International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 18-03-2022, Accepted: 04-04-2022, Published: 19-04-2022
Volume 7, Issue 4, 2022, Page No. 165-169

Efficacy of some botanicals and synthetic chemical insecticides against onion thrips, *Thrips tabaci* (l.) (Thysanoptera: Thripidae) in West Shoa Zone, Oromia Regional State, Ethiopia

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Abstract
Onion (*Allium cepa* L.) is one of the most popular vegetables in the world. It contributes substantially to the national economy apart from overcoming local demand. *Thrips tabaci*, a serious pest of onion in Ethiopia. The results showed that significant results were observed among the treatments. Sivanto energy 85% E.C gave 100% efficacy in both locations followed by Vayego S.C 200 (98.67%), Promax 44% E.C (96.88%), Prostar 72% E.C (94.67%), and Karate 5% E.C (94.28). Regarding botanicals *Adenium* sp. (leaf) (87.13%) followed by *Nicotiana tabacum (*cake*)* (85.33%), *Acokanthera schimperi* (bark) (67.13), and *Eucalyptus globules* (leaf) (57.27). The bulb yield in the treatment of synthetic insecticides gave a better quality of yield in both study areas as compared with botanicals and control.

Keywords: botanicals, efficacy, onion, synthetic insecticides, *Thrips tabaci*

Introduction
Onion (*Allium cepa* L.) is the most important vegetable crop in Ethiopia, and it is well known for its medicinal and health benefits for struggling with most diseases like cancer, heart, and diabetic diseases [1]. It is a source of food, and cash for the producers and also plays a significant role in income. The onion thrips, *Thrips tabaci* (Lindman) is an insect pest of considerable economic importance in the production of onion in several areas of Ethiopia [2]. However, infestations are usually high in dry, and arid conditions leading to reduce crop yield in the study areas. Alson and Drost [3] reported that thrips favor feeding on the young leaves in the centre of an onion open neck; the majority of thrips will be at the base of the youngest leaves in the lower center of the neck and the early bulb yield improvement stage of onion production is the most susceptible to thrips damage [3]. Liu and Sparks [4] are recognized as one of the most economically infesting pests of planting onion crops.
In order to conserve natural enemies present in the agroecosystem, the use of safer bio-pesticides or alternative methods of application, as mainly are important non-toxic to non-target insects, Humans beings and reduce Environmental pollution [5, 11].
Bio-pesticides are at the present one of the main important options that has been used by farmers to control onion thrips in the onion fields. A number of investigators have examined the result of bio-pesticides and insecticides against onion thrips in onion fields [6, 7, 12, 13]. Regardless of its significance, inadequate literature is available to determine the effect of bio-pesticides and insecticides against *Thrips tabaci*. Hence, it was necessary to study the effect of some bio-pesticides chemical insecticides on the control of onion thrips, and *T. tabaci* in open field conditions.

Materials and Methods
Description of the study areas
The experiment was carried out in a farmers' field at two different locations in West Shoa Zone, Oromia Regional State, Ethiopia, such as the Ambo and Toke Kutaye districts. Ambo is at a geographical coordinate of 858'59.988"N latitude and 3751'0. Toke Kutaye district is located 126 km west of Addis Ababa having an altitude of 1990 meters above sea level.

Field Study
A field experiment was conducted between September, 2020 and January, 2021 during the dry season. A total of nine treatments including standard check and control were used. A seed of "Bombey Red" variety was sown in seedling beds (1 x 2m) at the beginning of July and adopted standard agronomic practices for commercial onion cultivation. The seedlings were transplanted after two months at Ambo and Toke kutaye districts farmer's field in the plots having a size of 2.5m x 3.5m plot at spacing 15cm x 5cm between row to row and plant to plant, respectively. All agronomic practices are recommended when necessary. When a necessary number of onion

thrips were found, the synthetic insecticides and botanicals were sprayed with a knapsack sprayer in both locations.

For data recording, ten plants were selected randomly from each plot and tagged. The presence of insect pests was scouted every week for their symptoms, and damage. Before application of insecticides counts the population number of onion thrips per plant in each treatment. After 48 hours of treatment exposure post, spray counts were taken. The yield of onion bulbs was recorded separately for each treatment and computed yield and yield components. The total numbers of leaves per plant and leaf length were counted and recorded 45 days after transplanting. The bulb diameter of the average radial width was also measured by using a veneer caliper and expressed in centimeters after harvest.

There are four different synthetic insecticides and four botanicals were used in the experiment. These were: Profenofos (Prostar 72% E.C) 700 ml/ha; profenofos + Cypermethrin (Promax 44% E.C) 1000 ml/ha; Tetranilipole (Vayego 200 S.C) 300 ml/ha and Flupyradifurone + Deltametrin (Sivanto Eergy 85 E.C) 1200 ml/ha.

Plant extracts

Four insecticidal plants/botanicals were collected from different parts of Ethiopia in November 2020. These were: *Adenium* sp. (leaf), *Nicotiana tabacum (*cake*), Acokanthera schimperi* (bark), and *Eucalyptus globules* (leaf). The part of these plants was dried separately under shade and then ground to a fine powder using a pestle and mortar. The powder of each botanical was soaked in distilled water at a rate of 100 gm/L.

Table 1: List of treatments used in the study

Trade Name	Active Ingredient	Manufacturer	Rate
Prostar 72% E.C	Profenofos	NACL Industries Limited	700ml/ha
Promax 44% E.C	profenofos + Cypermethrin	NACL Industries Limited	1000ml/ha
Vayego S.C 200	Tetranilipole	Bayer Crop Science	300ml/ha
Karate 5% E.C standard check	Lambda-cyhalotrin		1000ml/ha
Adenium sp. (leaf)		Local region	50gm/L
Acokanthera schimperi (bark)		Local region	50gm/L
*Nicotiana tabacum (*cake*)*		Local region	50gm/L
Eucalyptus globules (leaf)		Local region	50gm/L
Untreated control			

Data analysis

Data collected were subjected to analysis of variance (ANOVA) and treatment means were compared using PROC GLM procedure (SAS, 2009) and differences among means were compared by the Student-Newman-keuls test at 5% level of significance.

Result and Discussions

Field Evaluation

The result showed that onion thrips were significantly ($P<0.05$) different among treatments in both locations with first and second-round spraying. The control treatment had extensive leaf damage by onion thrips compared to the treated treatments. In the first-round spraying, the minimum leaf infestation was recorded in plants treated with Karate 5% E.C, Prostar 72% E.C, Promax 44% E.C, and Vayego 200 S.C similar results were obtained in the first and second-round sprayings (Table 2). The number of live onion thrips in treated treatments was reduced as compared to untreated treatment. In the first-round spraying, the lowest number of live onion thrips was recorded in all synthetic insecticides and two botanicals (Figure 1). The number of live onion thrips was significantly ($p < 0.01$) reduced in treated plants in the first and second round sprayings in both study areas. In both districts, *Eucalyptus globules* (leaf) and *Acokanthera schimperi* (bark) spraying showed the lowest percent efficacy, while no live onion thrips were recorded from plants sprayed with Sivanto Energy 85 E.C in the first and second-round sprayings (Table 2). Analysis of data revealed significant ($P<0.01$) differences between time intervals and treatments. The exposure of all synthetic insecticides and botanical extracts outcome in the minimizing of the onion thrips population for up to 3, 5, and 7 days, respectively.

Table 2: Percent mortality of some botanicals and Synthetic Chemical Insecticides against Onion thrips during, 2020

Treatments	Mean percent mortality (%) and days after treatment application					
	Time of exposure					
	3 days		5 days		7 days	
	Ambo	T/ kutaye	Ambo	T/ kutaye	Ambo	T/ kutaye
Prostar 72% E.C	91.42[a]	94.27[a]	91.75[a]	94.35[a]	91.95[a]	94.67[a]
Promax 44% E.C	96.37[a]	95.13[a]	96.52[a]	95.64[a]	96.88[a]	95.90[a]
Vayego 200 S.C	90.33[a]	88.13[a]	98.67[a]	97.67[a]	98.67[a]	98.13[a]

Adenium sp. (leaf)	76.25[b]	69.33[b]	82.67[b]	83.42[b]	84.13[b]	87.13[b]
*Nicotiana tabacum (*cake*)*	73.52[b]	78.67[b]	81.33[b]	84.27[b]	83.55[b]	85.33[b]
Acokanthera schimperi (bark)	56.25[c]	60.33[b]	62.75[c]	63.45[c]	67.13[c]	65.67[c]
Eucalyptus globules (leaf)	38.75[d]	41.25[c]	48.37[d]	56.05[c]	52.67[d]	57.27[d]
Karate 5% E.C	91.05[a]	89.38[a]	88.67[a]	87.89[a]	94.25[a]	91.13[a]
Untreated control	0.00[e]	0.00[d]	0.00[e]	0.00[d]	0.00[e]	0.00[e]
LSD at 0.05	6.31	7.12	7.53	8.93	7.29	6.12
CV (%)	17.27	16.38	15.36	19.01	14.67	17.81
SE ±	3.67	4.02	4.19	3.62	3.18	3.54

Note: Means with the same letter(s) in the same columns are not significantly different for each other.
All treatment effects were highly significant at p<0.01 (DMRT).

Effect of insecticides on onion thrips

There were significant differences in onion thrips mortality between the synthetic insecticides and botanicals, and the interaction between time intervals. All the synthetic insecticides caused the highest percent mortality (91.13-98.13%) followed by botanicals, *Adenium* sp. and *Nicotiana tabacum* 87.13 and 84.33%, respectively, while *Eucalyptus globules* and *Acokanthera schimperi* caused the lowest percent mortality, 57.27 and 65.67%, seven days after exposure, respectively (Table 2). Results in both districts showed that there were significant reductions in the thrips population after the application of synthetic insecticides and botanicals on all observation dates except untreated control. The results in (Figure 1) show that significant ($P < 0.01$) differences were observed among the treatments. The number of onion thrips per plant and their respective population number caused by all synthetic insecticides till 42 days. But, in both districts botanicals caused a low population number within 21 days and then increased to 42 days. In the 3rd and 4th weeks (21st and 28th days), there were significant ($P < 0.05$) differences among treatments in the extended leaf damaged score after treatment application. The highest number of onion thrips population was recorded on untreated control followed by spraying *Adenium* sp. and *Eucalyptus globules*. On the other hand, 4th, 5th, and 6th weeks there were no significant ($P > 0.05$) differences among treatments in a number of populations, though there were leaf damage scale variations among treatments. In most cases, the spraying of all botanicals had the highest population whereas onion treated with synthetic insecticides had the lowest population numbers recorded. In all 21 days recorded, synthetic insecticides can reduce onion thrips population below threshold levels, since all applied synthetic insecticides and two botanicals were the property to control onion thrips, but the two botanicals *Adenium* sp. and *Eucalyptus globules* are a high number of onion thrips population.

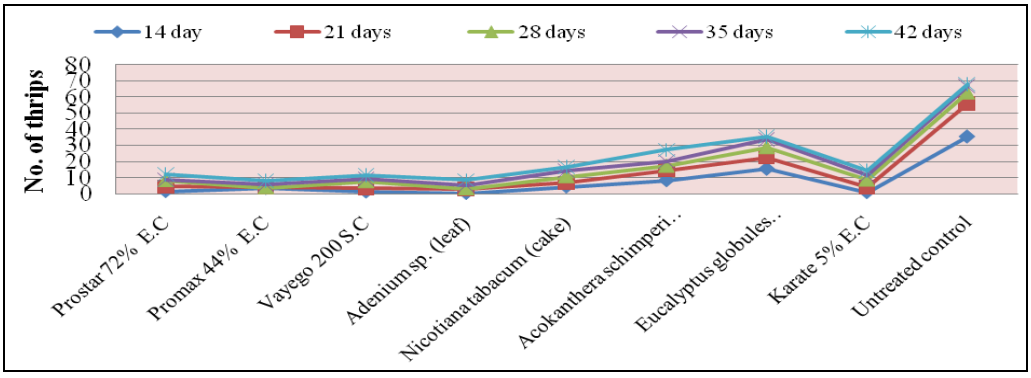

Fig 1: Mean onion thrips population count 14-42 days Within 7 days intervals after treatment spraying in ambo district during 2020

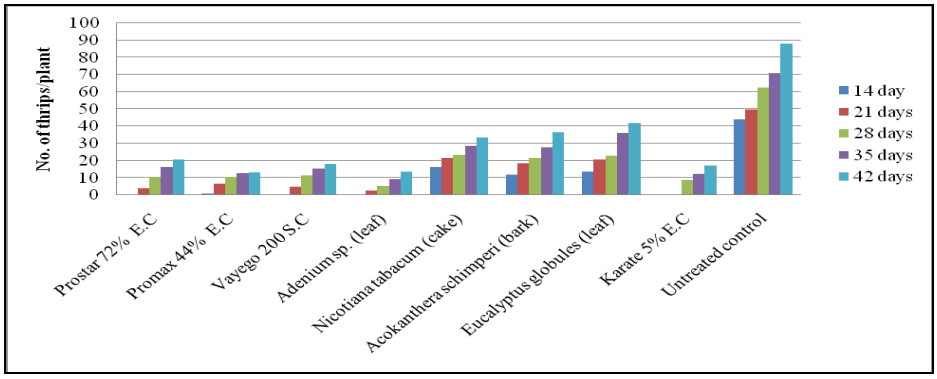

Fig 2: Onion thrips population count 14-42 days Within 7 days intervals after treatment spraying in Toke kutaye District, during 2020

Effect of insecticides on yield and yield components

There was no significant (P>0.01) difference among treated synthetic insecticides and a significant (P<0.01) difference between untreated checks but no significant (P > 0.05) difference among the botanicals when compared with each other. The yield results indicated that yield bulbs in the treatment of synthetic insecticides gave a high yield in both locations compared to botanicals and untreated plots (Tables 3 and 4).

Table 3: Onion bulb yield and yield components of the different insecticidal treatments in the Ambo district during, 2020

Treatments	Plant height (cm)	Leaf number per plant	Yield (Kg/ha)	Bulb weight per plant (gm/plant)
Prostar 72% E.C	38.11[a]	9.32[a]	13757.43[b]	0.577[a]
Promax 44% E.C	37.69[a]	9.20[a]	13687.27[b]	0.597[a]
Vayego 200 S.C	38.08[a]	9.65[a]	13693.87[b]	0.687[a]
Adenium sp. (leaf)	38.13[a]	9.77[a]	12314.65[bc]	0.522[c]
*Nicotiana tabacum (*cake*)*	38.17[a]	9.58[a]	13579.24[b]	0.564[b]
Acokanthera schimperi (bark)	37.81[a]	9.35[a]	12971.43[d]	0.517[c]
Eucalyptus globules (leaf)	37.82[a]	9.17[a]	11674.26[e]	0.472[d]
Karate 5% E.C	38.79[a]	9.89[a]	14584.55[a]	0.605[a]
Untreated control	36.12[b]	9.15[a]	10372.59[f]	0.342[e]
LSD at 0.05	1.03	0.82	317.48	0.34
CV (%)	18.27	12.67	19.61	21.53

Note: Means with the same letter(s) in same columns are not significantly different from each other.
All treatment effects were highly significant at p<0.01 (DMRT).

Bulb weight and Plant height

The current study showed that there were considerable yield variations among the treatments. The highest mean bulb weights were observed in the plot sprayed with all synthetic insecticides and the standard check (karate 5% E.C) yield of onion, while the lowest record was observed in the untreated treatment and botanical, *Eucalyptus globules* (Table 2 and 3). Leaf number and leaf heights were found to be statistically non-significant (P > 0.05) but significantly (P < 0.05) different from untreated control in plant height (Tables 3 and 4). Similarly, the moderate yield of onion was obtained from botanicals, *Nicotiana tabacum* (13363.17kg/ha) followed by *Acokanthera schimperi* (12797.57 kg/ha) whereas the lowest yield was recorded by untreated control (10262.64 kg/ha) followed by *Eucalyptus globules* (11329.82 kg/ha) (Table 4).

Table 4: Onion bulb yield and yield components of the different insecticidal treatments in Toke kutaye district during, 2020

Treatments	Plant height (cm)	Leaf number per plant	Yield (Kg/ha)	Bulb weight per plant (gm/plant)
Prostar 72% E.C	38.21[a]	9.24[a]	13234.52[b]	0.594[a]
Promax 44% E.C	38.20[a]	9.21[a]	13157.37[b]	0.611[a]
Vayego 200 S.C	38.18[a]	9.53[a]	13118.58[b]	0.682[a]
Adenium sp. (leaf)	38.14[a]	9.37[a]	12211.92[d]	0.517[c]
*Nicotiana tabacum (*cake*)*	38.23[a]	9.46[a]	13363.17[b]	0.561[b]
Acokanthera schimperi (bark)	38.11[a]	9.32[a]	12797.57[c]	0.526[c]
Eucalyptus globules (leaf)	38.17[a]	9.22[a]	11329.82[d]	0.468[d]
Karate 5% E.C	39.22[a]	9.71[a]	14745.42[a]	0.613[a]
Untreated control	36.14[b]	9.34[a]	10262.64[e]	0.316[e]
LSD at 0.05	1.20	0.68	261.83	0.38
CV (%)	16.08	14.84	21.27	19.27

Note: Means with the same letter(s) in same columns are not significantly different for each other.
All treatment effects were Highly significant at p<0.01 (DMRT).

Discussions

In present studies, percent efficacy on Onion thrips, non-significantly between locations to Prostar 72% E.C (profenofos), Promax 44% E.C (Profenofos + Cypermethrin), Vayego 200 S.C (Tetranilipole), and the standard check (Karate 5% E.C) insecticides treatment. Non-significantly lower percent efficacies were recorded in both Ambo and Toke kutaye districts thrips population to *Adenium* sp. (leaf), *Nicotiana tabacum (*cake*), Acokanthera schimperi* (bark), and *Eucalyptus globules* (leaf) botanical extracts. In field experiments conducted at Ambo and Toke kutaye districts, the efficacy of botanicals was low compared to new synthetic insecticides in controlling onion thrips on onion.

Belete *et al* [8] reported that the efficacy of profenofos in controlling thrips on onion is high as compared with λ – cyhalothrin and diazinon. Similarly, Profenofos and profenofos + Cypermethrin gave high percent efficacy in

both locations Ambo and Toke kutaye districts of West Shao of Ethiopia. However, the efficacy of botanicals was low compared to profenofos and profenofos + Cypermethrin in controlling the thrips population on onion.
The current study recorded the botanicals were achieved well in the population minimize of onion thrips. Spray against onion thrips *Adenium* sp. leaf and *Nicotiana tabacum* cake extracts was reduced maximum population. A similar study was conducted by Syed[9] in Sindh Agriculture University Tandojam who showed that tobacco extract has effective control of other sucking insect pests on other plants.
Syed [16] reported that the highest value of tobacco leaf extracts against aphids on spray was examined (92.22%). Similarly in this finding, the efficacy of tobacco cake extracts against onion thrips showed 84.13% in Ambo and 87.13% in Toke kutaye districts within 7days. The effect of botanical insecticide on three pests *viz;* whitefly, thrips, and aphids were treated with different botanicals showed that the highest mortality was obtained by tobacco and neem. These findings are in agreement with the work of [9]. Shiberu *et al*. [10] also reported *N. Tabacum* was minimizing onion thrips population within three days of application and then slowly decreased from 3rd day to 7th day of application.

Conclusions
The effectiveness of insecticides during this study was Vayego 200 S.C, Prostar 72% E.C, Promax 44% E.C, and Karate 5% E.C gave good results and significantly increased onion thrips mortality, declined leaf infestation, and maximized onion bulb yield as compared to the untreated control. However, the highest percent mortality recorded in botanicals were, *Adenium* sp. (leaf) and *Nicotiana tabacum* (cake) had good efficacy in terms of causing the highest mortality to onion thrips. Therefore, Vayego 200 S.C, Prostar 72% E.C, Promax 44% E.C, *Adenium* sp. and *Nicotiana tabacum* could be used in the future for the alternative management option of onion thrips.

Conflict of Interest
The author declares that he has no conflict of interest

Financial Support
This study was funded by the personal efforts of the author

Ethics Statement
None

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