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EFFECT OF CONCENTRATION AND APPLICATION INTERVAL OF *Chlorantraniliprole* ACTIVE INGREDIENT INSECTICIDE ON ATTACK INTENSITY OF *Spodoptera frugiperda* J.E Smith (*Lepidoptera: Noctuidae*) AND YIELD OF SWEET CORN (*Zea mays saccaharata sturt*) PLANTS

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ABSTRACT

Sweet corn productivity in the country is still low when compared to productivity abroad, the main factors that cause low corn yields in Indonesia are the use of local varieties, lack of soil fertility coupled with inadequate fertilization and pest and disease attacks. This experiment aims to determine the effect of Concentration and Application Interval of Chlorantraniliprole Active Ingredient Insecticide on the intensity of Spodoptera frugiperda J.E Smith (Lepidoptera: Noctuidae) attack and yield of Sweet Corn (Zea mays saccaharata sturt). The experiment was conducted in Getasan Village, Depok District, Cirebon Regency, in January-April 2023. The research method used a factorial pattern Randomized Group Design consisting of two factors, namely concentration and application interval. The results showed that the concentration and application interval of the active ingredient Chlorantraniliprole had a significant effect on the intensity of Spodoptera frugiperda attack and the yield of sweet corn (Zea mays saccaharata sturt). Chlorantraniliprole concentration of 3 cc/liter with 2 application intervals once a day was able to reduce the intensity of Spodoptera frugiperda attack up to 9.47%. Chlorantraniliprole concentration of 2 cc/liter with 2 application intervals once was able to produce 10.8 kg/plot of corn or equivalent to 19.2 ton/h (80% effective land).

KEYWORDS *Sweet Corn; Spodoptera frugiperda; Chlorantraniliprolee; Intensity*

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INTRODUCTION

Sweet corn (*Zea mays saccaharatas*) is a type of plant that originated in America and has long been recognized and developed in Indonesia. Sweet corn is an agricultural commodity that is very popular with the public, because it tastes good and sweet and contains carbohydrates, little protein and fat. This is what makes the high demand for sweet corn (Puspadewi et al., 2016). Efforts to increase sweet corn production have many challenges, such as the use of local varieties, lack of soil fertility coupled with inadequate fertilization and the attack of plant disrupting organisms (OPT), the main pest in sweet corn is *Spodoptera frugiperda* (Baco & Tandiabang, 1998). Pest management in sweet corn both mechanically, chemically and biologically is very necessary in an effort to overcome the decline in productivity of sweet corn plants, good maintenance of corn plants requires the application of adequate pesticides. Pesticide treatment is a factor that greatly influences the resistance of corn plants from pest attacks. According to Rahman (2007), if the right pesticide is applied, the active ingredients contained in it will protect plants from pest attacks so that they can produce well and maximize yields. There are several ways that can be done in order to increase the production of sweet corn, namely extensification and intensification of agriculture. Agricultural extensification is an effort to increase crop production by expanding agricultural land, this activity is difficult to do because currently agricultural land is getting narrower due to high population growth and the many conversion of agricultural land into residential land. Controlling pest or disease attacks is usually done using synthetic chemical pesticides. This is because these pesticides have a relatively fast way of working in suppressing pest populations so as to reduce losses. The results due to pest attacks, more effective in eradicating pests and easily available (Riana, 2012). *Spodoptera frugiperda* is a herbivorous insect associated with corn plants, favoring corn plants that contain high amino acids that are more nutritious. *Spodoptera frugiperda* insects can attack all stadia of corn plants starting from the vegetative phase to the generative phase (Bagariang et al., 2020; Prasanna et al., 2018) and the highest level of damage was found in the vegetative phase (Trisyono et al., 2019). The life cycle ranges from 32-46 days with egg stadia of 2-3 days, larvae of 14-19 days and pupae of 9-12 days (Kalleshwaraswamy et al., 2018). The damage caused to the leaves and cobs of corn results in significant yield loss. Based on the results of the study, *Chlorantraniplrole* was able to kill 90% of *Spodoptera frugiperda* larvae on the third day after application, both on instars 2-3 and instars 4-6. Application of *Chlorantraniliprole* to leaves, larvae or larvae+leaves killed 100% of test larvae after 5 days of application, but application to larvae+leaves killed larvae faster than others at 1 day after application (Bagariang et al., 2020).

Insecticides with the active ingredient *Chlorantraniliprole* are one type of insecticide that is widely used by farmers to control lepidoptera pests, but can also control coleoptera, diptera and isoptera pests. This is evidenced by the *Chlorantraniliprole* treatment effectively controlling *Spodoptera frugiperda* in shallot plants with an effectiveness of 93.3% (Febrianasari et al., 2014; Shi et al., 2023). *Chlorantraniliprole* is a selective insecticide from the anthranilic diamides group that is harmless to beneficial insects such as parasitoids, predators and pollinators (Dinter et al., 2010; Dinter et al., 2008) works by activating the

Ryanodine receptor (RyR) so that it causes the release of calcium from the sarcoplasmic reticulum in insects which results in irregular muscle movements, paralysis and ends with death. Symptoms seen in insects sprayed with *Chlorantraniliprole* are paralysis, stop eating, and die within a few days (Cordova et al., 2006).

Research Objectives

1) To determine the interaction effect between concentration and application interval of *Chlorantraniliprole* active ingredient on *Spodoptera frugiperda* attack intensity and sweet corn (*Zea mays saccaharata sturt*) yield.
2) To determine the concentration and application interval of *Chlorantraniliprole* active ingredient that gives the best results on *Spodoptera frugiperda* attack and sweet corn (*Zea mays saccaharata sturt*) yield.

Research Hypothesis

1) There is an interaction between the concentration and application interval of the active ingredient *Chlorantraniliprole* significantly affects the intensity of *Spodoptera frugiperda* attack and yield of sweet corn (*Zea mays saccaharata sturt*).
2) At a dose concentration of 3 cc/liter and an interval of 2 days the application of the active ingredient *Chlorantraniliprole* had a significant effect on the intensity of *Spodoptera frugiperda* attack and the yield of sweet corn plants (*Zea mays saccaharata sturt*).

RESEARCH METHOD

The research wes carried out at Getasan Village, Depok District, Cirebon Regency with ±50 measure above sea sea level (masl), in January – April 2023. The materials used in this experiment were sweet corn seeds of Pertiwi cultivar, Urea fertilizer, KCl, SP36, insecticide made from *Chlorantraniliprole* and other materials that support the research. The tools used in this experiment include: scales, handsprayers, markers, rulers, meters, buckets, hoes, signboards and other tools that support research. The method used is an experimental method with a Randomized Group Design (RAK) factorial pattern consisting of two factors, namely Concentration and Application interval. Each factor consists of three levels so that 9 experimental units are obtained and repeated 3 times. The treatments of Concentration and Interval of *Chlorantraniliprole* application are as follows:

Treatment Concentration of *Chlorantraniliprole* Active Ingredient Insecticide
K1 = Concentration 1 cc/liter
K2 = Concentration 2 cc/liter
K3 = Concentration 3 cc/liter
Chlorantraniliprole Active Ingredient Insecticide Interval Treatment
I1 = Once every 2 days interval
I2 = Once every 4 days interval
I3 = Once every 6 days interval

Insecticides are applied by spraying using the formulation according to the concentration according to the treatment. Spraying was done on the leaves. Spraying began 7, 14, and 21 days after the attack. To determine the effect of insecticides on the intensity of attack and yield of corn plants, supporting and main observations were made. Supporting observations included rainfall, and soil analysis. The main observations were made on several meters including Pest Attack Intensity (%), Plant Height per Clump (cm), Number of Leaves per Clump (blade), Stem Diameter (cm) and weight of cob per plot (kg). Plant growth and yield data were analyzed using the RAK linear model with a factorial pattern (Wijaya, 2018). If there is a significant difference from the treatment or the F-count value is greater than the F-table at the 5% level, the test is carried out using the Duncan multiple range test. To determine the correlation between growth components and sweet corn yield, it was analyzed using the Pearson correlation coefficient proposed by Wijaya (2018).

RESULT AND DISCUSSION

Supporting Observations

During the experiment, the average rainfall was 32.1 mm/month or an average day of 4.2 mm/day. The most common pests were *Spodoptera frugiperda*, corn stalk borer caterpillars, aphids, cob borers, and thrips, while diseases that often appear in corn plants are downy mildew, leaf blight, and rust.

Key Observations

Spodoptera frugiperda Pest Attack Intensity (%)

The results of the analysis of variance showed that the application of *Chlorantraniliprole* based on concentration and interval had a significant effect on the Attack Intensity of *Spodoptera frugiperda* pests at 7, 14, and 21 DAA. The average effect of insecticide dose is presented in Table 1.

Table 1. Attack intensity

Treatment	Attack Intensity(%)		
	7 DAA	14 DAA	21 DAA
Treatment K			
K1 (Concentration 1cc/liter)	39,39c	29,13c	24,93c
K2 (Concentration 2cc/liter)	30,20b	16,15b	12,97b
K3 (Concentration 3cc/liter)	21,10a	10,57a	9,47a
Treatment I			
I1 (Once every 2 days interval)	33,03c	13,57a	10,93a
I2 (Once every 4 days interval)	26,87a	17,40b	15,17b
I3 (Once every 6 days interval)	30,79b	24,87c	21,27c

Notes: Mean numbers accompanied by different letters in the same column indicate significant differences according to the Scott-Knot Cluster Test at the 5% level.

From the results of the analysis, it was found that the application of the highest concentration K3 (Concentration 3cc/liter) can suppress the intensity of pest attacks most optimally, both at 7 DAA, 14 DAA and 21 DAA. At the age of 7 DAA, 14

DAA and 21 DAA, the K3 (3cc/liter concentration) and K2 (2cc/liter concentration) treatments were significantly different when compared to K1 (1cc/liter concentration). By giving K3 (concentration of 3cc/liter), at the observation of 7 DAA the intensity of the attack can be suppressed up to 21.10%, 14 DAA to the intensity of the attack can be suppressed up to 10.57%, and 21DAA the intensity of the attack can be suppressed up to 9.47%.

At the age of 7 DAA, the interval treatment showed that the best treatment was at interval I2 (Interval 4 days). Then at the observation of 14 DAA and 21 DAA, the best treatment was at interval I1 (Interval every 2 days) with a value of 10.93%, in this case the closer the treatment, the *Spodoptera frugiperda* attack can be suppressed.

At the observation of 14 DAA and 21 DAA I1 and I2 had a significant effect compared to I3. This is because the denser the application, the more it can suppress pest attacks up to 13.57% at 14 DAA and 10.93% at 14 DAA. While at 7 DAA observation, treatment I2 had the lowest attack intensity. This is thought to be due to the low initial attack intensity and the young age of the corn, on the other hand, it is thought to be the application of *Chlorantraniliprole*. The most effective reduction in armyworm attack intensity occurred at a concentration of 3cc/liter with an interval of 2 days. According to Bagariang (2020), insecticides made from the active ingredient *Chlorantraniliprole* can suppress the population of *Spodoptera frugiperda* larvae with 100% mortality 5 days after application. Decreasing the intensity of armyworm attack can also be caused by increasing plant age, high concentration and frequent intensity treatments. The lowest level of *Spodoptera frugiperda* pest attack intensity occurred at 21 DAA with a concentration of 3cc/liter and an interval of 2 days. This is in accordance with the opinion of Trisyono et al. (2019) stated that the level of *Spodoptera frugiperda* attack was higher in young corn plants, the lowest production was caused by the high intensity of pest attacks and no control. Besides damaging the leaves of the plant, this pest can also attack the cob so that if no control is carried out, it will cause a decrease in production. According to MOA (2019), an average population density of 0.2-0.8 larvae per plant can reduce yield by 5-20%. In addition, armyworm infestation on corn plants when the young leaves are still rolling causes yield loss of 15-73% if the plant population is 55-100% infested.

Plant Height (cm)

Shows that the provision of *Chlorantraniliprole* based on concentration has an independent effect on Plant Height at the age of 28 DAP and has no significant effect at the age of 35, 42 DAP. While the interval treatment showed a significant effect on plant height at the age of 35 DAP, and had no significant effect at the age of 28 and 42 DAP. The average plant height after the application of *Chlorantraniliprole* is presented in Table 2.

Table 2. Plant Height

Treatment	Plant Height (cm)		
	28 DAP	35 DAP	42 DAP
Treatment K			
K1 (Concentration 1cc/liter)	303,82b	429,72a	561,29a
K2 (Concentration 2cc/liter)	310,79c	435,32a	562,02a
K3 (Concentration 3cc/liter)	293,99a	433,64a	553,15a
Treatment I			
I1 (Once every 2 days interval)	298,95a	425,89a	556,55a
I2 (Once every 4 days interval)	304,76a	439,32c	560,13a
I3 (Once every 6 days interval)	304,89a	433,47b	559,78a

Notes: Mean numbers accompanied by different letters in the same column indicate significant differences according to the Scott-Knot Cluster Test at the 5% level.

At the age of 28 DAP, the concentration treatment showed that the best treatment was K2 (2cc/liter concentration) with a value of 310.79cm. The treatment of K1 (1cc/liter concentration) and K2 (3cc/liter concentration) application had a significant effect when compared to K3 (3cc/liter concentration). While at 35 and 42 DAP the treatment of K1 (Concentration 1cc/liter), K2 (Concentration 2cc/liter) and K3 (Concentration 3cc/liter) application had no significant effect. In the interval treatment, the age of 28 and 42 DAP had no significant effect on plant height. At the age of 35 DAP, the treatment of I2 (Interval every 4 days) and I3 (Interval every 6 days) application had a significant effect compared to I1 (Interval every 2 days) application. And the best results were at the age of 35 DAP with treatment I2 (Interval 4 days once) with a value of 439.32cm. In general, the use of pesticides does not significantly affect plant growth, but the use of inappropriate or excessive pesticides often inhibits plant growth. As the opinion of Soleh (2020), which reveals that the use of excessive chemical pesticides not only causes crop damage but makes plant growth abnormal. Conditions such as dwarfism, spots on leaves, many damaged fruits and also discoloration of leaves are not only caused by a lack of nutrients in these plants but can also be caused by excessive use of pesticides.

Table 3. Number of Leaves

Treatment	Number of Leaves (sheet)		
	28 DAP	35 DAP	42 DAP
Treatment K			
K1 (Concentration 1cc/liter)	14,33a	21,87b	32,53c
K2 (Concentration 2cc/liter)	15,53b	21,13a	32,20b
K3 (Concentration 3cc/liter)	14,67a	20,67a	30,60a
Treatment I			
I1 (Once every 2 days interval)	15,40a	21,33a	30,67a
I2 (Once every 4 days interval)	14,47a	21,87b	31,87b
I3 (Once every 6 days interval)	14,67a	20,47a	32,80c

Notes: Mean numbers accompanied by different letters in the same column indicate significant differences according to the Scott-Knot Cluster Test at the 5% level.

In the concentration treatment at the age of 28 DAP it can be seen that K2 (Concentration of 2 cc/liter) is significantly different from K1 (Concentration of 1 cc/liter) and K3, at the age of 35 DAP K1 is significantly different from K2 and K3 (Concentration of 3 cc/liter) and at the age of 42 DAP K1 (Concentration of 1cc/liter) and K2 are significantly different compared to K3. So it can be seen that the best treatment is at the age of 42 DAP with treatment K1 (concentration of 1cc / liter) with a value of 32.53.

At the age of 28 DAP, the interval treatment did not significantly affect the number of leaves. At the age of 35 DAP I2 (Interval 4 days) application significantly influenced compared to I1 (Interval 2 days) and I3 (Interval 6 days) application. At the age of 42 DAP I3 (Interval 4 days once) and I2 (Interval 6 days once) applications were significantly different compared to I1 (Interval 2 days once) applications. So it can be seen that the best treatment is at the age of 42 DAP with treatment I3 (interval 6 days once) with a value of 32.80.

This is thought to be because the application of *Chlorantraniliprole* effectively kills *Spodoptera frugiperda* pests on the leaves, this is in accordance with previous research. According to Bagarian (2020), the application of *Chlorantraniliprole* on leaves, larvae, on larvae + leaves was able to kill 100% of the test larvae. Therefore, the leaves can grow optimally.

Table 4. Stem Diameter (cm)

Treatment	Stem Diameter (cm)		
	28 DAP	35 DAP	42 DAP
Treatment K			
K1 (Concentration 1cc/liter)	42,12a	54,59a	63,75a
K2 (Concentration 2cc/liter)	46,81b	56,09b	64,16a
K3 (Concentration 3cc/liter)	43,68a	56,43c	64,40a
Treatment I			
I1 (Once every 2 days interval)	44,10a	54,66a	63,77a
I2 (Once every 4 days interval)	44,30a	57,21b	65,61b
I3 (Once every 6 days interval)	44,22a	55,25a	62,93a

Notes: Mean numbers accompanied by different letters in the same column indicate significant differences according to the Scott-Knot Cluster Test at the 5% level.

In the concentration treatment at the age of 28 DAP, it can be seen that K2 (Concentration of 2 cc/liter) is significantly different from K1 (Concentration of 1 cc/liter) and K3 (Concentration of 3 cc/liter), at the age of 35 DAP K3 (Concentration of 3cc/liter) and K2 (Concentration of 2 cc/liter) have a significant effect compared to K1 (Concentration of 1 cc/liter), and at the age of 42 DAP has no significant effect. So it can be seen that the best treatment is at 35 DAP with K3 treatment (Concentration of 3 cc/liter) with a value of 56.43cm.

At the age of 28 DAP interval treatment had no significant effect, at the age of 35 DAP I2 was significantly different from the treatment of K1 (Concentration 1cc/liter) and K3 (Concentration 3 cc/liter), and at the age of 42 DAP I2 was not significantly different compared to treatment I1 (Interval every 2 days) and I3 (Interval every 6 days). So it can be seen that the best treatment is at the age of 42 DAP with treatment I2 (Interval 4 days once) application with a value of 65.61cm.

Table 5. Weight of Weighted Cob

Treatment	Cob Weight (g)	
	With husks	Without husks
Treatment K		
K1 (Concentration 1cc/liter)	1148,13a	831,93a
K2 (Concentration 2cc/liter)	1254,20c	911,27c
K3 (Concentration 3cc/liter)	1179,47b	856,33b
Treatment I		
I1 (Once every 2 days interval)	1171,07a	845,60a
I2 (Once every 4 days interval)	1213,07b	865,13a
I3 (Once every 6 days interval)	1197,67a	888,80b

Effect of Independent K on Weight of Tuberous Cob:

The treatment of K2 (Concentration of 2 cc/liter) and k3 were significantly different when compared to K1 (Concentration of 1cc/liter), the best results were obtained with the treatment of K2 (Concentration of 2 cc/liter) both on the cob and cob without cob.

In the treatment of weight interval, the weight of the weight with the treatment of K2 (Concentration of 2 cc/liter) was significantly different from K1 (Concentration of 1 cc/liter) and K3 (Concentration of 3 cc/liter), while in the weight without kelobot, the treatment of K3 (Concentration of 3 cc/liter) was significantly different from K1 (Concentration of 1 cc/liter) and K2 (Concentration of 2 cc/liter). The best results on weight with kelobot were achieved with treatment I2 (Interval of 4 days), while weight without kelobot the best results were obtained with treatment I3 (Interval of 6 days).

This is in accordance with previous research. According to Bagariang (2020), the intensity of *Spodoptera frugiperda* attack on fields applied with *Chlorantraniliprole* was lower than farmer fields and had higher corn cob weights. This is thought to be because maize plants were applied with *Chlorantraniliprole* at 1, 3 and 5 MST (vegetative phase) while farmers' fields were applied with other pesticides at 30 and 55 DAP. The vegetative phase is an important phase for control because the larvae are still in the early instar.

CONCLUSION

Based on the results of research on the effect of concentration and application interval of the active ingredient insecticide *Chlorantraniliprole* on the intensity of *Spodoptera frugiperda* J.E Smith (*Lepidoptera: Noctuidae*) attack and the yield of Sweet Corn (*Zea mays saccaharata sturt*), it can be concluded as follows; (1) concentration and application interval of *Chlorantraniliprole* active ingredient significantly affected *Spodoptera frugiperda* infestation intensity and yield of sweet corn (*Zea mays saccaharata sturt*)., (2) c*hlorantraniliprole* concentration of 3 cc/liter with a 2-day application interval was able to reduce the intensity of *Spodoptera frugiperda* attack by 9.47%, and (3) c*hlorantraniliprole* concentration of 2cc/liter with 2 application intervals can produce 10.8 kg/plot of maize or equivalent to 19.2ton/h (80% effective field).

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