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THE EFFECT OF VARIOUS INSECTICIDE ACTIVE INGREDIENTS ON THE INTENSITY OF PEST ATTACKS ON RED PEPPER PLANTS (*Capsicum annuum* L.)

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Abstract
Red Chili (*Capsicum annuum* L.) is an annuals of the eggplant family (*Solanaceae*). This plant comes from the American continent, precisely in the Peruvian area, and extends to other areas on the continent. The average consumption of red chili per capita of Indonesian people is 500 grams/year, 118,800 tons per year. Chili production in Indonesia has increased from year to year, in 2021 chili production reached 2,747,108 tons. Fruit caterpillars (Helicoverpa armigera) are pests that often attack important plants in Indonesia. This pest usually attacks young fruits by making holes and eating them. An effort that farmers often make to control this pest is to use insecticides. Insecticides are chemicals that function to eradicate annoying insects. Common active ingredients applied for fruit caterpillar control are *Chlorpyrifos*, *Chlorantraniliprol*, *Cipermethrin*, *Deltamethrin*. This research was conducted in Ambit Village, Waled District, Cirebon Regency, West Java Province. The implementation time lasts for 3 months (July to September 2023). The method used in this study was Randomized Group Design (RGD) consisting of 5 treatments of various insecticide active ingredients and control (without treatment) repeated 5 times so that there were 25 experimental plots with treatment A (*Chlorpyrifos*), B (*Chlorantraniliprol*), C (*Cipermethrin*), D (*Deltamethrin*), and E (Control). The concentration of insecticide used is 2 ml / liter. The experimental results showed that the treatment of insecticide active ingredients had a real influence on the intensity of fruit caterpillar pest attacks (*Helicoverpa amigera*) and on other pests such as whitefly (*Bemisia tabaci*). Insecticides have no real effect on the intensity of chili plant disease attacks such as anthracnose disease (*Colletotrichum gleosporioides*). The insecticide applied also does not cause *phytotoxicity* to the growth of chili plants. The active ingredients of insecticides *Chlorpyrifos*, *Chlorantraniliprol* and *Sipermethrin* gave better results when compared to *Deltrametrin* and control insecticides. Thehighest harvest result was obtained from the treatment of the insecticide *Chlorantraniliprol*, as much as 10.31 kg/plot, or equivalent to 10.31 tons/ hectare.

Keywords: *Red Chili Plant, Insecticide, Fruit caterpillar and Helicoverpa armigera*

INTRODUCTION
Red Chili (*Capsicum annuum* L.) is an annuals of the eggplant family (*Solanaceae*). This plant comes from the American continent, precisely in the Peruvian area, and extends to other areas on the continent. Red chili peppers in Indonesian territory are thought to have been brought by merchants from Persia when stopping in Aceh. The chili brought at that time included large red chili, cayenne pepper, curly red chili and paprika (Hayati et al, 2012 in Sahrun Riza, 2020).

According to Wahyudi (2011) the average per capita chili consumption of Indonesian people is 500 grams / year, then the need for chili in Indonesia is 118,800 tons per year. Chili

production in Indonesia has increased from year to year, in 2021 chili production reached 2,747,108 tons compared to other countries in Asia. Chili productivity in Indonesia is still relatively low, one of the factors causing low productivity is the lack of use of crop management technology, low-quality seeds are widespread in the community, lack of use of integrated technology packages, and the high incidence of pest and disease attacks (Mariyono and Bhattarai, 2009). Fruit caterpillars (*Helicoverpa armigera*) are pests that often attack various important plants in Indonesia (Setiawati, 1991). This pest moth is able to spread far following the cardinal directions or challenging the direction of the wind, thisusually attacks young fruit by making holes and eating them, the characteristics of this pest attack are that the fruit has holes, there are black or yellow spots on the fruit, the fruit is shriveled and smaller (Farrow &; Daly, 1987). The life cycle of fruit caterpillar consists of four life stages, namely egg, larva, pupa and imago.

To reduce the population of pests found on chili plants, it is necessary to apply insecticides. Insecticide is one part of pesticides, where insecticides are used to eradicate types of insects or pests. Eradication of insects or pests can use chemical types of insecticides and vegetable insecticides. Pest control is usually carried out using chemical insecticides (Indianti, 2017). Insecticides commonly used to eradicate chili pests are: *Chlorpyrifos*, *Chlorantraniliprol*, *Cypermethrin* and *Deltamethrin*. According to Eaton et al in Akbar (2020) stated that *Chlorpyrifos* is one of the active substances of the oganophosphate pesticide group. The main target organs for *chlorpyrifos toxicity* are the central and peripheral nervous system, due to the ability of the oxon-metabolite chlorpyrifos to inhibit the enzyme activity of acetylcholinesterese, which ends neurotransmission at cholinergic synapses (Eaton et al, 2008), *Chlorantraniliprol* is a potential insexticide for such control spinoteram, spinosad, lamda sihalotri, and chlorantraniliprol with The Effect levels reaching 90% at 72 hours after application (Sisay et al., 2019). From the group of etomopathogenic fungi, Beuveria bassiana, Metarhiziumanisopliae and Metarhiziun rileyi are reported to have the potential to be biological control agents (Wright et al., 2010; Prasanna et al., 2018). according to Sudjak in Perdana, F. (2016) stated that *Cypermethrin* is a box poison insecticide and a colored mapped stomach that can be used to control important pests in rice, cabbage, mustard cocoa, soybeans, corn, tea, tobacco and cotton, *Deltamethrin* is one of the insecticides that are widely used by farmers in rice plantations and one of the most widely used in crop protection. *Deltamethrin* is a broad-spectrum synthetic pyrethroid insecticide that acts as a contact toxin and stomach toxin (Dietz et al., 2009).

RESEARCH METHOD

This research was conducted in Ambit Village, Waled District, Cirebon Regency, West Java Province. The implementation time lasts for 3 months (July to September 2023). The method used in the study used Randomized Group Design (RGD). The study consisted of 5 treatments of various insecticide active ingredients and controls (without insecticides) were repeated 5 times so that there were 25 test plots. Plot size 1 m x 20 m, distance between plots (gutter width) 50 cm. The length between the replicates is 50 cm, using a plant distance of 40 cm x 50 cm and the number of plot plants is 48 plants. The treatment uses several insecticide and control active ingredients, with the following design ; A). *Chlorpyrifos, B). Chlorantraniliprol, C). Cypermethrin, D). Deltramethrin, and E).* Kontrol.

Insecticides are applied by spraying using formulations according to treatment (Deden *et al*, 2023). Insecticides active ingredients *Chlorpyrifos, Chlorantraniliprol, Cypermethrin* and *Deltrametrin* are applied using a sprayer with a formulation of 2 ml / liter. Spraying is carried out on chili plants and carried out in the morning. Spraying begins at the age of 34 days after

planting with a frequency of once every 1 week at the age of 41, 48, 55 DAP and the last spraying is 62 DAP. The observation method is carried out by calculating the intensity of pest attacks.

Processing of target pest population data or damage to insecticide plants tested is carried out in accordance with the experimental design used. If at the first observation the population of the target pest or the resulting crop damage does not differ markedly between treatment plots, then the efficacy of the insecticide is calculated by the following formula:

EI = X 100 %$\frac{Ca-Ta}{Ca}$

EI = efficacy of insecticides tested (%).

Ta = target pest population or percentage of crop damage on insecticide treatment plots tested after insecticide spraying.

Ca = target pest population or percentage of crop damage to control after insecticide spraying.

If at first observation the target pest population or the plant damage it causes differs markedly between treatment plots, then the efficacy of the insecticide tested is calculated by the Henderson and Tilton formula (Ciba-Geigy, 1981):

EI = (1 = $\frac{Ta}{Ca}$ x) X 100%$\frac{Cb}{Tb}$

EI = efficacy of insecticide tested (%)

Tb = target pest population or peresntase of crop damage on insecticide treatment plots tested prior to insecticide spraying

Ta = target pest population or percentage of crop damage on insecticide treatment plots tested after insecticide spraying

Cb = target pest population or percentage of crop damage to control before insecticide spraying

Ca = target pest population or percentage of crop damage to control before insecticide spraying

Phytotoxicity Formula

0= No poisoning, 0 – 5 % abnormal leaf shape or leaf color and plant growth.

1= Mild poisoning, > 5 – 20 % abnormal leaf shape or leaf color and plant growth.

2= Moderate poisoning > 20 – 50 % abnormal leaf shape or leaf color and plant growth.

3= Sevare poisoning, > 50 – 75 % abnormal leaf shape or leaf color and plant growth.

4= Poisoning is very sevare, > 75 % the leaf shape or leaf color and plant growth are abnormal until the plant dies.

RESULT AND DISCUSSION

Intensity of fruit caterpillar attack (%)

Based on the data in the table below, the average treatment using insecticides has significantly different attack intensity levels when compared to controls.

Table 1. The effect of various insecticide active ingredients on the intensity of fruit caterpillar pest *(Helicoverpa armigera)* attacks on red pepper plants aged 34, 41, 48, 55 and 62 DAP (%)

Insecticide Treatment	Average Intensity of Fruit Caterpillar Pest Attack (%)				
	34 DAP	41 DAP	48 DAP	55 DAP	62 DAP
A *(Chlorpyrifos)*	0.35 a	0.47 a	1.23 c	0.40 a	0.17 a
B *(Chlorantraniliprol)*	1.48 b	1.12 b	0.41 a	1.37 c	0.20 a
C *(Cypermethrin)*	0.58 a	0.36 a	0.37 a	0.32 a	0.37 a
D *(Deltramethrin)*	0.28 a	1.34 b	1.51 c	0.22 a	0.34 a
E (Control)	2.57 c	1.87 b	3.61 c	3.84 c	2.54 b

Remarks: The average value followed by unequal letters in the same column shows an unreal difference in the Duncan test.

When viewed from the index listed in the table above that *Cypermethrin* insecticide

treatment has better results than the other three insecticide active ingredients because based on the age of 34 to 62 does not show a significant attack. This is because *Cypermethrin* is a synthetic pyrethroid insecticide that has a function to control insect pests on chili, soybean, tomato, and cabbage vegetables (Sari &; Zilfa, 2012).

The intensity of the attack of other pests (not the target)

Based on the data in the table below, the average treatment using insecticides against the intensity level of attack by other pests is significantly different when compared to controls.

Table 2. The Effect of various insecticide active ingredients against the intensity of attack by other pests (not targets) on red pepper plants aged 34, 41, 48, 55 and 62 DAP (%)

Insecticide Treatment	Average Intensity of Other Pest Attacks (Not Target) (%)				
	34 DAP	41 DAP	48 DAP	55 DAP	62 DAP
A *(Chlorpyrifos)*	0.69 a	0.54 a	0.24 a	0.41 a	0.20 a
B (*Chlorantraniliprol)*	0.41 a	0.38 a	0.64 a	1.13 b	0.16 a
C *(Cypermethrin)*	0.78 a	0.49 a	0.48 a	0.54 a	0.19 a
D *(Deltramethrin)*	0.43 A	0.71 a	0.80 a	0.30 a	0.18 a
E (Control)	0.51 a	1.59 b	1.14 b	2.76 c	1.28 b

Remarks: The average value followed by unequal letters in the same column shows an unreal difference in the Duncan test.

When viewed from the index listed in the table above that insecticide treatment *Chlorpyrifos* It has better results than the other three active insecticides because based on the age of 34 to 62 it does not show significant infestation. This is thought to be because insecticides are able to overcome various pests on chili plants because insecticides can attract, repel, dispel or interfere with insect growth. Therefore, the definition of insecticide is all ingredients or mixtures of ingredients used to prevent, damage, resist, or reduce insect pests (vectors).(Joharina & Alfiah)

Intensity of attacks of other diseases (not targeted)

Based on the data in table 3 below, the average treatment using insecticides, the level of intensity of attack of other diseases does not differ markedly.

Table 3. The The Effect of various insecticide active ingredients on disease attack intensity (not targeted) on red pepper plants aged 34, 41, 48, 55 and 62 DAP (%)

Insecticide Treatment	Average Intensity of Disease Attacks (Not Targeted) (%)				
	34 DAP	41 DAP	48 DAP	55 DAP	62 DAP
A *(Chlorpyrifos)*	0.36 a	0.30 a	0.23 a	0.05 a	0.39 a
B *(Chlorantraniliprol)*	0.56 a	0.21 a	0.10 a	0.00 a	0.38 a
C *(Cypermethrin)*	0.47 a	0.35 a	0.09 a	0.06 a	0.42 a
D *(Deltramethrin)*	0.50 a	0.22 a	0.19 a	0.09 a	0.31 a
E (Control)	0.58 a	0.08 a	0.30 a	0.12 a	0.51 a

Remarks: The average value followed by the same letter in the same column shows an unreal difference in the Duncan test.

When viewed from the data above, the application of insecticide active ingredients does not have a real effect on the intensity of attacks of other diseases (not targets), because insecticides can only affect pests. The main uses of *Chlorpyrifos* are controlling flies, mosquitoes (larvae and adults), various types of agricultural pests, household pests, *(Blattellidae, Muscidae, Isoptera)* and larvae in water (WHO 2001). *Chlorantraniliprol* is a selective insecticide from the *antharanilic diamides* group that is harmless to beneficial insects such as parasitoids, predators and pollinators (Dinter *et al*., 2008; Brugger *et al*., 2010). *Cypermethrin* is a brownish-yellow concentrated contact and gastric poison insecticide that can be treated to control important pests in rice, cabbage, mustard, cocoa, soybeans, corn, tea, tobacco and cotton (Sudjak. 2011). *Deltamethrin* is one of the insecticides widely used by farmers in rice plantations and one of the most widely used in crop protection. *Deltamethrin* is a broad-spectrum synthetic pyrethroid insecticide that acts as a contact toxin and stomach toxin (Dietz *et al*., 2009).

Phytotoxicity

Based on table 4 below, it shows that insecticide application has no toxic effect on chili plants after application of various insecticide active ingredients.

Table 4. The Effect of various insecticide active ingredients against phytotoxicity in red chili plants aged 34, 41, 48, 55 and 62 DAP (%)

Insecticide Treatment	Phytotoxicity (%)				
	34 DAP	41 DAP	48 DAP	55 DAP	62 DAP
A *(Chlorpyrifos)*	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
B (*Chlorantraniliprol)*	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
C *(Cypermethrin)*	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
D *(Deltramethrin)*	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
E (Control)	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a

Remarks: The average value followed by a latter in the same column indicates a difference that is not significant in the Duncan test.

Based on the calculation of the results from (Table 4) it appears that there are no symptoms of poisoning (phytotoxicity) due to the application of insecticide active ingredients to red chili. So it was concluded that the active ingredients *chlorpyrifos*, *chlorantraniliprol*, *cypermethrin* and *deltrametrin* are safe for chili plants at a dose of 2ml / liter. Wati *et al.*, (2021) stated that phytotoxicity is a property that shows the potential for insecticides to cause poisoning effects on plants characterized by abnormal growth after insecticide application.

Chili yield weight (kg)

Based on Table 5 below, the average treatment using insecticides had a significant effect on chili yields when compared to control treatments. According to Insecticide is a biocide designed to be toxic to certain groups of organizations such as OPT, therefore the application of insecticides can increase crop yields because it can eradicate pests, so that crop yields can be further increased. (Kaimudin, Sumbono, & Istiqomah, 2020).

Table 5. The The Effect of various insecticide active ingredients on the harvest of red chili plants aged 34, 41, 48, 55 and 62 DAP (kg)

Insecticide Treatment	Sample plot yield (kg)
A *(Chlorpyrifos)*	10.11 c
B *(Chlorantraniliprol)*	10.31 c
C *(Cypermethrin)*	10.16 c
D *(Deltramethrin)*	9.55 b
E (Control)	8.04 a

Remarks: The average value followed by unequal letters in the same factor and column shows an unreal difference in the Duncan test.

The active ingredients of insecticides *Chlorpyrifos*, *Chlorantraniliprol* and *Cypermethrin* gave good results when compared to *Deltrametrin* and control insecticides. Thehighest harvest result was obtained from the treatment of the insecticide *Chlorantraniliprol, as* much as 10.31 kg / plot, or equivalent to 10.31 tons per hectare.

CONCLUSION

The treatment of various insecticides has a real effect on the intensity of the attack of fruit caterpillar pests *(Helicoverpa amigera)* and on other pests of the whitefly *(Bemisia tabaci)* and the application of insecticides has no real effect on the attack of anthracnose disease *(Colletotrichum gleosporioides)* at all ages (34, 41, 48, 55 and 62 DAP), the application of various insecticides also had no effect on phytotoxicity. In addition, the application of insecticides can increase crop yields, the application of the active ingredient insecticide *Chlorantraniliprol* produces the best yield of 10.31 kg / plot when compared to other active ingredients and in the control treatment produces the lowest harvest of 8.04 kg.

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