

Management of Onion Thrips, *Thrips Tabaci* L., Using Botanical Insecticide at East Shewa, Ethiopia

Feyisa Begna

Oromia Agricultural Research Institute, Batu/Zway, Ethiopia

Email address:

fbos2009@gmail.com

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Abstract: Onion thrips (*Thrips tabaci*) is one of the major insect pest of onion. The objective of this study is to evaluate effectiveness of Potential Botanicals for management of onions thrips. The experiment was conducted at Adami Tulu Agricultural Research Center (ATARC) and Dugda district for two years (2020 & 2021) using irrigation. The experiment was done using six treatments, i.e., Five botanicals, Mexican marigold (*Tagetes minuta*), Jimson weed, (*Datura Stramoniu*), Tree tobacco, (*Nicotinia glauca*) Neem seed, (*Azadirachta indic*), and one synthetic chemical insecticides, Fastac and non-treated control where only water was applied. From the first year results, it can be concluded that across all parameters, the chemical insecticide, Fastac and neem and tree tobacco from the botanicals showed a significance effect in reducing the damage of onion thrips. This saves the farmers yield and its value appreciably. The combined, two years data showed still a significant yield increment in both treatments insecticides and botanicals particularly the tree tobacco.

Keywords: Onion, Thrips, Botanical, Dugda, Insect, Neem, Fastac

1. Introduction

Onion is used for food and cash crop in Ethiopia [8, 18] predominantly grown by smallholder farmers under irrigation with the total area covered with onion increasing from time to time [7]. Onion yield in Ethiopia has very low at 10.7 t/ha, whereas the current average world yield stands at 19 t/ha with the highest average onion bulb yields of 42 to 64 t/ha [7].

Onion thrips (*Thrips tabaci*) is one of the major insect pest of onion [2, 14] known to reduce huge losses, 30–50% annually [16]. *T. tabaci* is a cosmopolitan pest of onion and it feeds on leaves rather than the bulb [16]. Thrips feeding on onion causes silvery leaf spots that turn into white blotches along the leaves followed by the development of silvery patches and curling of leaves. This injury reduces the photosynthetic ability of the plant by destroying chlorophyll-rich leaf mesophyll [11]. Which may interfere with transportation of nutrients to the bulb [10, 17]. In Ethiopia, *T. tabaci* is an important onion insect pest [18] that destroys onion fields, especially in the dry seasons. Onion bulb yield losses due to onion thrips reported ranged between 10 to 85% [1, 14].

Currently, producer control thrips by applying insecticides

several times in a growing season. However, most insecticides are ineffective because a large number of thrips are always protected between the inner leaves of the onion plant and the pupal stage is spent in the soil. In addition, *Thrips tabaci* is a very prolific species with many overlapping generations [15]. Managing thrips is further complicated by lack of natural parasites and the presence of numerous other host plants on which the pest thrives [5]. Development of resistance by onion thrips to most commonly used insecticides has been reported [13]. Besides increasing the cost of production, the use of pesticides has negative effects on the environment and human health which is attributed to high chemical residues [6].

Therefore, there is need to integrate the use of chemicals with other methods of control such as cultural practices and use of resistant varieties in the management of thrips and other pests of onion. Moreover, as most smallholder farmers may not afford the ever increasing costs of pesticides, alternative non-chemical insecticides, such as botanicals [4, 19] are found to be the best option for smallholder vegetable production.

Use of botanical insecticides is ideal for organic farming and is safe for both the environment and human health, and is affordable where the materials are locally available. The

system is characterized by minimal use of pesticides and increased land productivity [12].

The objective of this study is to evaluate effectiveness of Potential Botanicals for management of onions thrips.

2. Methodology

2.1. Description of the Experimental Sites

The experiment was conducted at Adami Tulu Agricultural Research Center (ATARC) and Dugda district for two years (2020 & 2021) using irrigation. ATARC is located in the mid Rift Valley of Ethiopia about 167km south from Addis Ababa. It lies at a latitude of 7° 9'N and longitude of 38° 7'E. It has an altitude of 1650 m.a.s.l. and it receives a bimodal unevenly distributed average annual rainfall of 760.9 mm per annum. The long-term mean minimum and the mean maximum temperature are 12.6 and 27°C respectively. The pH of the soil is 7.88. The soil is fine sandy loam in texture with sand, clay and silt in proportion of 34, 48 and 18%

respectively.

2.2. Experimental Design and Management

The experiment was done using six botanicals, Mexican marigold (*Tagetes minuta*), Jimson weed, (*Datura Stramonium*), Tree tobacco, (*Nicotinia glauca*) Neem seed, (*Azadirachta indic*), and one synthetic chemical insecticides, Fastac and non-treated control where only water was applied (Table 1).

The crop spacing of 40 x 5cm for onion was used.

All data were collected only from the central four rows. Plots fertilized with NPS and UREA at the rate of 200 and 100 kg/ha, respectively. The whole amount of NPS was applied just before transplanting, while urea was applied by splitting the total amount in two. Half of the UREA 100 kg was applied one month after transplanting and the remaining half at the beginning of head formation stage. Other field management practices like weeding, cultivation and maintenance of ridges was carried out as needed.

Table 1. List of treatments with their rates and time of application.

Treat No	Common Name	Scientific name	Part used	Rate	Frequencies
1	Neem tree	<i>A. indica</i>	Seed	50 gm/ l of water	Per week
2	Mexican marigold	<i>Tagetes minuta</i>	Leaf	50 gm/ l of water	Per week
3	Tobacco	<i>Nicotinia glauca</i>	, leaf	50 gm/ l of water	Per week
4	Jimson weed	<i>Datura stramonium</i> ,	Leaf	50 gm/ l of water	Per week
5	Fastac			1 litre/ ha	Per week
6	Untreated plot				

2.3. Data Collected

2.3.1. Vegetative Data

Leaf numbers and Plant height leaf numbers.

Plant height was measured from the soil surface to the apex of the plant using ruler at the time of harvest. The highest point reached by the plant was recorded as the height of the plant.

2.3.2. Yield Component

Bulb length (cm), bulb diameters/plant (cm), marketable yield kg/row, unmarketable yield kg/row, total yield q/ha was collected.

Small and big size bulbs (<2.5cm diameter and >6.5cm diameter) are categorized under unmarketable bulb yield as they have no demand from the market.

2.3.3. Thrips Population

The number of nymph and adult was recorded before and after 24hr application of chemicals at weekly interval thereafter. Totally ten plants were selected randomly and examined for the presence of the different life stage of onion thrips. The number of nymph and adult from each tagged leaves was recorded by using hand lens and mean number was calculated.

2.4. Economic Analysis

To identify the benefits derived from the application of

each treatment, the simple partial budget technique was employed.

Gross field benefit: it was computed by multiplying farm gate price that farmers receive for the crop when they sell it.

Total cost: It includes the material and the application costs. The cost of neem, Mexican marigold, tobacco and jimson weed were wage paid for collecting plant parts at the rate of 100 birr/day, respectively. The cost of Fastac chemical was 450birr/L. These prices were based on 2017 off- season market. A single preparation and application cost for each treatment was also 280birr/ha. The cost of inputs and production practices such as labor cost for land preparation, weeding, hoeing, watering and harvesting were assumed to remain the same among all the treatments. On untreated plot there only inputs and production cost which was the same for all treatments.

Net benefit: was calculated by subtracting the total costs from the gross field benefit for each treatment.

2.5. Data Analysis

Data analysis was carried out using the SAS version 9.2. To stabilize the variance count and percentage data was transformed either to logarithmic or square root scale. The mean value of the recorded data's was subjected to analysis of variance (ANOVA). If there was significant difference among the treatments, mean separation was carried out using tukey's significance difference at P 0.05.

3. Results and Discussion

3.1. The Population of Onion Thrips

3.1.1. First Year (2020)

Across all the weeks, there were significant differences ($P < 0.05$) among treatments in the extended of thrips population (table 2), the thrips population in the control plots, where only water was sprayed during each spraying time,

was higher than the rest of the treatments. The Fastac treated plots had the lowest thrips population across all assessment dates. Leaf extracts of neem and tree tobacco had also significantly lower thrips infestation on the assessment date than the control treatment. While Datura treated plots had statistically lower thrips count ($p < 0.05$) than only the control treatment.

Table 2. Mean number of thrips per plant sprayed with botanicals and chemical in 24h post applications across the weeks.

Treatments	On station					On farm				
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 1	Week 2	Week 3	Week 4	Week 5
Fastac chemical	4.33c	5.23a	3.22c	6.86b	4.22b	8.13c	9.33c	3.22c	11.12b	8.4c
Neem	8.33bc	7.33ab	10.42bc	8.33b	5.30b	7.02c	13.33b	10.42bc	18.33b	17.12b
Mexican marigold	11.23b	12.56b	13bc	8.96b	5.11b	15.14b	17.22b	13bc	21.96b	19b
Tobacco	10cb	13.22b	8.33bc	12.96b	6.22b	19cb	11.74b	8.33bc	16.22b	12b
Jimson weed	9cb	18.33bc	13.56c	13.30b	11.33a	28.12b	18.33bc	13.56c	22.30b	21.04bc
Control	17a	23.33a	32d	24.40a	18.20a	34.22a	31.33a	32d	38.84a	27.11a
LSD	5.20	4.22	11.42	6.33	4.02					
CV	24.41		22	29	28	23.11	26	18	25	

3.1.2. Second Year (2021)

Population density of onion thrips was statistically different ($P < 0.05$) among treatments (table 3). The thrips population was significantly the least in Fastac treated plots across all assessment dates after each application. The population of onion thrips highly decreased in plots sprayed with Fastac (2.1) compared to the control (27). Next to the insecticides application of tree tobacco and neem seed reduced the thrips population as compared to control, respectively [21]. However, the performance of plant parts in terms of lowering the thrips population across all assessment dates was not consistent with the plots that received the remaining botanical extracts. This is

due to re-infestations from the neighboring onion fields where no insecticides were applied during the growing period.

Identified that the effectiveness of neem, datura and bitter apple, and insecticides against onion thrips (*Thrips tabaci*) [8]. In line with the findings regarding to the effectiveness of botanical insecticides, they indicated that botanicals and insecticides tested caused significant reductions (45-70%) in thrips populations; b) the botanicals gave more than 60% control of thrips compared to the chemical insecticides where acephate was found to be the most effective followed by spirotetramat and spinetoram; and c) the insecticides gave better control than the botanicals.

Table 3. Mean number of thrips per plant sprayed with botanicals and chemical in 24h post applications across the weeks.

Treatments	On station					On farm				
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 1	Week 2	Week 3	Week 4	Week 5
Fastac chemical	2.1d	4.33c	3.00b	2.67c	4.03c	3.33c	4.22c	3.00c	5.1b	4.64b
Neem	7.00cd	7.33c	4.87b	4.68bc	6.56bc	9.67bc	11.23b	6.22bc	10.7b	7.87b
Tagetus	14.00b	12.33bc	5.64b	8.22b	10.23b	15.00b	11.67b	7.67bc	14.44bc	9.63b
Tobacco	6.33cd	15.00abc	3.00b	6.12b	6.33bc	7.33bc	14.33b	5.33c	9.74b	12.67ab
Datura	9.67bc	17.33ab	6.43b	11.22b	13.22b	16.33b	19.33ab	14.00ab	18.22a	17.00a
Control	27.00a	19.00a	24.00a	21.33a	26.00a	32.22a	23.41a	21.56a	21.33a	26.67a
LSD (0.05)	6.43	11.00	4.61	8.84	6.33	11.51	6.33	7.10	5.66	12.23
CV	19	24	27	22	24	22.56	26.33	28.89	24	23

3.2. Onion Agronomic Parameters

3.2.1. First Year (2020)

(i). Plant Height and Leaf Height at Harvest

There is significant difference ($P < 0.05$) among treatments in affecting plant height (Table 4). plot sprayed with either fastac, neem and tobacco produced the tallest plants. Medium plant height was measured from plot treated with other botanicals. However, plot sprayed with tagetus and the

control had the shortest plants height.

This is similar with the finding of [3] who indicated that treating onion with insecticide reduced the insect population and hence better growth of the crop. okra grows vigorously when treated with botanical insecticides.

(ii). Stem Length and Leave Number

The result showed that all parameters were found to be statistically non-significant (Table 5).

Table 4. Mean comparison of the effect of insecticidal treatments Onion agronomic parameters.

Treatments	On station				On farm			
	Plant height	Stem length	Leaf height	Number of leave	Plant height	Stem length	Leaf height	Number of leave
Fastac chemical	48a	11a	41.33a	10.52a	51a	10.45a	43.22a	9.66a
Neem	48.26a	8.99a	38.20a	9.86a	46.23a	8.99a	36.66ab	8.56a
Tagetus	37b	10.23a	29.93b	8.44a	42a	9.88a	33.45b	10.23a
Tobacco	48a	9.06a	39a	9.22a	51a	8.76a	32b	11.12a
Datura	43a	9.23a	37.98a	8.86a	34b	7.68a	32.56b	9.88a
Control	36b	8.6a	29.33b	8.22a	36b	7.88a	29.34b	8.66a
LSD (0.05)	8.70	4.52	7.56	3.63	5.20	2.78	4.32	5.66
CV	9.46	22.86	10.70	12.45	10.65	11	9.24	27

3.2.2. Second Year (2021)

(i). Plant Height and Leaf Height at Harvest

There is significant difference ($P < 0.05$) between treatments in affecting plant height (Table 5). plot sprayed with either Fastac, Neem, Tagetus And Tobacco produced the tallest plants. Medium plant height was measured from plot treated with other botanicals. However, plot sprayed with datura and the control had the shortest plants height.

This is consistent with the finding of [11] who indicated that treating onion with insecticide reduced the insect population on onion and hence better growth of the crop okra grows vigorously when treated with botanical insecticides.

(ii). Stem Length and Leave Number

The result showed that all parameters were found to be statistically non-significant (Table 5).

Table 5. Mean comparison of the effect of insecticidal treatments Onion agronomic parameters (2021).

Treatments	On station				On farm			
	Plant height	Stem length	Leaf height	Number of leave	Plant height	Stem length	Leaf height	Number of leave
Fastac chemical	51.33a	6.94a	41.00a	11.44a	53.11a	7.66a	13.35a	43.12a
Neem	46.66ab	6.67a	39.12a	11.33a	48.12a	7.05a	10.89a	41.22a
Tagetus	47.10ab	7.00a	38.64a	10.63ab	46.33ab	6.33a	11.00a	39.65a
Tobacco	45.22ab	5.75a	36.44a	9.77ab	48.66a	5.78a	8.33b	36.0ab
Datura	41.00b	7.22a	34.22a	8.22b	43.21ab	6.33a	7.56b	33.22b
Control	41.33b	6.33a	34.56a	8.02b	40.33b	5.66a	7.11b	32.12b
LSD (0.05)	2.80	2.77	2.77	2.32	2.33	2.45	2.66	2.23
CV	10.02	22.55	13.44	14.00	14.56	18.44	15.23	16.22

3.3. The Effect of Different Insecticidal Treatments Onion Yield and Yield Components

3.3.1. First Year (2020)

There were significant differences ($P < 0.05$) among treatments in marketable yield of onion (Table 6). Marketable yield of onion ranged from 320 to 390 Qu/ha. The highest level of marketable onion yield was obtained

from plots sprayed with Fastac, followed by neem and other botanicals treated plot. The untreated plot (control) had the lowest marketable yields. This indicates that controlling thrips populations with botanicals can increase the yield of onion production, even though botanicals were not equally as effective as the chemical insecticide in reducing thrips population and reducing associated losses.

Table 6. Mean comparison of the effect of insecticidal treatments Onion yield and yield components (2020).

Treatments	On station				On farm			
	Bulb diameter	Bulb length	Yield Qu/ha	Un marketable Qu/ha	Bulb diameter	Bulb length	Yields Qu/ha	Un marketable Qu/ha
Fastac chemical	5.67a	6.22a	402a	5.89b	5.23a	5.63a	378a	5.22c
Neem	5.45a	5.88a	371a	4.56b	5.10a	5.33a	339ab	6.6b
Tagetus	5.33a	5.43a	338b	6.33b	5a	5.45a	314abc	7b
Tobacco	4.89a	5.13a	386a	7.89ab	4.6a	5.6a	312abc	6.63b
Datura	4.78a	4.76a	315b	8.23ab	4.86a	4.22a	274c	7.33b
Control	4.53a	4.22a	304b	11.23a	4.33a	4.03a	236d	12a
LSD (0.05)	2.11	1.43	37	3.45	1.08	1.16	58	4.05
CV	12.45	11.32	23	14.33	10.65	11	9.24	27

3.3.2. Second Year (2021)

The results were significant differences ($P < 0.05$) among treatments in marketable yield of onions (table 7). The yield of onion ranged from 302 to 381 Qu/ha. The highest level of

marketable onion yield was obtained from plots sprayed with Fastac, followed by neem and other botanicals treated plot [2, 10]. The untreated plot (control) had the lowest marketable yields. This indicates that controlling thrips populations with botanicals can increase the yield of onion production, even

though botanicals were not equally as effective as the chemical insecticide in reducing thrips population and reducing associated losses.

The neembicide was superior than wild tobacco leaf extract and carbosulfan (250g.a.i./hactare) in managing the thrips, obtain higher bulb yield and high cost: benefit ratios in both the seasons [22]. The tree tobacco was found to be very effective against the thrips by 67-75% compared to the

untreated [19]. In line with the findings, [11] showed that an extracts of tree tobacco make it possible to produce yields equivalent to Deltamethrin and therefore, represents an alternative to chemical insecticides. In another study [20] also showed that the efficacy of tobacco based bio pesticides against whitefly was 70.88%, against thrips 57.27% and against aphid 60.40%.

Table 7 Mean comparison of the effect of insecticidal treatments Onion yield and yield components.

Treatments	On station				On farm			
	Bulb diameter	Bulb length	Yields Qu/ha	Un marketable Qu/ha	Bulb diameter	Bulb length	Yields Qu/ha	Un marketable yield Qu/ha
Fastac chemical	5.88a	5.75a	381a	5.36a	6.05a	5.21a	375a	6.11a
Neem	6.11a	5.47a	374a	3.45a	5.88a	4.91a	368a	5.45a
Tagetus	5.65a	4.67a	346ab	4.22a	5.73a	4.81a	340ab	5.66a
Tobacco	4.66a	4.53a	352ab	2.89a	4.77a	4.86a	342ab	4.85a
Datura	4.12ab	4.61a	320b	3.24a	4.65a	4.81a	321b	3.89a
Control	4.33ab	4.33a	318b	4.22a	4.33a	4.60a	302b	4.23a
LSD (0.05)	2.33	2.71	4.56	2.33	2.44	2.63	5.61	
CV	12.45	16.44	24.78	29.45	11.64	18.58	24.51	26.35

3.4. Economic Return

Spraying onion with Fastac Chemical gave the highest net benefit per hectare with the highest marginal return rate (Table 8). This was followed by onion treated with neem and tobacco [9], but the marginal return rates of all treatments were similar because the application and preparation costs of

all treatments were almost similar. Untreated plot (control) resulted in the lowest economic return with lowest marginal return rate. The economic evaluation indicated that controlling thrips population using botanicals increased net benefit and marginal return rate when compared to untreated check.

Table 8. Mean of onion yield and economic return 2021.

Treatment	Marketable yield qu/ha	Farm gate Price birr	Gross return birr/kg	Variable cost birr/ha	Net benefit birr/ha	Marginal return rate
Control	310	15	465,000	41,200	423,800	0.91
Fastac chemical	381	15	571,500	43,500	528,000	0.95
Neem tree	374	15	561,000	42,820	518,180	0.92
Tobacco	352	15	528,000	42,820	485,180	0.90
Tagetus	346	15	519,000	42,820	476,180	0.92
Datura	320	15	480,000	42,820	437,180	0.90

4. Conclusions and Recommendations

From the first year results, it can be concluded that across all parameters, the chemical insecticide, Fastac and neem and tree tobacco from the botanicals showed a significance effect in reducing the damage of onion thrips. This saves the farmers yield and its value appreciably. The combined, two years data showed still a significant yield increment in both treatments insecticides and botanicals particularly the tree tobacco. Considering, the high risks of chemical insecticides on human being, mammals and birds as well as in the environment bio-pesticides are a cheap, valuable, safe and environmentally friendly alternative insect pest management. There are indications that producers consider available information on management of *T. absoluta* when choosing different control strategies.

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