrips in onion crop.

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