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# Effects of Synthetic Insecticides and Crude Botanicals Extracts on Cabbage aphid, *Brevicoryne brassicae* (L.) (Hemiptera: Aphididae) on Cabbage

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## Abstract

The study was conducted to evaluate the insecticidal action of two new chemical insecticides and three locally available botanicals. These materials were evaluated for their efficacy against cabbage aphids, *Brevicoryne brassicae* (L.), under laboratory and field conditions. The laboratory result revealed that Lambda Cyhalothrin (Triger 5 E.C™) and Emamectin benzoate (Cutter 112 E.C™) were non-significant difference from the standard check within 1 day after application. The field results showed between the new insecticides, Triger 5 E.C™ and Cutter 112 E.C™ were non-significant difference from that of the standard check (Diazinon 60% E.C™) at both locations (Guder and Mutulu) within three days after application. Extracts of neem (*Azadirachta indica*) seed, Hop bush (*Dodonae angustifolia*) fresh leaf and Lemon grass (*Cymbopogon citrates*) gave positive performance under laboratory while the efficacy percent were decline at both field locations on field. *Azadirachta indica* seed, *Dodonae angustifolia* and *Cymbopogon citrates* were given 59.48, 57.16 and 52.50 at Mutulu and 53.92, 37.26 and 62.72 at Guder location mortality percent, respectively, after 3rd day observation in first spray. The obtained results revealed that all tested materials were exhibited mortality rate action against cabbage aphids. Powdered neem seed, *Dodonae angustifolia* fresh leaf and leaves of *Cymbopogon citrates* caused moderately mortality percent against cabbage aphid within 3 days after applications. Higher damage and low yield were observed in control and botanicals application. This study indicated that the two insecticides Cutter 112 E.C™ and Triger 5 E.C™ and botanicals could be recommended as an alternative management option of *Brevicoryne brassicae* (L.) in Ethiopia.

**Keywords:** Cabbage; Botanicals; Chemical insecticides; Cabbage aphid

## Introduction

Cabbage (*Brassica oleracea* L. var. *capitata*) is cultivated in about 31,783.54 ha [1]. Its annual production is 43,483.94 ton with 3, 230,180.49 ton head cabbage, estimated yield per hectare is 9.1 ton [1]. Ethiopia has the favorable agro-climatic conditions for the production of cabbage head for fresh market. However, cabbage yield and quality has been shown to be influenced by several factors, among of these factors cabbage aphids are very serious in cabbage growing areas of Ethiopia especially in dry season. A number of insect species including cabbage aphid *Brevicoryne brassicae* inflict damage on brassica crops in Ethiopia [2]. The cabbage aphid, *Brevicoryne brassicae* L. (Homoptera: Aphididae), is found on brassica crops with worldwide distribution and severe damage and outbreaks [3]. Cabbage aphid cause significant yield losses in many crops in the family Brassicaceae, which includes the mustards and crucifers. Continued feeding by aphids causes yellowing, wilting and stunting of plants [4]. Severely infested plants become covered with a mass of small sticky aphids, which can eventually lead to leaf death and decay [5]. Cabbage aphids feed on the underside of the leaves and on the center of the cabbage head [6]. They prefer feeding on young leaves and flowers and often go deep into the heads of brussels sprouts and cabbage [7]. Colonies of aphids are found on upper and lower leaf surfaces, in leaf folds, along the leafstalk, and near leaf axils. It also secretes honey dew while feeding on leaves that reduces the quality of cabbage. With development of sooty mold on this honey dew, the produce have became sooty and unmarketable [8-11]. Controlling cabbage aphid is not an easy practice although synthetic chemicals are apparently available for use. Effective pest control is no longer a matter of heavy application of limited insecticides, because continuous use of chemicals promotes development of pesticide resistance in the target pests, pest resurgence, emergence of secondary pests, affects non-target insects species, affects the environment and human health. Therefore use of alternatives including botanicals, biopesticides and new generation synthetic insecticides is essential to grow health crops of cabbage. The use of different botanical insecticides to protect plants from pests is very promising because of several distinct advantages [12]. Pesticidal plants are generally much safer than conventionally used synthetic pesticides. Pesticidal plants have been in nature as its component for millions of years without any adverse effect on the ecosystem [12]. Plant product pesticides can be undertaken into practical applications in natural crop protection, which can help the small-scale farmers [13]. The use of natural and easily biodegradable crop protection inputs like *Azadirachtin* can be a useful component of an IPM strategy since the compound is known for its low toxicity against beneficial insects [14]. Therefore, two newly introduced insecticides Emamectin benzoate (Cutter 112 E.C.™) and Lambda Cyhalothrin (Triger 5 E.C.™) and three locally available plants (*Azadirachta indica* seed, *Dodonae angustifolia* fresh leaf and *Cymbopogon citrates*) leaf were evaluated to determine their efficacy percent on mortality of *cabbage aphids* under laboratory as well as on the fields. *Dodonaea angustifolia*, commonly known as hop bush, called "Etecha" in afan oromo and "Kitkita" in Amharic is a perennial shrub belonging to Sapindaceae family. This plant commonly found in West shawa of Ethiopia, the branches used for teeth brush because of its interesting aroma and the leaves used for cultural medicinal value.

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## Materials and Methods

### Description of the study area

The experiment was carried out under irrigation on two locations of farmers' field at Toke Kutaye district West Shawa Zone, Oromia Regional state, Ethiopia. The district is 125 km far away from Addis Ababa and 12 km from Ambo town having an altitude of 1990 meter above sea level, latitude of 08° 59" 01.1" north and longitude of 37° 46" 27.6" east. The average annual rainfall is 1028.7 mm and maximum and minimum temperatures of the area 26.2°C and 12.3°C, respectively.

### Preparation of botanicals and insecticides

Fresh leaves of *Dodonae angustifolia* and *Cymbopogon citrates* were collected from the surrounding areas of Ambo town, cut into small pieces, and dried under shade. Dried the leaves and seeds of *Azadirachta indica* were ground and mixed with water at 5% concentration level (w/v) i.e., 10g of powder in 100ml of water and filtered through cheese cloth. The extract suspensions were sprayed on the cabbage aphid populations using hand sprayer at the rate of 150 liters per hectare. There was two times spray at seven days interval. The two insecticides Emamectin benzoate (Cutter 112 E.C™) and Lambda Cyhalothrin (Triger 5 E.C™) mixed separately with 100 liter of water and sprayed at the rates of 1 and 0.4 liter per hectare, respectively.

### Treatments and experimental design

The laboratory study was conducted at Ambo University Plant science department, entomology laboratory using complete randomized design with three replications. The leaf powder extracts were diluted with distilled water to obtain 10% test solutions, which were used in the bioassay studies. The nymphs and adults of cabbage aphids used for the study were collected from the host cabbage crops in the cabbage fields.

### Laboratory treatments application

Studies were conducted for a period of 24hrs in the laboratory 100 nymph and adults were inserted in a Petridis and provided with fresh leaves of cabbage that was collected from the field to serve as food source, botanical crude extracts and insecticides were applied on against aphid insects in the Petridis at defined rate. All the experiments were conducted at 24°C ± 2 and70% humidity of laboratory condition. Twenty four hour latter larval mortality was observed.

### Field treatment application

The fields' experiments were scouted every week for the signs and symptoms of aphids' damage and occurrence till reach economic threshold level. Botanicals were sprayed in the afternoon at 4 p.m. Aphid population pre-spray counts were made before 24 hrs of each spray. Hand sprayers were used and suspension performed at the plant stage of 6-8 true leaf and when aphid population is reached its economic threshold level 2% infestation [15]. Opfer and McGrath [4] also stated that when more than 20% of leaves are infested with aphids, then an insecticide application is recommended. However, we used at 2% infestation level. The field study was laid out in Randomized Complete Block Design with three replications. Plant to plant and row-to-row distances were kept at 40 × 80 cm. The single plots size was 6 $m^2$. The Copenhagen variety of cabbage was brought from local market. Seedlings were raised on a seedbed. Ready seedlings were transplanted. All agronomic practices and management treatments were applied as recommended. Head cabbages were harvested at maturity stage in an extended harvesting period.

### Data collection

The experimental fields were scouted every week for the signs and symptoms of aphids' damage and occurrence till reach economic threshold level. Numbers of aphid cabbage per cabbage head were counted and their economic threshold levels were determined. After treatment application numbers of live cabbage aphids' post-treatment data were recorded after 1 and 3 days of each spray. Finally, the cabbage head yield was measured and expressed as kg/ha.

### Data analysis

Data were analyzed with SAS version 9.1 [16] and the effects of the treatments were compared. Least significant difference (LSD) test was used to determine the differences among the means for different treatments and yield parameters. Efficacy percentages were calculated by using the following formula:

$$\text{Efficacy (\%)} = \frac{Pr\,SC - Posc}{Pr\,SC} X100$$

**Where:** PrSC=Pre Spray Count

PoSC=Post Spray Count

## Result and Discussion

### Effect of botanicals against Cabbage aphid

The result presented in (Table 1a) indicted there are significant (P<0.01) differences among the treatments. The presented data are

| Treatments | Efficacy percentage (%) | | |
|---|---|---|---|
| | Under laboratory condition | Under field condition | |
| | | Mutulu site | |
| | | 1 day ADTA | 3 days ADTA |
| Lambda Cyhalothrin (Triger 5% E.C™) | 100(90.00)[a] | 85.04(67.21)[a] | 95.05(77.08)[a] |
| Emamectin benzoate (Cutter 112 E.C™) | 100(90.00)[a] | 83.36(68.87)[a] | 94.2275.85)[a] |
| *Azadirachta indica* seed | 75.67(60.67)[c] | 50.81(45.57)[b] | 59.48(50.19)[b] |
| *Dodonae angustifolia* fresh leaf | 87.33(68.87)[b] | 49.09(42.43)[b] | 57.16(49.02)[b] |
| *Cymbopogon citrates* | 72.06(58.05)[c] | 36.34(36.87)[b] | 52.50(46.72)[b] |
| Diazinon 60 E.C™ | 100(90.00)[a] | 97.67(81.87)[a] | 99.22(84.26)[a] |
| Water/control | 14.33(21.97)[d] | 12.64(21.13)[c] | 11.57(20.26)[c] |
| MSE | 3.12 | 7.78 | 6.11 |
| LSD at 0.01 | 7.77 | 19.4 | 15.25 |
| CV (%) | 3.97 | 13.12 | 9.12 |

**Note:** Means with the same letter are not significantly different ADTA (After Day of Treatment Application) Figures in parentheses are Arcsin *percent* transformed value.

**Table 1a:** First spray mean efficacy of insecticides and botanicals on cabbage aphids, *Brevicoryne brassicae* under laboratory and field conditions.

pertaining to mean percent reduction of aphid population reveals that, among all the treatments the new chemical insecticides and the standard check (Diazinon 60% E.C.™), Emamectin benzoate (Cutter 112 E.C™) and Lambda Cyhalothrin (Triger 5 E.C™) were recorded to be significantly superior in efficacy against cabbage aphids of first sprayed (97.67, 96.29), (95.05, 98.48,) and (94.22, 98.15) within three days of application, respectively. All insecticides gave the highest mean percent reduction of aphids (Table 1b). However, among the botanicals extracts *Cymbopogon citrates* and *Azadirachta indica* gave moderate mortality rate in both locations and *Dodonae angustifolia* (57.16, 37.26) showed the lowest values but significantly higher than control treatment. The results were similar with those of Eileen and Sydney [17]. They reported that the treated insect with *Azadirachta indica* extract usually cannot molt to its next life stage and dies within a few days and acts primarily as a repellent when applied to a plant, and may kill an insect within 24 hrs (Table 2). The obtained results were in agreement with those of Ahmad and Akhtar [18]. They reported that aphids developed resistance against chemical insecticides including pyrethroids (cypermethrin, lambdacyhalothrin, bifenthrin and deltamethrin) and neonicotinoids (imidacloprid, acetamiprid, and thiamethoxam). Aphids resistance level increased progressively in concurrence with regular use of vegetables. A field experiment was undertaken to evaluate the efficacy of fresh leaves powder extracts of *D. angustifolia* against cabbage aphids during the dry season in irrigation and it gave promising results. Similarly, a field experiment was conducted in Sorapet, India, to evaluate the efficacy of crude extracts of *D. angustifolia* against *Earias vitella* on rain fed cotton. It was reported that the extracts of the product was also drastically reduced the number of larvae similar to a neem product. The extracts drastically reduced the number of larvae *Earias vitella* [19]. Naqvi [20] stated that *Azadirachtin* based neem pesticides having diverse pest control properties affect insect growth, disturb adult fertility and different negative physiological processes in insects such as metamorphosis in addition to direct toxicity and anti-feedant and oviposition deterrent effects. Gandhi et al. [21] tested the performance of neem oil as seed treatment against aphid on Okra crop and found excellent results up to 45 days after treatment and provided better yield compared to control. Muhammad et al. [22] reported that *Azadirachtin* based biosal performed well with 59.77 % reduction against green peach aphid, *Myzus persicae* in Pakistan. Ahmed et al. [23] also evaluated the toxicity of *Azadirachtin* based formulations Neem-Azal T/S and Neemix against mature and immature stages of bean aphid (*Aphis fabae Scop*.) both products had remarkable effects on adult aphid when used as systemic insecticides (Tables 3a-3d). In another comparative study with neem oil 2% and neem seed water extract at 3% caused significant reduction in the population of jassid, whitefly and thrips on cotton up to 168 hrs but lost their efficacy at 336 hrs [24] (Table 4). Dodia et al. [25] reported that *Cymbopogon citrates* had an effect on the onion thrips management. Shiberu et al. [26] also mentioned that *Cymbopogon citrates* was reduced the population number of onion thrips at the rate of 10 g/liter of water. An overall performance of two consecutive sprays in two different locations against the population of cabbage aphid by insecticides gave as an average effect after third day of application. Triger 5%$^{MT}$ (97.26) and Cutter 112 E.C$^{MT}$ (97.24%) were revealed. The most effective control on cabbage aphids. However, *Azadirachta indica* (56.49), *Cymbopogon citrates* (55.20), and *Dodonae angustifolia* (48.96) gave less effective control on cabbage aphid as compared with tested insecticides.

| Treatments | Efficacy percentage (%) | |
|---|---|---|
| | Under field condition | |
| | Guder Site | |
| | 1 day ADTA | 3 days ADTA |
| Lambda Cyhalothrin (Triger 5% E.C™) | 92.86(74.66)$^{a}$ | 98.48(81.87)$^{a}$ |
| Emamectin benzoate (Cutter 112 E.C™) | 91.97(73.579$^{a}$ | 98.15(81.84)$^{a}$ |
| *Azadirachta indica* seed | 44.18(41.55)$^{b}$ | 53.92(47.29)$^{b}$ |
| *Dodonae angustifolia* fresh leaf | 36.31(36.87)$^{c}$ | 37.26(37.46)$^{c}$ |
| *Cymbopogon citrates* | 48.39(43.85)$^{b}$ | 62.72(52.53)$^{b}$ |
| Diazinon 60 E.C™ | 94.32(75.82)$^{a}$ | 96.29(78.46)$^{a}$ |
| Water/control | 20.06(26.56)$^{c}$ | 16.57(24.35)$^{d}$ |
| MSE | 9.33 | 4.35 |
| LSD at 0.01 | 23.27 | 10.86 |
| CV (%) | 15.26 | 6.58 |

**Note:** Means with the same letter are not significantly different
ADTA (After Day of Treatment Application)
Figures in parentheses are Arcsin *percent* transformed value.

**Table 1b**: First spray mean efficacy of insecticides and botanicals on cabbage aphids, *Brevicoryne brassicae* under field conditions.

## Frequency of application

The frequency of application made two times within 15 days intervals at the recommended application rates. After 15 days of the first application the aphid infestation was reach economic threshold level. Therefore, the second sprays were made. Application timing is very important to keep aphids under control [5,6].

| Treatments | Efficacy percentage (%) | | | |
|---|---|---|---|---|
| | On field | | | |
| | Mutulu site | | Guder Site | |
| | 1 day ADTA | 3 days ADTA | 1 day ADTA | 3 days ADTA |
| Lambda Cyhalothrin (Triger 5% E.C™) | 92.97(74.65)$^{a}$ | 96.03(78.46)$^{a}$ | 98.03(81.87)$^{a}$ | 99.50(84.26)$^{a}$ |
| Emamectin benzoate (Cutter 112 E.C™) | 96.53(80.02)$^{a}$ | 97.10(80.01)$^{a}$ | 99.03(84.26)$^{a}$ | 99.50(84.26)$^{a}$ |
| *Azadirachta indica* seed | 48.8(44.43)$^{c}$ | 49.10(44.42)$^{c}$ | 46.67(43.28)$^{b}$ | 63.47(52.53)$^{b}$ |
| *Dodonae angustifolia* fresh leaf | 56.20(48.44)$^{b}$ | 56.67(49.02)$^{b}$ | 34.17(35.67)$^{c}$ | 44.76(42.13)$^{c}$ |
| *Cymbopogon citrates* | 36.87(37.46)$^{d}$ | 42.67(40.97)$^{c}$ | 39.83(39.23)$^{bc}$ | 62.90(52.53)$^{b}$ |
| Diazinon 60 E.C™ | 95.93(78.46)$^{a}$ | 98.70(84.26)$^{a}$ | 98.67(84.26)$^{a}$ | 99.27(84.26)$^{a}$ |
| Water/control | 9.73(18.43)$^{e}$ | 12.50(21.13)$^{d}$ | 14.70(22.79)$^{d}$ | 16.17(23.58)$^{d}$ |
| MSE | 2.51 | 2.65 | 3.95 | 2.41 |
| LSD at 0.01 | 6.29 | 6.59 | 9-86 | 6.02 |
| CV (%) | 4.01 | 4.09 | 6.42 | 3.48 |

**Note:** Means with the same letter are not significantly different
ADTA (After Days Treatment Application)
Figures in parentheses are Arcsin *percent* transformed value

**Table 2:** Second spray mean efficacy of insecticides and botanicals on cabbage aphids, *Brevicoryne brassicae* under field conditions.

| Mutulu site | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1Day ATA | | | | | | | |
| **Spray** | **$T_1$** | **$T_2$** | **$T_3$** | **$T_4$** | **$T_5$** | **$T_6$** | **$T_7$** |
| 1st Spray | 92.97(74.66)[a] | 83.36(65.65)[a] | 50.81(45.579)[a] | 49.09(44.43)[a] | 36.34(36.37)[a] | 97.67(81.87)[a] | 12.60(21.13)[a] |
| 2nd Spray | 96.53(80.02)[a] | 84.9(67.21)[a] | 49.80(45.0)[a] | 56.2(48.459)[a] | 36.87(37.46)[a] | 95.93(78.46)[a] | 14.83(22.79)[a] |
| MSE | 2.25 | 3.19 | 7.58 | 3.4 | 7.74 | 3.89 | 2.14 |
| CV (%) | 2.53 | 3.55 | 15.07 | 6.46 | 21.16 | 4.02 | 15.61 |

**Note:** Means with the same letter are not significantly different
ATA (After Treatment Application)
Figures in parentheses are Arcsin percent transformed value
$T_1$(Lambda Cyhalothrin (Triger 5 E.C™)), T2(Emamectin benzoate (Cutter 112 E.C™)), $T_3$(*Azadirachta indica*), $T_4$(*Dodonae angustifolia*), $T_5$(*Cymbopogon citrates*), $T_6$(Diazinon 60 E.C™), and $T_7$(Water/control)

**Table 3a:** Effect of spray and time on efficacy of treatments at Mutulu Site After Days Treatment Application.

| Mutulu site | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3 Days ATA | | | | | | |
| **Frequency of spray** | **$T_1$** | **$T_2$** | **$T_3$** | **$T_4$** | **$T_5$** | **$T_6$** | **$T_7$** |
| 1st Spray | 95.05(77.08)[a] | 94.22(75.82)[a] | 59.10(50.18)[a] | 54.12(47.29)[a] | 52.50(46.71)[a] | 99.22(84.26)[a] | 11.51(20.26)[a] |
| 2nd Spray | 96.03(78.46)[a] | 97.0(80.03)[a] | 63.47(52.53)[a] | 48.38(43.85)[a] | 62.90(52.53)[a] | 99.27(84.26)[a] | 16.35(23.57)[a] |
| MSE | 1.96 | 5.15 | 4.64 | 10.46 | 8.67 | 1.46 | 2.38 |
| CV (%) | 2.05 | 5.39 | 7.56 | 20.41 | 15.02 | 1.47 | 17.07 |

**Note:** Means with the same letter are not significantly different
ATA (After Treatment Application)
Figures in parentheses are Arcsin *percent* transformed value
$T_1$(Lambda Cyhalothrin (Triger 5 E.C™) ), T2(Emamectin benzoate (Cutter 112 E.C™), $T_3$(*Azadirachta indica*), $T_4$(*Dodonae angustifolia*), $T_5$(*Cymbopogon citrates*), $T_6$(Diazinon 60 E.C™), and $T_7$(Water/control)

**Table 3b:** Effect of spray and time on efficacy of treatments at Mutulu Site after treatment application.

| Guder site | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1Day ATA | | | | | | | |
| Frequency of spray | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ |
| 1st Spray | 92.86(74.66)[a] | 91.67(73.57)[a] | 44.18(41.55)[a] | 28.24(31.95)[a] | 48.39(43.85)[a] | 94.32(75.82)[a] | 20.06(26.56)[a] |
| 2nd Spray | 98.03(81.87)[a] | 99.03(84.26)[a] | 50.17(45)[a] | 34.17(35.67)[a] | 46.50(43.28)[a] | 98.67(84.26)[a] | 14.70(22.78)[b] |
| MSE | 5.59 | 7,08 | 4.56 | 7.18 | 8.84 | 3.29 | 0.91 |
| CV (%) | 5.53 | 7.37 | 9.66 | 19.83 | 16.94 | 3.42 | 5.26 |

**Note:** Means with the same letter are not significantly different
ATA (After Treatment Application)
Figures in parentheses are Arcsin percent transformed value
$T_1$(Lambda Cyhalothrin (Triger 5 E.C™) ), T2(Emamectin benzoate (Cutter 112 E.C™), $T_3$(*Azadirachta indica*), $T_4$(*Dodonae angustifolia*), $T_5$(*Cymbopogon citrates*), $T_6$(Diazinon 60 E.C™), and $T_7$(Water/control)

**Table 3c:** Effect of spray and time on efficacy of treatments at Guder Site after treatment application.

| Guder site | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3 Days ATA | | | | | | |
| **Frequency of spray** | **$T_1$** | **$T_2$** | **$T_3$** | **$T_4$** | **$T_5$** | **$T_6$** | **$T_7$** |
| 1st Spray | 98.48(81.87)[a] | 98.14(81.87)[a] | 53.92(47.29)[a] | 37.30(37.46)[a] | 64.92(53.73)[a] | 96.30(78.46)[a] | 16.47(23.58)[a] |
| 2nd Spray | 99.50(84.26)[a] | 99.50(84.26)[a] | 63.43(52.53)[a] | 44.67(42.13)[a] | 62.90(52.53)[a] | 99.27(84.26)[a] | 16.23(23.58)[a] |
| MSE | 1.25 | 1.67 | 8.15 | 2.54 | 3.01 | 1.83 | 2.37 |
| CV (%) | 1.26 | 1.69 | 13.09 | 6.19 | 4.72 | 1.87 | 14.46 |

**Note:** Means with the same letter are not significantly different
ATA (After Treatment Application)
Figures in parentheses are Arcsin percent transformed value
$T_1$(Lambda Cyhalothrin (Triger 5 E.C™) ), T2(Emamectin benzoate (Cutter 112 E.C™), $T_3$(*Azadirachta indica*), $T_4$(*Dodonae angustifolia*), $T_5$(*Cymbopogon citrates*), $T_6$(Diazinon 60 E.C™), and $T_7$(Water/control)

**Table 3d:** Effect of spray and time on efficacy of treatments at Guder Site after treatment application.

## Effect of treatments on yield

There was a significant difference among treatments and untreated check but no significant ($P<0.001$) difference among the insecticides when compared to the standard check (Diazinon 60 E.C) and also no significant difference among insecticides and botanicals except *Cymbopogon citrates* where it gave less yield compared to other treatments but better than water treated check. However, cabbage head yields in the standard check (Diazinon 60 E.C$^{MT}$) gave high yield percentage in all locations compared to untreated plot.

## Conclusion and Recommendation

The results in all locations indicated that the mortality rate

| Treatments | Yield/plot in kg | |
|---|---|---|
| | Mutulu site | Guder site |
| Lambda Cyhalothrin (Triger 5% E.C™) | 9.50[a] | 7.67[ab] |
| Emamectin benzoate (Cutter 112 E.C™) | 8.67[a] | 7.00[ab] |
| *Azadirachta indica* seed | 7.83[ab] | 6.00[ab] |
| *Dodonae angustifolia* fresh leaf | 7.33[ab] | 6.00[ab] |
| *Cymbopogon citrates* | 7.17[ab] | 5.67[b] |
| Diazinon 60 E.C™ | 8.83[a] | 8.00[a] |
| Water/control | 6.17[b] | 5.50[b] |
| MSE | 0.58 | 0.87 |
| LSD at 0.01 | 2.42 | 2.18 |
| CV (%) | 12.31 | 12.34 |

**Note:** Means with the same letter are not significantly different.

**Table 4:** Effect of insecticides and botanicals on cabbage yield against cabbage aphids, *Brevicoryne brassicae*.

percentage of the two newly introduced insecticides Emamectin benzoate (Cutter 112 E.C™) and Lambda Cyhalothrin (Triger 5 E.C™) were comparable and effective when compared to the standard check (Diazinon 60 E.C™) in reducing the number of cabbage aphid population. The yield of all treatments except lemon grass extract and the untreated check were similar. Therefore, the newly introduced insecticides Emamectin benzoate (Cutter 112 E.C™) and Lambda Cyhalothrin (Triger 5 E.C™) and botanicals could be recommended to be considered as alternative insecticides for the management of cabbage aphid, *Brevicoryne brassicae* (L.) under Ethiopian condition.

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