Evaluation of Insecticides for the Management of Diamondback Moth, (Plutella xylostella (L.) (Lepidoptera: Plutellidae) on Cabbage under Field Condition

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Abstract
Diamondback Moth (DBM) is one of the major constraints for the profitable production of cabbage in the country as well as Ambo highlands in particular. The field study was conducted to evaluate the susceptible varietal resistance of cabbage (*Brassica oleracea* var.capitata) against diamondback moth (DBM) (*Plutella xylostella*) infestations and damages at the Ambo university farm in a relay cropping (Rain season) in 2019. Varietal resistance was compared with conventional spraying using Randomized complete block design (RCBD) spraying chemical of insecticides at different spray interval. The Cabbage varieties were Copenhagen from local market. Sampling was done by weekly counting of larvae and pupae, and scoring pest damage on six randomly selected plants per plot for 5 weeks from the third week after transplanting. The number of damage and undamaged cabbage heads were counted on all plants per plot at maturity stage. Results showed that sprayed and unsprayed plots had significantly (P<0.05) different numbers of DBM stages (larvae and pupae). The yield losses of cabbage caused by DBM could reach up to more than 80% as several infestations occurred in the field. Due to this problem, farmers in Ambo highlands are preferred to apply the broad spectrum of non-systematic insecticides rather than implementing other pest management strategies. The demand for insecticides in Ambo highlands seems endless until today, but more aggressive. This paper highlighted the possibility of implementing intercropping cabbage with six treatments in reducing pupae and larvae populations of DBM in the polyculture system. The distributions of pupae and larvae population of DBM against the factors of temperature and rainfall also have been addressed in this study. A total of six treatments were indicated, that including Cutter, Trigger, Ethiozenon, Nomax, Fastac and Control which arranged in (RCBD). The result indicated that nonsignificant variations (P<0.05) were observed among the population of pupae and larvae at all seven treatments tested compared with the control. Moreover, pupae and larvae of DBM were negatively correlated with temperature and rainfall factors. The results also showed that a critical period of DBM infestations was detected in the pre-heading stage (< 30 DAT). In terms of performance among treatments, our finding also has shown that Nomax was the best treatment acted as a repellent.
Keywords: Diamondback Moth, Management Strategies, (Plutella xylostella) Insecticide Resistance.
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Introduction
Cabbage, both head and kale, is the second most important vegetable crop in Ethiopia both in area coverage and as well as level of production next to red pepper, *Capsicum* spp. (Moa 2002). It is among the major vegetables produced by private farmers 3.4 million hectares were grown worldwide (FAOSTAT, 2012) and the state farms in Ethiopia (Lemma *et al*., 1994). Land allotted for kale cabbage alone in the main rainy season (Maher) is estimated to be 14, 528 ha with a production level of 143,680 tons (Moa, 2002). Between 1993 and 2009 the global area of *Brassica* vegetable crops increased by 39%, and in 2009 an estimated concomitant with this change was an intensification of farming practices, with cabbage yields increasing by 27%, and *Brassica* vegetables now contribute more than US$26 billion to the world economy. Over the same period, the area of oilseed rape planted increased by 59%, and in 2009 more than 31 million hectares were cultivated worldwide (FAOSTAT, 2012), often in regions where the crop was not previously grown. These changes have resulted in considerable modifications to many local landscapes (Furlong *et al.,* 2008) and provide revised challenges for DBM management (Schell horn *et al*., 2008).

A number of insect species including the diamondback moth (DBM), *Plutella xylostella*L. (Lepidoptera: Plutellidae), cabbage aphid *Brevicoryne brassicae (*L.) (Homoptera: Aphididae), mustard aphid *Lipaphiserysimi* Kaltenbach (Homoptera: Aphidian), flea beetles *Phylloterta* sp. and cabbage leaf miner *Chromatom yiahorticola* Goureau (Dipteral: Agromyzidae) inflict damage on brassica crops in Ethiopia (Tsedeke and Gashaw beza, 1994). As in any of the tropical countries, the severity of damage inflicted by DBM on cabbage is higher than other insect pests (Talker and Shelton, 1993). Diamondback moth (DBM) (*Plutella xylostella*L., (Lepidoptera:

Plutellidae) is one of the most serious pest of cruciferous crops and causes huge economic losses of more than 1 billion US dollars in terms of annual management costs (Talker, 1992; Talker and Shelton, 1993). It occurs wherever crucifers are grown, and is believed to be the most universally distributed of all Lepidoptera (Merick, 1928), especially in tropical and sub-tropical regions. The amount of damage varies greatly, depending on plant growth stage, larval densities and size. Larval feeding causes typical symptoms in the form of shot holes of irregular shape in the leaves. If larvae are numerous they may eat the entire leaf, leaving only the veins and causing more than 90% crop loss (Verk GMM Trek and Wright, 1996). It is a serious pest as it feeds on the marketable portion of the plant, the (leaves of cabbage and other leafy brassicas); only a few fourth stage larvae on a cabbage can make it un-saleable (Shelton *et al.*, 1983; Malta is *et al.*, 1998). A recent study (Saluki et al., 2012) estimated that annual DBM control in *Brassica* vegetable crops alone costs US$1.4 billion worldwide, rising to US$2.7 billion if yield losses are included and to $4–5 billion if DBM losses and control costs to the worldwide canola industry are added.

DBM is one of the few insect species that has developed field resistance to all major classes of insecticides like and is ranked second in the Arthropod Pesticide Resistance Database (APRD) for the highest number of insecticides with reported resistance in at least one population (APRD, 2012).The gap or the Statement of the problem of this research is the yield of cabbage has decreased due to diamond back moth, the quality of cabbage has also reduced due to diamond back moth, DMB has developed résistance to many insecticides, and the management options available are very limited. Therefore, selecting insecticides which are environmentally friendly is crucial. Therefore, this study was designed with the objectives of scaling up production and productivity through evaluation of some selected insectside efficacy to reduce DBM.

Materials and Methods
Description of the Study Area
The experiment was conducted at field and green house station of Ambo farm research center during 2019. Ambo Town is located 120 km west of Addis Ababa at 8^0 98' South latitudes and 37^0 83' North longitudes. The Annual rainfall ranges from 900-1100mm an average of 1000mm with the minimum Temperatures means ranging from $10 – 27C^0$ for the maximum with an average of $18c^0$ and altitude ranging from1380-3300 m.a.s.l.

The Experimental Site and Experimental Design
The experimental design of field trials consisted of Randomized Complete Block Design (RCBD) with six treatments and four replications i.e. there is possibility of treatment combinations (Cabbage of Copenhagen + Cutter), (Cabbage of Copenhagen + Trigger), (Cabbage of Copenhagen + Ethiozinon), (Cabbage of Copenhagen + Nomax), (Cabbage of Copenhagen + fastac), (only Cabbage of Copenhagen as Control). Each block was divided into six raised beds. The size of each unit of raised bed was 1.5m*3m ($4.5m^2$) of spacing between 50cm*50cm both plant and rows respectively. The DBM seedlings were transplanted at the four true leaves stage (30 days after sowing). A 0.5m wide unplanted alley left between each plot to avoid spray drift between adjacent plots. A separate 20L capacity knapsack sprayer was used to apply each for the treatment solution to the point of runoff including underside of the leaves. Applications were recommended at 69 days after transplanting of seedlings. Insect present was assessed in weekly on 6 plants from the random from each row. Infestation by B. brassica were scored and harvested or the plants in each plot were used for yield and insect damage assessment. In other case all agronomic practices like weeding and fertilizer were applied as recommended.

Insecticide Application and Spraying Schedule
All treatments were sprayed with insecticides using the agricultural knapsack sprayer (Model PB-20) with a tank capacity of 20 liters. Insecticides were sprayed starting at seedling stage until late heading stage. Applications were commenced 1-2 month after transplanting of seedlings and were continued on weekly bases thereafter.

Data Collected
The type of cabbage worm (DBM), sowing and harvesting dates, date of spraying, plant height (cm), number of larvae and pupa, plot yield were recorded. In addition, description of the farm and locality including altitudes, field history, field size and environmental conditions like monthly rain fall were also recorded. Harvested Cabbage was categorized as clean marketable and unmarketable if it had symptoms of damage of insect infestation was seen. The weight of marketable and unmarketable was recorded separately. The mean number of \Cabbage per plant was assessed in each plot.

Yield Loss Estimation
The relative yield loss in each treatment was determined by percent of that of Cabbage per plots of the experiment. Yield Losses were calculated separately for each of the treatment and yield component of the cabbage were determined as a percent of that of the protected plots and yield losses were calculated based on

formula:

$$RL\% = \frac{(Y_1 - Y_2)}{Y_1} \times 100$$

Where, RL- relative loss (reduction of the parameters yield and yield components), Y_1- mean of the respective parameters on protected plot (plots with maximum protection) and Y_2 –mean of the respective parameters in unprotected plots (untreated plots).

Cost Benefit Analysis

Cost benefit analysis is a quantitative analytical tool used to find out how resources are allocated gain over the whole project life (Belli *et al.,* 1998). It is determined using the mathematical expression given in according to the following. The deference between treatments, the option economic data was subjected to analysis using the partial budget analysis method (CIMMYT, 1988). Marginal rate return was calculated using the following formula:

MRR (%) =$\frac{DNI}{DIC} \times 100$. Where, MRR is marginal rate of returns, DNI is Deference in net income compared with control, DIC is difference in input Cost compared to control.

Data Analysis

Data on insecticide parameters (plant growth and yield components, yield loss and cost benefit analysis were subjected to analysis of variance (ANOVA) using (SAS) version 9.0 software (SAS Institute, 2002). Fisher's protected least significant difference (LSD) values were used to separate differences among treatment means (P≤ 0.05) for the field assessment of cabbage DBM and change in plant growth and yield components (dependent variables). Mean cabbage head weight was analyzed using ANOVA and SNK test. The proportion of cabbage heads in each plot with damaged and undamaged were analyzed using generalized linear model with a binomial distribution and logit link.

Result and Discussion
Effects of Insecticide Application on DBM
The different insecticides were sprayed to respective plots sown cabbage at every seven days interval so that to evaluate the effectiveness of each insecticide against DBM as follows; Cutter (Emamectin benzoate 48gm/lt+Acetamipride 64gm/lt), Trigger (Lambda Cyhalothrin (50g/ltEC), Fastac (alphaCypermethrime), Nomax (Teflubenzuron (150Sc) and Ethio-zinon (Diazinon (600gm/l) consecutively. The chemicals were formulated based on the recommendation written down on the containers of each pesticide by the Companies. Further information on the application, amount of formulation and specification of each pesticides used were presented clearly on (Table 1).

Table 1 Different Insecticide Application of Spray interval at per hector of treatment

No.	Insecticide (Trade name)	Common name	Company	(Recommendation) Dosage/ha	(Recommendation) Dosage/ha
1.	Fastac (100g/lEC)	alpha-Cypermethrime (10gm/l E C)	BASF	150-300ml/1000lt of H_2O/ha	150-300ml/1000lt of H_2O/ha
2.	Trigger(5 EC)	Lambda-Cyhalothrin (50g/l t EC)	Agrisher	800-1500ml/ha	800-1500ml/ha
3.	Ethiozinon(600gm/l)	Diazinon (60% E C)	Adami Tulu Pesticide Company	1-2lt/ha	1-2lt/ha
4.	Nomax (150 Sc)	Teflubenzuron (150gm/lt EC)	BASF	0.25-0.3lt/ha	0.25-0.3lt/ha
5.	Cutter(112 E C)	Emamectin benzoate 48gm/lt+Acetamipride 64gm/lt	Agrisher	0.3lt/ha	0.3lt/ha
6.	Untreated	Control	-	-	-

Effect of Spraying Interval on Diamond Back Moth
Application of treatment (dosage) of (0.54ml) of Cutter for four (4) plots by the addition of thousand (1000lt) of water with mixed 0.54ml of Cutter. The spray of Cutter per plot was 0.135ml. But, in general the application of Cutter on block (replication)/plot-1for replication -1, plot-7 for replication-2, plot-14 for replication-3, & plot-

21for replication-4.The application of Trigger (dosage/treatment was 2.07ml) to four (4) plots by the same water (1000lt) of mixed with Trigger. The spray of Trigger per plot was 0.520ml. But, in general the application of Trigger on the replication or block/plot. Plot-2 for replication-1, plot-8 for replication-2, plot-18 for replication-3 & plot-22 for replication-4. The application of dosage/treatment of Ethionenon was 2.7ml to the four (4) plots of mixing (1000lt) water with Ethiozenon. The spray of Ethioninon per plot was 0.675ml. But, in general the application of Ethiozenon plot per replication. Plot-3 for replication-1, plot-9 for replication-2, plot-17 for replication-3 & plot-24 for replication-4. The application of dosage/treatment of Nomax is 0.54ml to the four (4) plots mixed with (1000lt) water with Nomax. The spray of Nomax per plot was 0.135ml in general the application of Nomax replication of plot-4 for replication-1, plot-10 for replication-2, plot-13 for replication-3 and plot-20 for replication-4. The application of dosage/treatment of Fastac was 0.405ml to the four (4) plots of the mixed (1000lt) of water with Fastac. The spray of Fastac per plot was 0.101ml. in general the application of Fastac replication per plot. Plot (5) for replication-1, plot-11for repplication-2, plot-16 for repplication-3 & plot-19 for repplication-4.and the control one was on replication-1 was plot number-6, on replication-2 was plot number-12, on replication-3 was plot number-15 & on replication-4 was plot number-23 as shown in (Table 2).

Table 2. Different treatment Dosages at 4 replication of Application.

Treatment number	Trade name	Dose/Trt (for 4 reps.) Application	Dose/plot (ml)	Frequency of application
1	Fastac 100EC	0.405ml	0.101	Every7 day
2	Trigger 5EC	2.07ml	0.520	Every14 days
3	Ethiozinon 60%	2.7ml	0.675	10-14 days
4	Nomax 150Sc	0.54ml	0.135	1-4 weeks
5	Cutter 112Ec	0.54ml	0.135	7-10 days
6	Control	-	-	-

Application of treatment on the plot in four replication

For a treatment the application of all treatment on each plot of four replications was the same. When we apply the treatment on the rep-1 was down the slope, on rep-2 upward, on rep-3 down the slope and on rep-4 upward. It is W-shape or zigzag line of the spray interval. On plot one T1 was applied, on plot two T2 was applied, on plot three T3 was applied, on plot four T4 was applied, on plot five T5 was applied and the control left without application. On replication two the application of treatments in each plot was the same with the application of treatments on replication one. But, on replication three the application of treatment on each plot was not the same. The application of treatment number four was on plot number thirteen, the application of treatment number one was on plot number fourteen, plot number six was the control. The application treatment number five was on plot number sixteen, the application of treatment number three was on plot number seventeen, and the application of treatment number two was on plot number eighteen. The application of treatment number three was on plot number twenty-four, there is no application of treatment number six on plot number twenty-three, the application of treatment number two was on plot number twenty-two, the application of treatment number one was on plot number twenty-one, the application of treatment number four was on plot number twenty, the application of treatment number five was on plot number nineteen.

Table 3 Application of each treatment per plot within replication.

No	Trade name	Number of Treatment	Plot Number	Number of Treatment	Plot Number	Number of Treatment	Plot Number	Number of Treatment	Plot Number
1.	Cutter	1	1	1	7	2	18	5	19
2.	Trigger	2	2	2	8	3	17	4	20
3.	Ethiozinon	3	3	3	9	5	16	1	21
4.	Nomax	4	4	4	10	6	15	2	22
5.	Fastac	5	5	5	11	1	14	6	23
6.	Control	6	6	6	12	4	13	3	24
		R-1		R-2		R-3		R-4	

Plant growth and yield component

The effect of different Insecticides on the plant height and head weight of cabbage

On the analysis of plant height and Mean of head weight of cabbage at significant difference of P- value at (0.05), there was no significant difference between plant height among the treatments, but significant difference among the treatments on the damage crop of the Mean of head weight of cabbage. Application of Nomax in (100g) was more damaged as compared with other treatments. There were significant differences with Fastac, Ethiozenon,

Trigger, Cutter and the Control one. But, the control was highly damaged (2.75g) as compared with the other treatments. But, when we compared the undamaged one Ethiozenon (1320.2g) is highly control than the other treatment the least control one is the untreated (580.2g). On the other hand, the treatment among each other there is significant difference. The largest control one is highly significant with Fastac, Cutter, Control, and Trigger & Nomax (Table 4).

Table 4 The effect of different insecticide on the plant height and head weight of cabbage.

Treatments	Plant height (cm)	Mean of head weight of cabbage (gm)	
		Damage (gm)	Undamaged (gm)
Cutter	32.75a	18.75d*	806.2bc*
Trigger	33.04a	22.5d*	1020.6abc*
Ethiozenon	33.21a	30c*	1320.2a**
Nomax	32.29a	100a**	1095.6ab*
Fastac	32.54a	60b*	784bc*
Control	31.33a	2.75e*	580.2c*
CV (%)	6.82	10.20	31.37
LSD(0.05)	Ns	4.90	360.71
Mean	32.53	39	934.47

Ns=non-significant,*=significant, **=highly significant, LSD=least significant difference, CV= coefficient of variation, the letters with the same values are not significant difference.

Yield loss Estimation
On the yield loss estimation there is significant difference among the treatment application on variety of the Copenhagen for each plot. Application of Nomax in (100g) is more damage as compared with other treatment. There is significant difference with Fastac, Ethiozenon, Trigger, Cutter and the Control one. But, the highly damage Control one (2.75g) as compared with the highest damage. Comparing were the undamaged one Ethiozenon (1320.2g) is highly control than the other treatment the least control one is the untreated (580.2g). When we compared the treatment among each other there is significant difference. The largest control one is highly significant with Fastac, Cutter, Control, and Trigger & Nomax.

The Percent of Relative Yield loss
On the treatment of Cutter are (38.93%), treatment of Trigger is (22.73 %), treatment of Ethiozenon are (0%), treatment of Nomax is (17.03%), treatment of Fastac is 40.62%), and (the untreated one is (56.05%) which can compared the damage and undamaged yield loss.

Table 5 The effect of different insecticide on the head weight of cabbage.

Treatments	Yield loss		
	Damage (gm)	Undamaged (gm)	Relative yield loss (%)
Cutter	18.75d*	806.2bc*	38.93
Trigger	22.5d*	1020.6bac	22.73
Ethiozenon	30c*	1320.2a**	0.00
Nomax	100a**	1095.6ba*	17.03
Fastac	60b*	784bc*	40.62
Control	2.75e*	580.2c*	56.05
CV (%)	10.20	31.37	-
LSD (0.05)	4.90	360.71	-
Mean	39	934.47	-

LSD=least significant difference, CV= Coefficient of variation, the letters with the same values are not Significant difference.

Cost Benefit Analysis

The paramers of Cabbage yield/ha on the treatment value is significant different. Ethiozinon (28,844) is the highest value than the other treatment & The Control (15244) one is the least Value than the other treatment. It is highly Significant among each other as compared the rest value. As shown in (Table 5). When we compared Ethiozinone means values are (28,844) with Nomax (26,177) it is significant difference but, when we compared the other treatment like Fastac (24,666), cutter (23,200) and Trigger (20,888) highly significant. On Cabbage yield (birr/kg) there is no significant diffirence among the treatment value (9.5). The Total Cabbage sale (birr/ha) among the treatment is highly significant value. Ethiozinon (274,018) is the highest value than the other treatment. When we compared with Nomax (248,682) it is highly significant as compared among the treatment. The least value among the treatment is the Control (144,818) one. The Input & labor cost among the treatment significantly difference values. The highest value among the treatment is Nomax (13,400) as compared the other treatment significant different. The least value is the control (12,400) one. On Marginal Cost value is significant difference among the treatment. Nomax (3,400) is the highest value than the other treatment and it is significant difference among in each the treatment. The least value is the control one among the treatment. The Net benefit values are highly Significant among the each treatment. Ethiozinon is the highest value than the other treatment. The least value of among the treatment is the control. The Marginal benefit values are highly Significant among the each treatment. Ethiozinon is the highly significant than the other treatment. The least value of among the treatments is Control. The Marginal rates of return value are highly significant difference among the treatment. Ethiozinon is the highest value and highly significant difference among the treatment. The least value of among the treatment is the control one.

Table 6. Different parameters of Cost Benefit Analysis in different treatment value

parameters	Unit	Treatments					
		Cutter	Trigger	Ethiozinon	Nomax	Fastac	Control
Cabbage yield/ha	kg	23,200	20,888	28,844	26,177	24,666	15,244
Cabbage yield (birr/kg)	birr	9.5	9.5	9.5	9.5	9.5	9.5
Total Cabbage sale (birr/ha)	birr	220,400	198,436	274,018	248,682	234,327	144,818
Input & labor cost	birr	13,000	12,900	12,625	13,400	13,100	12,400
Marginal Cost	birr	3,00 0	2,900	2,625	3,400	3,100	2,400
Net benefit	birr	207,400	1,85,536	2,61,393	235,282	221,227	132,418
Marginal benefit	birr	195,000	1,73,136	2,48,993	222,882	208,827	120,018
Marginal rate of return	birr	6,500	5970	9485	6555	6736	5000

The effect of different application of insecticide on cabbage DBM growth stage

The data analysis for larvae and pupae assessment at the first round (DAT 69) was indicated no significance difference especially in pupae and larvae mortality rate among treatments except significantly difference between Fastac and Ethiozenon in larvae mortality(Table 7). The number of small larvae per 6 plants ranged from 0.7 to1.83 at the pre count through the 69 days after treatment (DAT). Larger -sized larvae ranged from 0.8 to 1.7 larvae per 6 plants at 3 DAT then increased to range as high as 1.83 larvae per 6 plants after 7 DAT. In the second round (DAT 78) was indicated no significance difference among the treatment in egg, larvae and pupae mortality rate.except Significant difference in Fastac and Ethiozenon in egg mortality. There is significant diffirence in each treatment except the means with the same letter in Larvae mortality and it also the significant difference among treatment with the Control. At significant diffirence of Cutter, Trigger and Fastac in a pupae mortality. In the third round of (DAT (85) of egg, larvae and pupae was indicated significant difference among the treatment. In each treatment of Cutter, Trigger, Ethiozenon, Fastac and Control is significant diffirence in egg mortality rate. Except, means with the same letter in each treatment. There is significant diffirence among the treatment as compared with Control in the mortality rate of larvae. Among the treatment there is significant differences are their in Trigger, Ethiozenon, Nomax, Fastac, and Control except cutter. In the pupae mortality there is significant diffirence among the treatment Cutter with trigger and trigger with Nomax and Fastac. In the four rounds (DAT (92) there is no significant diffirence among the treatment except Trigger and Control in Larvae mortality rate and in pupae mortality rate Trigger and Nomax is significant diffirence among each other. At the Last five rounds (DAT (99) are no significant. Difference among the treatment except Cutter, Trigger, Ethiozenon and Fastac in egg mortality rate. The others Larvae and pupae mortality rate are significant difference among the treatment with Control.

Table7. The effect of different application of insecticide on cabbage DBM growth stage

Treatments	1st round DAT (69)		2nd round DAT (78)			3rd round DAT (85)			4th round DAT (92)			5th round DAT (99)		
	larvae	pupae	egg	larvae	pupae	egg	larvae	pupae	egg	larvae	pupae	Egg	larvae	pupae
Cutter	1.7ab	0.54a	0.17ab	0.83c	0.75c	0.17a	0.8bc	0.75c	0.23a	0.21cd	0.96ab	0.05c	0.21b	0.54b
Trigger	0.8ab	0.33a	0.1bc	0.75c	1.29a	0.09b	0.75c	1.29a	0.21a	0.13d	1.00a	0.15b	0.1b	0.58b
Ethiozenon	0.71b	0.54a	0.09c	1.04b	1.08ab	0.09b	1.04b	1.08ab	0.24a	0.3abc	0.9abc	0.25a	0.18b	0.54b
Nomax	1.5ab	0.25a	0.13abc	0.42d	0.8bc	.13ab	0.42d	0.8bc	0.23a	0.3bcd	0.63c	0.2ab	0.12b	0.42b
Fastac	1.83a	0.71a	0.18a	1.04b	0.75c	0.17a	0.46d	0.79c	0.22a	0.38ab	0.71bc	0.15b	0.18b	0.55b
Control	1.4ab	0.54a	0.1bc	1.54a	0.87bc	0.09b	1.96a	0.87bc	0.24a	0.42a	0.96ab	0.2ab	0.84a	0.92a
CV (%)	22.48	25.64	36.86	15.0	20.1	25.86	18.24	19.21	25.44	34.09	21.03	29.79	34.44	34.89
LSD(0.05)	0.45	NS	0.07	0.17	0.33	0.18	0.65	0.93	NS	0.119	0.22	0.08	0.114	0.25
Mean	1.32	0.49	0.13	0.84	0.93	0.13	0.84	0.93	0.23	0.28	0.85	0.17	0.27	0.59

Ns=non-Significant, LSD=least significant difference, CV= coefficient of variation, the means with the same letters are not significant difference. DAT=Days after transplanting.

CONCLUSION AND RECOMMENDATION
Conclusion
The result from evaluation of insecticide on the management of Cabbage of diamond back moth in Ambo agricultural Farm research center showed that, diamond back moth was with high infestation on cabbage. The different insecticides were sprayed to respective plots sown cabbage at every seven days interval so that to evaluate the effectiveness of each insecticide against diamond back moth. The chemicals were formulated based on the recommendation written down on the containers of each pesticide by the Companies. The effect of Spraying interval on diamond back moth was the application of treatments (dosage) of (0.54ml) of Cutter to four (4) plots by the addition of thousand (1000lt) of water with mixed 0.54ml of Cutter solution. The spray of Cutter per plot was 0.135ml. For one treatment the application of all treatment on each plots of four replications was the same. The effect of different insecticide on the plant height and head weight of cabbage was no significant difference between plant heights among the treatments. But, significant difference among the treatments on the damaged crop of the Mean of head weight of cabbage.

Recommendation
The farmers should use such a recommended insecticides to increase the cabbage production and productivity as well as to control the diamond back moth effectively chemicals like Trigger, Cutter, Ethiozinon, Nomax and Fastac.

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