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RESEARCH PAPER

Evaluation of Insecticides on Management of some Sucking Insect Pests in Tomato (Lycopersicon esculentum Mill.) in West Shoa Zone, Toke kutaye District, Ethiopia

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Abstract

Tomato plants (Lycopersicon esculentum L.), which belongs to family Solanaceae, is one of the most popular and cost-effective vegetables for fresh consumption and processing. Certain sucking insects viz., thrips, whiteflies and aphids cause severe damage to crop by transmitting virus disease rather than direct feeding, particularly to the tomato plants. The present study was carried out in RCBD with four replications in open farmer's fields by irrigation water for the period from October to March 2018/2019 for two consecutive years. Two new insecticides Sivanto Energy EC 85 and Delta 2.5 E.C with the doses of the former and later, 800, 1000 & 1200ml-1ha and 350, 400 & 450ml-1ha respectively; and Diazinon 60 E.C at 1000ml-1ha were tested for their efficacy against sucking insect pests on tomatoes. Percent efficacy recorded after 48 hours of each spray in the fields was significantly affected by the dose applied. The percent efficacy obtained by Sivanto Energy EC 85 and Delta 2.5% E.C at the highest doses proved to be the most effective and gave better efficacy against whiteflies, thrips and aphids. Therefore, both insecticides can be used for the management of sucking pests (whitefly, thrips, and aphid) on tomato crops in the field.

Keywords: Aphid, Thrips, Whitefly, Insecticide, Efficacy, Dose, and Tomato

Introduction

Tomato *(Lycopersicon esculentum* Mill.) belongs to the nightshade family Solanaceae. It is one of the most important vegetable crops in the world, and popularly and widely grown crops in Ethiopia (FAOSTAT, 2011). It is an economically important crop among vegetables in the country. For consumption as fresh vegetable, tomato is produced under open fields and green-house conditions. It can be eaten either fresh or processed into different products. It is helpful in healing wounds because of antibiotic properties found in ripe fruits. Tomatoes are the good sources of several vitamins (A, B and C) and minerals such as potassium, and folate and also the carb contents consists mainly of simple sugars and insoluble fibers (Baloch, 1994; Adda, 2019).

The diversity of worldwide biotic communities has greatly changed in recent years due to the collapse of natural barriers to wild species movements mainly in relation to human activities (Liebhold and Tobin, 2008). Among the newly introduced insect species, some can become invasive, with subsequent significant economic impacts. The success or failure of a biological invasion may depend on the species' life history parameters, on its response to climatic conditions, on the competition with native species and on the impact of natural enemies (Grabenweger *et al*., 2010).

In Ethiopia, out of the total vegetable crop production area tomato (L. esculentum Mill.) contributed 2.51% and total production of 5,235.19 hectares during 2017/18 (CSA, 2018). Tomato production faces many problems from several factors which leads to significant yield loss. Among these factors, insect pests are the most important. Sucking insect pests cause a very high level of damage (quantity and quality) to tomato crops (Megido *et al.*, 2012), particularly if no control measures are practiced (Desneux *et al*., 2011).

Tomato growers in Ethiopia regularly experienced the economic damage caused by fruit borer (*Helicoverpa armigera* Hubner), tomato leafminer (*Tuta absoluta*, Meyrick) whitefly (*Bemisia tabaci* Gennadius), aphid (*Aphis gossypii* Glover) and thrips (*Frankliniella schultzei* Trybom). The sucking pests are polyphagous in nature throughout the year. Moreover, the cultivation of tomato and availability of alternate hosts encourage the development of pest pressure all year round. The sucking pests *viz.*, thrips, whiteflies and aphids cause severe damage to crop by transmitting virus disease in addition to direct feeding.

In sucking pest complex, whitefly is important as it imparts direct damage to the crop by desaping and also acts as vector for transmission of leaf curl virus disease in tomato (Jones, 2003). Yield losses due to direct and indirect damage caused by whiteflies were reported to the extent of 20 to 100 per cent (Papisarta and Garzia, 2002). Therefore, the study was aimed at evaluation of different doses of insecticides on sucking insects attacking tomato in Toke kutaye district, West Shoa Zone, Oromia Regional State, Ethiopia.

Materials and methods

Description of the study area

The present study was carried out during October to March 2018 to 2019 for two consecutive years at Guder, Toke kutaye district of west Shoa in open farmer's fields. Toke Kutaye districts, is located at 126 km west of Addis Ababa having an altitude of 1990 meter above sea level, latitude of 08° 59' 01.1' North and longitude of 37° 46' 27.6' East (Fig 1**)**.

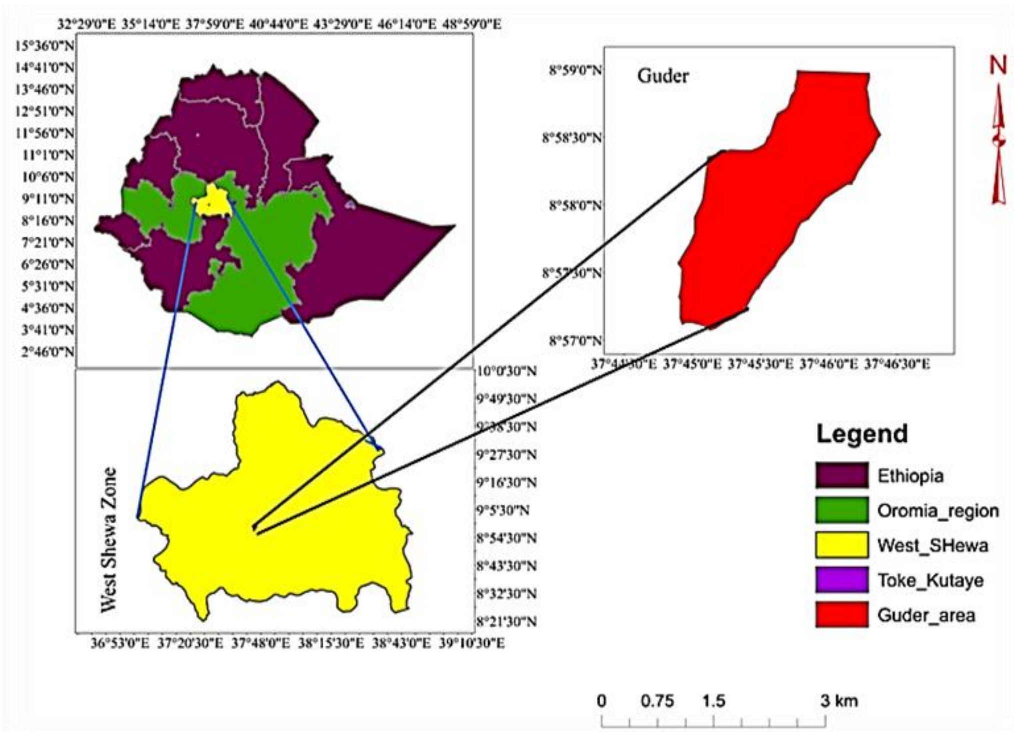

Fig 1: Toke Kutaye District Agricultural Office (2018)

Land preparation and layout

The experiment was laid out in RCBD with eight treatment and four replications including standard check and untreated control. The seedling was transplanted after 40 days in the plots having a size of 4.0m x 3.6m plot at spacing 100 cm x 40 cm between row and plant, respectively. When an appropriated number of sucking pests were reached economic threshold level, the chemicals sprayed with knapsack sprayer as specific doses. In both years insecticides spray was under taken at vegetative, flowering and fruit setting stages.

Table 1: List of experimental treatments at different doses

Common Name	Trade Name	Dose ml ha^{-1}	Dilution in water lt ha^{-1}
Flupyradifurone + Deltametrin	Sivanto Energy EC 85	800	200
		1000	200
		1200	200
Deltamethrin	Delta 2.5 E.C	350	500
		400	500
		450	500
Diazinon	Diazinon 60 E.C	1000	200
Control (untreated)			

For data recording, five plants were selected randomly from each plot and tagged. On each selected plant, three leaves each from upper, middle and bottom portion were inspected from lower side for presence of sucking pests. However, nymphs as well as adults were recorded in respect of aphids, whitefly and thrips by using the hand lenses of 10 times magnifications. Pre-spray count was taken prior to each spray and subsequent counts were recorded after 48 hours of application. Observations were recorded early in the morning before 8.00 a.m. as suggested by Mote (1977). The marketable tomato fruits plucked at each picking were recorded separately for each treatment plot and computed yield data were converted into ton/ha.

Data analysis

Analysis of variance (ANOVA) was conducted using Statistical Analysis Software (SAS, 2009) and treatment effects were compared. The mean comparisons were carried out using Duncan's Multiple Range Test (DMRT). Efficacy analysis was done after data transformation to Arcsine (Gomez and Gomez, 1984):

$$CM(\%) = \frac{[T(\%) - C(\%)]}{[100 - C(\%)]} X100$$

Where: CM (%) - Corrected mortality
T - Mortality in treated insects
C- Mortality untreated insect

Result and discussions

Efficacy of insecticidal treatments against sucking pests of tomato

Efficacy of insecticides against sucking insect pests in the field is shown in Table 2. The data on the effectiveness of insecticides against aphids, thrips and white flies revealed that significant ($P < 0.05$) difference compared to untreated control (Table 2). The results showed that the Sivanto Energy EC 85 insecticide at the rate of 1000ml and 1200ml/ha was significantly ($P < 0.05$) superior over the control but there was no significant ($P > 0.01$) difference with the standard check.

All treatments are significantly ($P < 0.01$) different on plant treated with various treatments and reduced the total numbers of sucking pest per treatment. Effect of Sivanto Energy EC 85 insecticides were evaluated against aphids, thrips and whiteflies at three different doses after 48 hours exposure time. Table 2 shows Sivanto Energy EC 85 at 800 ml ha^{-1}, 1000 ml ha^{-1} and 1200 ml ha^{-1} had maximum toxicity (85.67, 99.33 and 100%) against Aphids, respectively. while Delta 2.5 E.C showed the minimum mortality (63, 79.33 and 84.33%) after 48 h of application.

On the other hand Delta 2.5 E.C at 450 ml ha^{-1} on aphids, white flies and thrips resulted in the percent mortality of 84.33, 81.67 and 86.33%, respectively. Low toxicological effect was observed by low doses of Delta 2.5 E C and Sivanto Energy EC 85 (300 and 800 ml ha^{-1}), respectively (Table 2). In the second year, similar results were observed (Figure 1).

The results showed the combination of flupyradifurone and deltametrin gave better results as compared with deltametrin alone. The result agrees with Worthing (1987) who reported that deltamethrin has very good residual activity for outdoor and indoor insect pests. The result was also in conformity with the work of Haug and Hoffman (1990), who reported that they are reported that deltamethrin is a synthetic insecticide based structurally on natural pyrethrins, which rapidly paralyze the insect nervous system giving a quick knockdown effect. The presented result confirmed the previous work of Shafiq and Maher (2016), also reported that deltametrin caused significant reduction of thrips populations as compared to the untreated control.

Table: 2 Effect of insecticidal treatments (spray) against sucking pests of tomato after 48 hours of applications at Toke kutaye district, west Shoa Zone, Ethiopia during 2018.

Treatment	**Dose ml ha^{-1}**	**Mean number of sucking insect pests /3 leaves**		
		Percent Efficacy		
		Aphids	White flies	Thrips
T_1	(800)	85.67^b	77.72^c	70.08^c
T_2 Sivanto Energy EC 85	(1000)	99.33^a	97.67^a	98.58^a
T_3	(1200)	100.0^a	100.0^a	99.33^a
T_4	(350)	63.0^c	65.33^d	62.33^c
T_5 Delta 2.5 E.C)	(400)	79.33^b	83.33^b	81.33^b
T_6	(450)	84.33^b	81.67^b	86.33^b
T_7 (Diazinon 60 E.C)	(1000)	97.33^a	98.67^a	97.67^a
T_8 (Control)		3.75^d	6.05^e	4.92^d
LSD		9.82	8.78	9.01
CV (%)		14.04	12.68	16.91
SE ±		3.09	2.01	2.13

T1= Sivanto Energy EC 85 (800ml), T2=Sivanto Energy EC 85 (1000ml),T3= Sivanto Energy EC 85 (1200ml), T4= Delta 2.5 E.C(), T5= Delta 2.5 E.C, T6= Delta 2.5 E.C, T7= Diazinon 60 E.C and T8= Control

Effect of insecticides on tomato crops

Physical observations were undertaken in the field to assess the impact of the insecticides from the treated plots on health of the crop in the application areas. After application of insecticide there was no phototoxicity effect (abnormal coloring and scorching) on the leaves of tomato crops at recommended rate.

Frequency of application

The spay was made three times at different growth stage. The first and second applications were undertaken at vegetative and flowering stages then the third spray was made at fruit setting stages. The number of application per season presented in the study can serve as an indication for the number of applications on crops and cannot be used as a robust result. The reason for this is that the data was collected within two years and no correction was made for other influences such as extreme climate conditions or infection pressure in the crops. However, this study was in disagreement with the previous work of Ann (2001), who reported the average frequency of applications of the mostly used insecticides and fungicide products on the intensively treated crops was between 10 and 20 times a year. But on most crops single pesticide products were not used more than seven times a year.

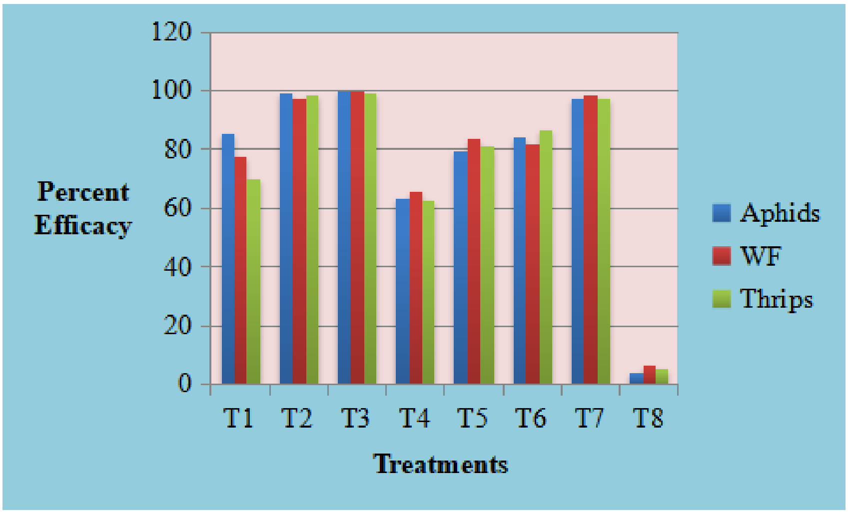

Figure 1: Effect of insecticidal treatments against sucking pests of tomato after 48 hours of spray at Toke kutaye district, West Shoa Zone, Ethiopia during 2019.

Effect of insecticides on yield

Present study attempted to develop alternative control technique, mainly for sucking pests using new chemical insecticides that contribute to reduce the infestations and protect the main crop tomato contributing to increase yield. The obtained result was from studies on the effect of insecticides of the sucking pests. Here the pest is controlled by introducing the new insecticides in to the field and the yield is compared with the untreated plots. There were significant different between doses of insecticides and untreated check but no significant ($P > 0.05$) different between the insecticide (Sivanto Energy EC 85) at highest dose when compared to the standard check (Diazinon 60 E.C).

Table 3: Effect of insecticides against sucking insect pests on yield of tomato

Treatments	Dose ml ha^{-1}	Marketable Yield ton ha^{-1} (2018)	Total Yield ton ha^{-1} (2018)	Marketable Yield ton ha^{-1} (2019)	Total Yield ton ha^{-1} (2019)
T_1	(800)	25.17^{ab}	28.25^{ab}	24.48^{b}	27.38^{b}
T_2 (Sivanto Energy EC 85)	(1000)	27.67^{a}	30.28^{a}	26.65^{ab}	29.85^{a}
T_3	(1200)	30.33^{a}	33.52^{a}	29.50^{a}	31.65^{a}
T_4	(350)	25.5^{ab}	28.87^{ab}	24.33^{a}	29.25^{a}
T_5 (Delta 2.5 E.C)	(400)	25.67^{ab}	28.67^{ab}	25.68^{a}	30.42^{a}
T_6	(450)	26.38^{ab}	29.88^{ab}	26.88^{a}	28.90^{a}
T_7 (Diazinon 60 EC)	(1000)	29.67^{a}	32.58^{a}	28.15^{a}	31.40^{a}
T_8 (Control)		21.4^{c}	25.54^{c}	19.75^{c}	24.62^{c}
LSD		3.52	3.32	2.95	2.25
CV (%)		15.87	18.06	15.26	17.35
SE ±		4.21	4.75	3.54	3.88

The result indicated that yield in the treatment Sivanto Energy EC 85 and Diazinon 60 E.C gave better yield percentage in both years compared to untreated plot (Table 3). The results could be due to low sucking insect pest infestation in tomato crops grown with Sivanto Energy EC 85. High infestation level was recorded in the untreated control treatment that gave low yield due to high damage occurred to tomato by sucking insect pest.

Conclusion and recommendations

Sucking insect pests have been a serious pest of tomatoes in Ethiopia. These studies clearly indicated that the tested insecticide showed good efficacy in controlling whitefly, thrips and aphid. Hence, they can be used in conjunction with chemical products and integrated pest management. Therefore, from this study it is recommended that sivanto energy EC 85 at doses of between 1000-1200ml/ha) and delta 2.5 E.C at dose of 450 ml ha^{-1} can used as a management option of sucking insect pests as components of integrated pest management.

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