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Efficacy of land-cyhalothrin pesticides against onion thrips, thrips tabaci l. (Thysanoptera: Thridae) on onion

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Abstract
An experiment was conducted to test the efficacy of Landa-Cyhalothrin Pesticides against Onion Thrips, Thrips Tabaci L. (Thysanoptera: Thridae) on Onion at Gudera area Toke Kutaye district and Holeta area in Walmera district during 2019 cropping season, using randomized complete block design with four replication at both locations. The result of Bartlett's test confirmed the homogeneity of variance for all collected which allowed applying combined data analysis and the analysis of variance (ANOVA) of combined data of the two locations revealed highly significant difference among the treatments after spraying of day 1, day 3, day 5, day 7, total mortality percentage, yield, and yield loss. In the present study, the maximum mortality rate percentage of onion thrips was manifested for Lamda-Cyhalothrin than Diazinon60% EC, and zero yield loss was recorded for Lamda-Cyhalothrin treated plot, while 25.95 yield loss was manifested for Diazinon60% EC. Therefore, Lamda-Cyhalothrin 100g/lt is efficient for onion producers to control onion thrips and it can be replaced or comparable to other insecticides.

Keywords: efficacy, landa-cyhalothrin, mortality, onion thrips, yield loss

Introduction
Onion (*Allium cepa Linnaeus)* belongs to the Alliaceae family and it is the most important bulb crop and widely grown herbaceous biennial vegetable crop Anisimova, *et al*., (2019) [4]; Al-Shukri, *et al*., (2020) [3]. Its consumption has been increasingly significant in the world partly because of the health benefits they possess (Wang *et al*., 2006) [2]. In Ethiopia, it is an important vegetable that produced across a wide range of agro-ecology and it is one of the oldest known bulbous crops and Ethiopia has a great potential to produce various vegetable crops including onion throughout the year for both local consumption and export (Negash *et al*., 2019) [15] with an average yield of 8 tons per hectare (FAO, 2019 [6] One of the constraints in onion production is the onion thrips (*Thysanoptera: Thripidae*) pest. Onion thrips, *Thrips tabaci* L. (*Thysanoptera: Thripidae)* is polyphagous and has been recorded on more than 300 species of plants. Thrips tabaci is one of the major insect pests of onion which can bring huge losses 30-50 % of annual production Nault and Hessney, (2010) [13]; Nault *et al*., (2012) [14]. The injury caused by thrips rasping of the leaves enables various plant pathogens on their mouthparts from one plant to another and in an entire onion, fields can be destroyed especially in the dry season. Similarly, in Ethiopia, according to different researchers' findings onion yield is lost due to thrips from 10-85 % Bekele *et al*., (2006) [5]; Shibiru *et al*.,(2013)[18].
To overcome onion yield losses due to onion thrips farmers are using different insecticides chemicals such as carbosulfan 20 E.C, spinetoram 120 SC, fipronil 5% SC, Diazon 60 % E.C and lambday-cyhalothrin 4.9 % SC as the most effective insecticide in onion thrips controlling Singh *et al*.,(2013) [20]; Shibiru and Mohamed, (2014) [19]; Hussien *et al*, (2015) [8]. But onion thrips can develop resistance to the most commonly applied insecticides used (Marton *et al*., 2012) [11]. So, it is very important to search for other alternative insecticides that can be used alternatively with already registered insecticides to reduce the chance of insecticides resistance by the insect pests.
Therefore, the present investigation was carried out to test the effectiveness of Lambda-cyhalothrin 100g/lt to control onion thrips in onion production in comparison with Diazinon 60% E.C insecticides which was commonly used.

Materials and Methods
Description of the Experimental sites
The experiment was conducted under partial rain-fed and irrigation conditions at two different locations Guder area in Toke Kutaye and Holeta area in Walmera districts of West Shewa Zone, Oromia, Ethiopia during the main cropping season of 2019/20. Toke Kutaye is located at 126km West of Addis Ababa, with an altitude of 1990 meters above sea level, a latitude of 08° 59' 01.1' North, and a longitude of 37° 46' 27.6' East. The average annual rainfall is 1028.7 mm and maximum and minimum temperatures of the area 29.6°C and 11.8°C, respectively. The soil type is a vertisol which is suitable for onion production. Walmera is located at 34km West of Addis Abeba, with an altitude of 2400masl. Spaviero 100g/Lt (Lambda-cyhalothrin) was obtained from Tensae International Business Enterprise P.L.C. for verification. The field was plowed and disked as required to create a seedbed suitable for onion production.

Experimental design, treatment and Field management
The experiment was arranged in a randomized complete

block design (RCBD) with four replication at both sites. The targeted insecticide, Lambda-cyhalothrin, Diazinion 60% E.C (as a standard check), and unsprayed (Control) are used as treatments. The area of the experimental plot was 3mx4m at each experimental location and spaces used between blocks, rows and plants were 1 m, 0.2 m, and 0.1 m, respectively. The experimental field was irrigated three times per week for the first three weeks after transplanting and weekly thereafter. The field was fertilized with Di-ammonium phosphate (DAP) and urea at the rate of 200 kg and 150 kg per hectare, respectively. The DAP was applied during transplanting and urea was applied split into two times. The first half was applied during transplanting and the remaining half after 30 days transplanted. Other recommended agronomic practices were carried out as required. Onion seeds will be raised on seedbed at Guder experimental site and Walmera district, Holeta poly Technique College.

Seeds of onion (*Allium cepa* L. var. Adama red bombe) were purchased from Onion seed agency, which was seeded on 10m2raised nursery bed on September 20th, 2019, and seedlings were transplanted into farmer's field on October 16th, 2019. The new pesticide was applied at the recommended rate (Table.1). A thorough application was done to prevent the drift of pesticide to another plot. The experiment was made with half irrigation water and rainfall. Pre-spray counts were recorded every week till reached the economic threshold level 5 to 10 thrips per plant before treatment application (Abate, 1985) [1]. After foliar treatment application of 1st, 3rd, 5th, and 7thday, post spray count, the number of live onion thrips were recorded from ten pre-tagged plants by using hand lenses and digital.

Table 1: Pesticide trade name, common name, formulation types, Manufacturer company and application rates

S/N	Trade name	Common name	Formulation type	Manufacturer company	Application rates
1	Sparviero 10CS	Lambdacyhalothrin	EC	SIPCAM	300ml/ha
2	Diazinon 60%E.C		EC		1.5Lt/ha
3	Control	-	-	-	-

Pest observation for Assessment

Pre-counted was recorded from the middle rows every 3 days until the pest reaches the economic threshold level 5 to 10 thrips per plant before treatment application (Abate, 1985) [1]. Scoring of the pest has started at about the crop growth stage of 30days after transplanting (DAT). The insect infestation was assessed from each tagged plant of 10 randomly selected per plot. The insecticide treatments were applied with the help of a knapsack sprayer after calibration. After foliar treatment application of 1st, 3rd, 5th, and 7th day, post spray count of the number of live onion thrips was recorded by using hand lenses and digital. The mean percent mortality was corrected using Abbott's form (Abbott, 1987) [2]

$$P = \frac{Ta - Ca}{00 - Ca} \times 100$$

Where P=the corrected percent mortality; Ta=the observed percent mortality in treatment; Ca=the percent mortality in the control

Yield Loss Assessment

Onion bulb yield data were collected at the plot base and converted to hectare bases. The relative loss of yield (%) due to the insect pest was calculated for the yield parameters.

$$\textbf{Yield loss (\%)} = \frac{Yp - Yt}{Yp} \times 100$$

Where Yp is the yield of the maximum protected plot and Yt is the yield from plots of other treatments

Data Analysis

All the collected data were Subjected to SAS software version 9.3 for analysis of variance (ANOVA). Combined data analysis was carried out after testing the homogeneity of data using Bartlett's test and the means of treatments were tested using (LSD) test at 0.05 levels of significance to determine the significant difference among treatments. Efficacy analysis was done based on data transformation to Arcsine when necessary according to (Gomez, 1984) [7].

Results and Discussion

The result of Bartlett's test confirmed the homogeneity of variance for all collected which allowed applying combined data analysis. The analysis of variance (ANOVA) of combined data of the two locations revealed highly significant difference among the treatments after spraying of day 1, day 3, day 5, day 7, total mortality percentage, yield, and yield loss, whereas, the interaction of the treatment with location is manifested non-significant difference (Table 2). This indicates that the effectiveness of sprayed chemicals (Lamda Cyhalothrin and Diazinon 60% E.C) was not dependent on the environment. It was revealed that the thrips attack showed a non-significant difference among different plots before the application of treatments.

Table 2: The analysis of variance (ANOVA) among the treatment at two locations

SV	D f	Treatment mean square							
		PSC	Day1	Day3	Day5	Day7	Total Mortality (%)	Yield (kg/ha)	Yield loss (kg/ha)
Treatment	2	706.0ns	1218.79**	648.23**	223.80**	42.43**	14637.58**	7311538.89**	1772.23**
Block	3	10.08*	1.47ns	0.81	0.06ns	0.01ns	6.00ns	32872.22ns	10.58ns
Location	1	6.24ns	1.78ns	9.68ns	0.29ns	0.01ns	27.75ns	3755.56ns	4.08ns
Treatment x Location	3	1.80ns	2.13	7.05ns	6.19ns	0.005ns	32.13*	8938.89ns	18.48
Error		2.28	0.98	6.35	1.42	0.22	6.02	11978.89	8.59
CV		2.31	6.02	21.03	18.62	18.05	4.19	1.96	15

Ns, * & ** is represent non-significant, significant and highly significant respectively, Cv= coefficient of variance, Df; degree of freedom, PSC= pre-spray count

In the present study, natural mortality is usually less than 2 %. This indicates that using an insecticide is mandatory in controlling onion thrips even if the mortality among the treatments was drastically reduced from 3rd day after insecticidal application. Similarly, (Lebedev, *et al*., 2012) [10] reported the natural mortality in control treatment was less than 10 %. But, other researchers (Shaikle *et al*., 2015) reported a significant mortality reduction from the 8th day among the insecticides after insecticidal application. The new brand insecticide Lamda-Cyhalothrin revealed the highest potential than the standard insecticide (Diazinon60%EC) to control onion thrip insects (Fig.1) and the onion producer can be more effective if they used Landa-Cyhalothrin instead of Diazinon 60% EC to control the insect.

Table 3: Percent mean mortality of Onion Thrips/days after spray and yield loss due to Onion Thrips at both locations.

Treatments	Mean of mortality rate					
	Day1	Day3	Day5	Day7	Total Mortality %	Yield loss (kg/ha)
Lamda Cyhalothrin	39.52(38.83)A	32.44(34.61)A	17.55(24.69)A	7.67(16.03)A	97.18 (80.08)A	0.00 A
Diazinon 60%E.C (standard check)	38(37.94)B	20.71(26.99)B	12.46(20.61)B	4.42(12.09)B	75.51(60.15)B	25.95B
Untreated	0.014(0.68)C	0.99(5.71)C	0.043(1.18)C	0(0.2)C	1.05 (5.86) C	32.49C
LSD 5%	1.27	3.24	1.53	0.61	3.16	3.77

One day after

The mortality rate percentage among the treatments was significantly different after day one spray. The maximum onion thrips onion mortality rate (39.52) was revealed for Lambda-Cyhalothrin followed by Diazinon60%EC (38), while the minimum mortality rate (0.014) was manifested for untreated plots (Table 3). This indicates that the Lambda-Cyhalothrin 100g/L to control against onion thrips more effective than the standard check (Diazinon 60 % E.C) starting from day one.

Three days after

The maximum onion thrips mortality rate percentage (32.44) was manifested for a plot treated with Lamda-Cyhalothrin after three days sprayed, while the minimum mortality percentage (0.99) was revealed for an untreated plot (Table 3).

Five days after

The mortality rate percentage among the treatments was significantly different after day one spray. The maximum onion thrips onion mortality rate (7.67) was revealed for Lambda-Cyhalothrin followed by Diazinon 60% EC (12.46), while the minimum mortality rate (0.014) was manifested for untreated plots (Table 3).

Seven days after

The maximum onion thrips mortality rate percentage (32.44) was manifested for a plot treated with Lambda-Cyhalothrin after three days sprayed, while minimum or no mortality percentage (0) was revealed for an untreated plot (Table 3).

Total mortality percentage

In the present study, the maximum mortality rate percentage (97.18) was manifested for Lamda-Cyhalothrin followed by Diazinon 60% EC (75.51) (Fig.1), while the significantly highest mean thrips population was recorded on an untreated plot. This result agrees with (Pandey *et al*., 2020) [16]

Percentage of yield loss

The percentage of yield loss among the treatments manifested a significant difference (Fig. 2).

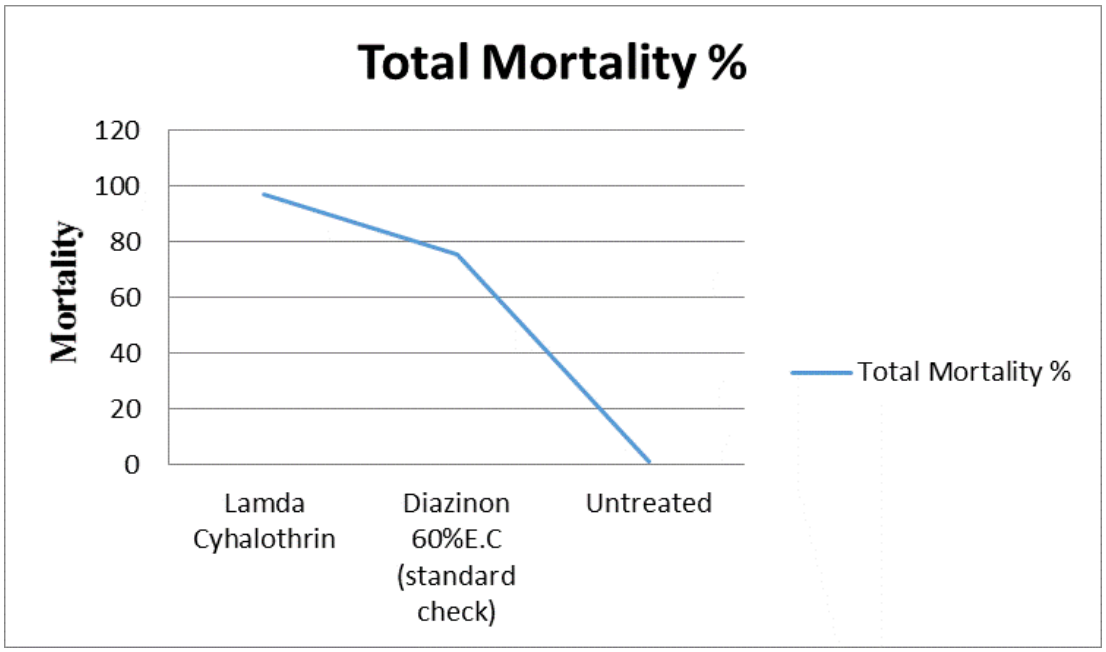

Fig 1: Percentage of Onion thrips mortality after chemical spray

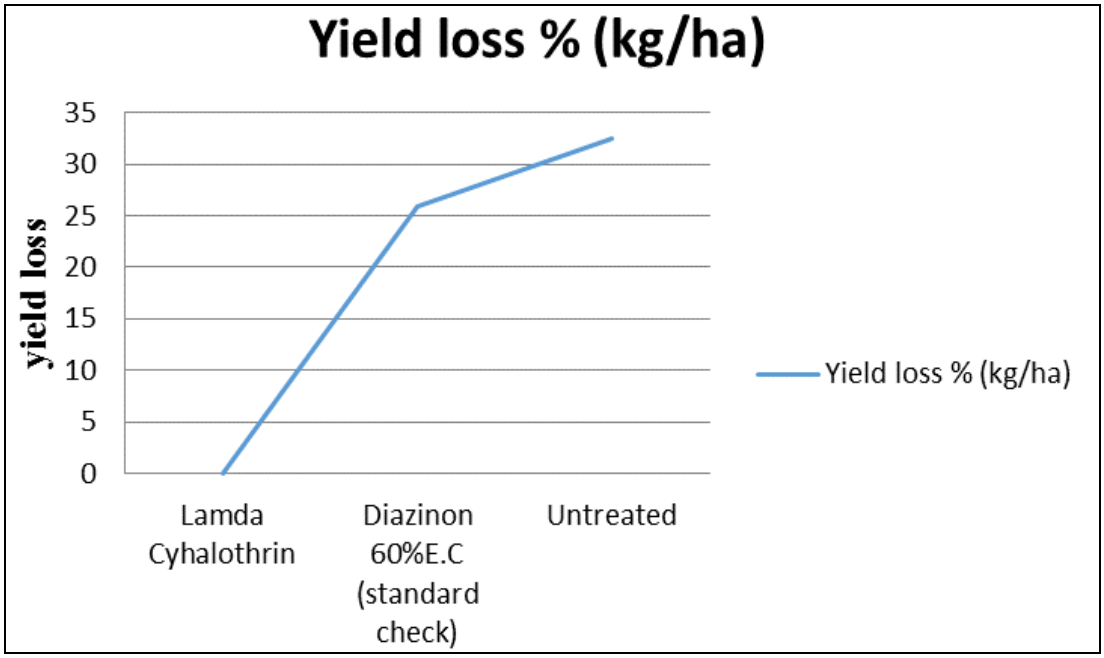

Fig 2: Percentage of Yield loss due to Onion thrips

The maximum yield loss (32.49) was revealed for untreated plot followed by Diazinon60% E.C (25.95), while no yield loss was manifested for a plot treated with Lamda Cyhalothrin (Fig. 2). Similarly, Shibiru, *et al*., (2013) [18]; Karar *et al*., (2014) [9] also reported that onion trips can bring 36 %-37 % yield loss if it is left to uncontrol. This indicates that this insect can bring highly damage the crop yield and other researchers (Yadav *et al*., 2018) [22] reported onion thrips is a major insect pest of bulb crops reduce the yield potential. On other hand, using Lamda-Cyhalothrin insecticide to control onion thrips can increase onion yield by 25 % than using Diazinon60% E.C according to the present study (Table 1). Similarly, other researchers Hussein *et al*., (2015) [8]; Pandey *et al*., (2020) [16] also reported that the highest gross yield on a plot treated by Lamda-Cyhalothrin @ 0.5 ml/lit. In contrast to this Negash, *et al*., (2020) [12] reported that the plot treated by Lamda-Cyhalothrin manifested low yield potential in his research. This is could be due to the resistant development of onion thrips against Lambda-Cyhalothrin.

Conclusion

The consumption of onion has been significantly increasing throughout the world because of the health benefits. But onion thrips insect is one of the crop production constraints since vegetables are more susceptible to insects. That why they need more attention during production. To eliminate yield loss due to onion thrips, was designed to test the efficiency of the Lamda-Cyhalothrin insecticide chemical in controlling onion thrips since insecticides were the only control methods for onion growers to control thrips infesting onion. The onion producers can lose 32 % of the onion yield if they fail to control onion thrips insects during onion production. The present study manifested using Lamda-Cyhalothrin insecticide is more preferable to Diazinon 60% E.C to control the onion thrips. Therefore, based present study, this new insecticide (Lamda-Cyhalothrin 100g/lt) is efficient for onion producers and it is comparable or can be replaced or complementary to other insecticides.

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Conflict of interest

No conflict of interest among the authors

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