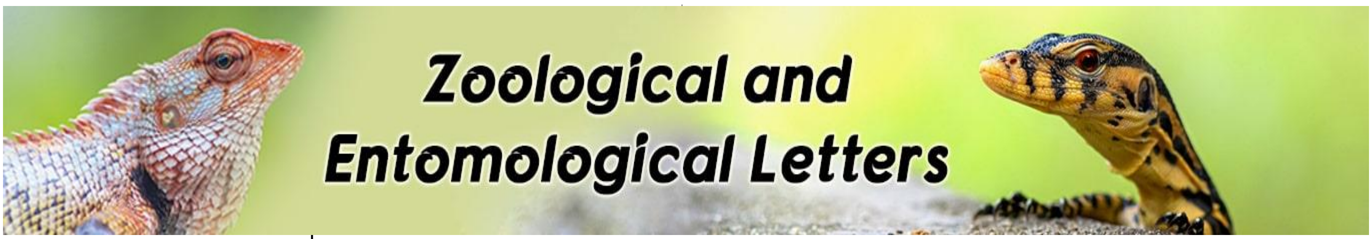

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Field evaluation of insecticides against chickpea Podborer (Lepidoptera: Noctuidae) of Chickpea (*Cicer arietinum* L.) in the midlands of Bale Zone

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Abstract
Chickpea (*Cicer arietinum* L.) is one of the first grain legumes originated and domesticated in western Asia and spread to India, Europe and Africa. Ethiopia is considered as a secondary center of genetic diversity for chickpea. The field experiment was conducted at Goro district on two sites (farmers'field and SARC sub-site) for two consecutive years to study the effectiveness of different insecticides for management of chick pea pod borer. Chick pea Varietiy Arerit and nine insecticides were used as a treatment in the experiment. All the tested insecticides significantly reduced the pod borer larval population as compared to the unsprayed treatments. The percentage of larval population reduced over check was highly recorded with Profit 72% EC (97.52), sprayed plots followed by Karate 5% EC (83.37) and Helerat 5% EC (83.37) spayed plots. The maximum percent yield was obtained from Helerat 5% EC sprayed plot with 73.62% followed by Karate 5%EC with 71.87% and Selecron 720 EC with 70.6% as compared to control plot. From the finding I recommend that insecticides Helerat 5% EC and Karate 5% EC are the most effective insecticide for controlling pod borer as compared to the tested insecticides, I also recommending all the insecticides tested in the experiment addition of the two against pod borer of chickpea at the right time and optimum rate. Hence, any stake holders who are working on the production of chickpea can use one insecticide in the absence of the other as an option/alternatives to increase their productivity even if they have different degrees of efficacy.

Keywords: pod borer, insecticides, chickpea

1. Introduction

Chickpea (*Cicer arietinum* L.) is one of the first grain legumes originated and domesticated in western Asia and spread to India, Europe and Africa (Vander, 1987) [18]. Subsequently, it spread to Latin and Central American countries and is grown under rain fed agricultural areas receiving 350-650 mm annual rainfall (Tibebu, 1983) [16]. It has been cultivated for centuries in the Middle East, Asia, India, the Mediterranean region and Ethiopia (Westphal, 1974) [19]. Ethiopia is considered as a secondary center of genetic diversity for chickpea and the wild relative of cultivated chickpea (*Cicer arietinum* L.), is found in Tigray region of Ethiopia (Yadeta and Geletu, 2002; Kanouni *et al*., 2011) [21, 5]. Ethiopia shares 2% among the most chickpea producing countries next to India (64%), Turkey (8%) and Pakistan (7%) (ICRISAT, 2004) [3].

Two groups of chickpeas are cultivated in Ethiopia Desi with pink flower and Kabuli with white flower types. Chickpea is good source of dietary protein (17% - 23%) compared with cereals (8% - 10%), maintain and restore soil fertility (can fix up to 60 kg N /ha/year), chickpea has high potential crop for domestic and export market. Gram pod borcr, *Helicoverpa armigera* (Hubner) (Lepidoptera: Nocluidae) is the major biotic constraint limiting the production and productivity of chickpea (Srivastava and Srivastava, 1900a and 1990b. Lateef, 1985 and Reed *et al*. 1987) [14, 15, 7, 10]. This pest is the major constraint in chickpea production causing severe losses up to 100% in spite of several rounds of insecticidal applications. Sometimes in serious cases, there may be a complete crop failure. The pod borer, *H. armigera*, is the most serious pest in causing economy loss to the chickpea crop (Singh & Yadav, 2006) [11]. It is a highly polyphagous pest, feeding on a wide range of food, oil and fiber crops. Due to its wider host range, multiple generations, migratory behavior, high fecundity and existing insecticidal resistance; it has become a difficult pest to tackle. It selectively feeds upon growing points and reproductive parts of the host resulting in significant yield loss.

In chickpea, it feeds on buds, flowers and young pods of the growing crop, the crop often fails to recover and yields extremely poor. The pest status of this species has increased steadily over the last 50 years due to agro-ecosystem diversification by the introduction host crops such as chickpea (Knights *et al.*, 1980; Passlow, 1986) [6, 8]. Commercial chickpea crops are important sources of *Helicoverpa* species (White *et al.*, 1995) [20]. Sequeira *et al.*, (2001) [12] reported chickpea attractive to oviposition of *Helicoverpa* moths from as early as 14 days after planting and throughout the growth period. Of all *Helicoverpa* species larvae recorded from the entire samples and crop combinations, 98.3% were found on chickpea.

This days there are so many pesticide are found on the market. Most of them are imported from the abroad. Every pesticide imported should be tested for their efficacies and registered before they reached to the users. But most pesticide supplied by local pesticide dealers are mostly ineffective according to the information obtained from the users.

Though, farmers, investors and local seed producer cooperatives are confused to select these pesticides because they are many and not effective for the management of pests.

They complain local pesticide dealers for their supplying such pesticide and they also vulnerable to unnecessary cost to buy pesticide. Therefore, we need to test the insecticides efficacy for the management of pod borer to increase their production and productivity.

1.1 Objectives

- To study the effectiveness of different insecticides for management of chick pea pod borer.

2. Materials and Methods

To screen effective insecticide chemicals in chickpea tomanage *H. armigera*, all available insecticides were evaluated for their efficacy to *H. armigera.* All chemicals were purchased from the local pesticide dealers. A large seeded chickpea variety Arerit was used in this experiment.

The experiment was done at Goro Districts (farmers'field and SARC sub-site) for two years. The experiment was laid out in RCBD with three replications. The experimental plots have a size of 5.4m^2(3m length x 1.8m width) having 6 rows which was 0.3m apart. The space between blocks was 1.5m and between plots was 1m. All the agronomic practices were done as the recommendation for the chickpea production. Insecticides were sprayed starting from the emergence of pod borer on chickpea and continued as necessary.

Table 1: List of Insecticides tested against chickpea pod borer at Goro district, 2018 cropping season

No.	Trade Name	Common Name	Rate (ml/ha)
1	Highway 50% EC	Lambda-cyhalothrin	400 ml
2	Modan 5% EC	lambda –cyhalothrin 5% EC	400 ml
3	Nimbicidine	Azadirachtin	3000 ml
4	Agro-plus 175 SC	Imidacloprid125g/l + Lambda-cyhalothrin 50g/l Sc	400 ml
5	Helerat 5% EC	Lamdacyhlothrin	250-400 ml
6	Diazinon 60% EC	Diazinon	1200 ml
7	Karate 5% EC	Lambda-cyhalothrin	200-500 ml
8	Selecron 720 EC	Profenofos "Q" 720 g/l	500-750 ml
9	Profit 72% EC	Profenofos	1000 ml

2.1 Data collected

The number of larvae before and after insecticides spray were recorded from five randomly selected plants in each treatment. The reduction percentage of larvae were computed by counting the number of larvae numbers on the sprayed plots over unsprayed control check.

During harvesting, the number of damaged pods due to pod borer were recorded from five randomly selected plants in each plots. The percentage of pods damaged were assessed by using the following formula.

$$\%\ \text{Pod damage} = \frac{\text{Total number of pod produced per plant} - \text{Number of undamaged Pods X 100}}{\text{Total number of pods produced per plant}}$$

$$\%\ \text{Larval reduction} = \frac{\text{Total number of larval density before spray} - \text{Number of larval density after spray X 100}}{\text{Total number of larval density before spray}}$$

All the recorded data were analyzed by SAS Stastical software. Data were subjected to the analysis of variance using GLM Procedure SAS software (SAS 2002). The means were compared using Duncan's multiple range test (DMRT) (Duncan, 1955) [23] at 0.05 probability level.

3. Result and Discussions

3.1 Reduction percentage of larval population

The study, showed that all the insecticides significantly reduced the pod borer larvae density. The highest larvae mortality were recorded from plots treated with Profit (95.65%) and Karate 5%EC (72.28%) that a statistically at par followed by Nimbicidine (61.73%), Selecron 720 EC (59.54%) and Modan 5% EC (58.64%). The larval population were increased on untreated plots. So from the tested insecticides Profit and Karate 5%EC were the most effective insecticides to gave high mortality larvae on chickpea under field conditions. The highest reduction percentage of larvae number over check were recorded from plots sprayed by Profit (97.52), followed by Karate 5%EC (83.37) and Helerat (83.37), Where As the minimum larvae reduction percentage was recorded from plots sprayed Agro-plus (59.55) (Table 2).

Table 2: Effect Insecticides on Mortality of Pod borer Larvae of Chickpea.

Treatment	Larvae infestation Before spray	Larvae infestation After spray	%ge Larval Reduction	%ge Larval reduction over check
Highway50% EC	1.23b	0.80cb	33.33a	80.15
Modan 5%EC	2.46ba	1.00cb	58.64a	75.19
Nimbicidine	2.90ba	1.10cb	61.73a	72.70
Agro-plus 175 SC	3.90a	1.63b	58.41a	59.55
Helerat 5% EC	2.10ba	0.67cb	56.97a	83.37
Diazol 60 EC	1.76b	0.90cb	48.72a	77.67
Karate 5%EC	2.0b	0.67cb	72.28a	83.37
Selecron 720 EC	2.33ba	0.90cb	59.54a	77.67
Profit	2.00b	0.10c	95.65a	97.52
Control	2.10ba	4.03a	-91.43b	
LSD (0.05%)	1.85	1.36	70.72	

Tukey's Studentized Range (HSD) Test, Means with the same letter are not significantly different.

3.2 Pod damage Reduction

Regarding to the pod damage reduction the result showed that the plots sprayed by Diazol 60% EC were gave highest pod damage reduction percentage of 87.34%, followed by Highway 50% EC (83.06%) and Profit (80.77%), and Selecron 720 EC sprayed plots were also reduce pods damage by (77.91%) over check.

Table 3: Effect insecticides on yield and yield components of chickpea at Goro district in 2017/2019 Cropping Season.

Treatment	% pod damage	Reduction % age over check	No. of Pod/plt	HSW	Yield (kg/ha)	Yield Increased over Unsprayed check (kg)	% ge yield Increased over control
Highway 50% EC	5.93[b]	83.06	35.67[a]	211.73[a]	1595.5[dc]	661.1	41.43
Modan 5% EC	11.46[b]	67.26	46.10[a]	199.13[a]	1965.6[bdac]	1031.2	52.46
Nimbicidine	9.70[b]	72.28	49.80[a]	209.17[a]	1756.3[bdc]	821.9	46.8
Agro-plus 175 SC	8.33[b]	76.2	56.47[a]	190.13[a]	1458.2[d]	523.8	35.92
Helerat 5%EC	8.70[b]	75.14	48.00[a]	205.73[a]	3542.7[a]	2608.3	73.62
Diazol 60% EC	4.43[b]	87.34	39.33[a]	218.87[a]	2108.3[bdac]	1173.9	55.68
Karate 5% EC	8.40[b]	76	51.77[a]	214.40[a]	3321.9[ba]	2387.5	71.87
Selecron 720 EC	7.73[b]	77.91	56.43[a]	216.87[a]	3178.1[bac]	2243.7	70.6
Profit	6.73[b]	80.77	47.77[a]	223.53[a]	1445.6[d]	511.2	35.36
Control	35.00[a]		45.53[a]	208.37[a]	934.4[d]		
LSD%	10.88		57.59	101.52	1695.4		

Tukey's Studentized Range (HSD) Test, Means with the same letter are not significantly different.

3.3 Effects of insecticides on yields and yield components of chickpea

From the study, the plots treated with Helerat gave the maximum seed yield of 3542.7 kg/ha, followed by the plots sprayed by Karate 5% EC which gave 3321.9 kg/ha and also Selecron 720 EC spayed plots which gave 3178.1kg/ha, and whereas the minimum yield 1445.6 kg/ha was obtained from Profit treated plots. Similarly, the highest percent of seed yield increased over check was obtained from plots sprayed by Helerat which was 73.62% followed by Karate 5% EC which was 71.87% and Selecron 720 EC sprayed plots which was 70.6%, whereas the lowest increased percent was obtained from Profit which was 35.36%.

3.4 Cost/benefit analysis

The Cost /Benefit analysis showed that Helerat 5% EC sprayed plots gave the highest gross returns (ETBirr 121,144.00 per ha) and the lowest gross return (ETBirr 31,920.00 per ha) were obtained from the untreated check. The plots sprayed with Helerat 5% EC gave the maximum net return (ETBirr 101, 987.6 per ha) and also gave the highest benefit cost ratio (5.32). Karate 5% EC sprayed plots also gave the higher gross returns (ETBirr 113,582.0 per ha) and gave the higher net return (ETBirr 93, 945.3 per ha) and benefit cost ratio (4.78). The highest (ETBirr 462.61 and 410.34) marginal rate of return was obtained from Helerat 5% EC and Karate 5% EC treated plots, respectively. Therefore from the cost benefit analysis the most economic benefit for pod borer management was obtained from insecticides Helerat 5% EC and Karate 5% EC sprayed plots.

Table 4: Partial Budget analysis for the Control of pod borer on chickpea during 2017/19 GC Season at Goro Districts.

Treatment (Insectides)	Yield obtained (Qt/ha)	Adjusted Yield (Qt/ha)	Sale price (ETB/Qt)	Total Variable Cost (ETB/ha)	Gross Return (Price x Qt)	Net Return (GR-TVC)	Benefit cost ratio (GMP/TVC)	Marginal Rate of Return %
Highway50% EC	15.95	14.36	3800	19190.8	54,568.00	35377.2	1.84	114.69
Modan 5%EC	19.65	17.69	3800	19290.7	67,222.00	47931.3	2.48	179.17
Nimbicidine	17.56	15.8	3800	20124	60,040.00	39916	1.98	131.92
Agro-plus 175 SC	14.58	13.12	3800	19153.6	49,856.00	30702.4	1.60	90.50
Helerat 5% EC	35.42	31.88	3800	19156.4	121,144.00	101,987.6	5.32	462.61
Diazol 60 EC	21.08	18.97	3800	19589.1	72,086.00	52496.9	2.68	199.75
Karate 5%EC	33.21	29.89	3800	19636.7	113,582.00	93,945.3	4.78	410.34
Selecron 720 EC	31.78	28.6	3800	19698	108,680.00	88982	4.52	383.87
Profit	14.45	13.01	3800	19340.3	49,438.00	30097.7	1.56	86.50
Control	9.34	8.4	3800	18552	31,920.00	13368	0.72	0.00

4. Conclusion and Recommendation

From the evaluated insecticides Helerat 5% EC and Karate 5% EC are the most effective insecticides against chickpea pod borer infestation and they gave the maximum larvae mortality and decreased pods damage as compared to other insecticides. Similarly the seed yield in kg per hectare was also increased with Helerat 5% EC over check and further more it was also indicated from the yield data that in normal conditions pod borer can causes about 35.36% to 73.62% losses to chick pea yield. The maximum net return ETBirr 101,987.6 per ha and highest benefit cost ratio (5.32) was obtained from Helerat 5% EC. and followed by Karate 5%EC sprayed plots. The highest (ETBirr 462.61 and 410.34) marginal rate of return were obtained from Helerat 5% EC and Karate 5% EC sprayed plots, respectively. There fore, from the present finding all of the evaluated insecticides have shown a promising efficacy as compared to the control plots against the pod borer larvae. However, out of the tested insecticides Helerat 5% EC and Karate 5%EC have shown a better controlling potential against the pod borer infestation. Therefore, they are recommended for the management of pod borer larvae for chickpea production.

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