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The Interval Effect Of Applying Various Types Of Insecticides In Controlling Fruit Fly (*Bactrocera* sp.) Pests on Curly Red Chili (*Capsicum annum* L.) Plants Production

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ABSTRACT

This research entitled "The Internal Effect of Applying Various Types of Insecticides in Controlling Fruit Fly (Bactrocera sp.) Pests on Curly Red Chili (Capsicum annum L) Plants Production" has been conducted in Riau Islamic University at Dormitory area from July 2021 to October 2021. The study aimed to determine the Interval interaction application and the effect of various vegetable insecticides in controlling fruit fly pests on curly red chili plant production. This study used a completely randomized design consisting of two factors. The first factor was various insecticides consisting of 4 levels: betel leaf extract 100 cc/l, neem leaf extract 100 cc/l, lime leaf extract 100 cc/l, and isoprocarb 2 g/l. At the same time, the second factor is the application of time intervals consisting of 4 levels: 3 days, 6 days, 9 days, and 12 days. So there were 16 treatment combinations consisting of 3 replications; overall, there were 48 experimental units. Each experimental unit contained 4 plants, and 2 plants were used as samples; the total was 192 plants. The data is statistically processed and further tested using the BNJ test. The results indicated that the interaction and interval application combination and various insecticides were not affecting overall parameters in all treatments. Such the experimental parameters were the odds of flowers becoming fruit, age at first harvest, fruit weight per plant, fruit weight per fruit, the odds of fruit being attacked by fruit flies, other types of attacking pests, and the age of attacked by disease.

Keywords*:: Insecticides, fruit fly, chili pepper*

1. INTRODUCTION

For Indonesian people, curly red chili (Capsicum annum L.) is a superior horticultural commodity as a flavoring agent and a complement to typical Indonesian dishes menu. Data for the last five years from Kementerian Pertanian RI (2019), curly red chili production in Riau Province from 2015 to 2019 has increased from year to year by 7,393 tons, 12,002 tons, 15,813 tons, 17,324 tons, and 17,513 tons, respectively. While in 2019, Riau people's consumption through the National Socioeconomic Survey (SUSENAS) was 0.32 kg per capita/month, household consumption a year was 26,247 tons and was the fourth highest after West Sumatra, North Sumatra, and Aceh.

Based on a survey of trade distribution patterns for 2020, Riau Province receives supplies from red chili production centers, including East Java, West Sumatra, Yogyakarta, Central Java, and North Sumatra (Badan Pusat Statistik RI, 2020). Dependence on chili commodities is due to low production from the farmers. Some of the reasons are factors of cultivation techniques, fertilizers usage, soil fertility, and Plant Destruction Organisms (OPT), which cause damage and even crop failure. One of the pests that can reduce crop production from pests is the fruit fly pest. Fruit flies are insects that live in the tropics of Africa and Asia. The fruit flies are very detrimental to farmers, and this is because fruit flies can cause fruit to rot and then fall (Risnawati et al. (2019). Fruit flies are potential pests that destroy chili fruit resulting in a high yield loss rate of up to 80%.

In general, farmers in controlling fruit fly pests use relatively high doses of synthetic pesticides and irregular or frequent spraying intervals so that these treatments would bring a negative impact on crop yields and the environment. Excess insecticides can kill natural enemies; pests become resistant, resulting in pest explosions (resurgence). Another disadvantage of excessive synthetic pesticides is that they harm human and mammalian health and cause environmental (agroecosystem) pollution.

One of the efforts that can be made to overcome OPT attacks, such as fruit fly pests and environmental pollution, as well as the residual impact of synthetic pesticides on chili cultivation, is using vegetable pesticides. In addition to producing healthy products for consumption, plant-based pesticides can also reduce environmental pollution and production costs because the materials used for manufacturing vegetable pesticides are relatively cheap and easy to obtain.

Botanical pesticides are pesticides with basic ingredients derived from certain plants that can function as repellents and affect the behavior of target pests, disrupting the reproductive system, respiratory system, and hormone balance and reducing appetite. Plant types used for vegetable insecticides contain chemical compounds that can inhibit insects' growth and development, including betel leaves, neem leaves, and lime leaf extract.

Betel leaves contain compounds such as phenols, chavicol, and tannins, so it has the potential to be used as poisons for insects. The tannin compounds in betel leaves work as an astringent substance that can shrink tissues and cover protein

structures in the skin and mucosa. And also, the leaf reduces the ability of animals to consume food so that they can inhibit the growth of insects both in the larval phase and after becoming adult insects (Anisah 2018; Yushananta and Ahyanti 2021). In addition, betel leaf also functions as a bio fungicide and can reduce the intensity of plant disease attacks (Hasibuan et al., 2021).

Meanwhile, according to Debashari and Tamal (2012), neem leaves contain four natural chemical compounds active as pesticides: Azadirachtin, Selanin, Meliatior, and Nimbin.

Lime leaves give off a fresh aroma like lime fruit, yet plant pests dislike it because lime leaves contain organic chemical compounds. Kurnia (2014); Manulang et al. (2020) stated that lime could also be used as an insecticide because lime leaves contain saponins, flavonoids, tannins, and tapens, which function as poisons for plant pests.

Besides using vegetable insecticides, synthetic insecticides cannot be separated from plant pest control. Therefore the importance of synthetic insecticides with active chemical compounds that are harmless, especially for humans and mammals, including synthetic insecticides of the carbamate type from the synthetic pyrethroid group with the active ingredient isoprocarb 50%. According to Wispriyono (2013), Carbamate is a type of pesticide widely used to eradicate fruit and vegetable pests with carbamate toxicity in vegetables that are still safe for consumption by living things.

Based on the description above, the authors have conducted a study entitled "The Internal Effect of Applying Various Types of Insecticides in Controlling Fruit Fly (*Bactrocera* sp.) Pests on Curly Red Chili (*Capsicum annum* L) Plants Production."

2. MATERIALS AND METHODS

The research was carried out in the Riau Islamic University Dormitory, Kaharuddin Nasution Street No. 113, Air Dingin Village, Bukit Raya District, Pekanbaru City.

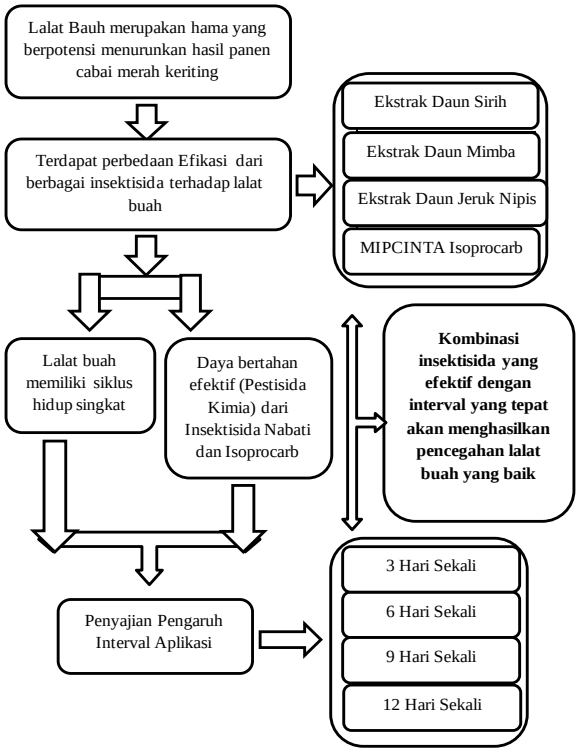
The materials used in this study were red chili seeds of the Laban variety, betel leaves, neem leaves, lime leaves, MIPCINTA 50 WP, Dithane M-45 80 WP, fermented goat manure, Ketapang leaf compost, NPK fertilizer 16:16:16, 35x40 poly bag, zinc plate, research banner. The tools used are hoes, machetes, Water splash, cameras, 1000 ml measuring cups, blenders, buckets, hand sprayers, and stationery.

This study used a completely randomized design (CRD) factorial, which consisted of two factors. The first factor is the various types of pesticides (P) which consists of 4 levels, while the second factor is the application time interval (W) which consists of 4 levels. Thus, 16 treatment combinations were obtained, where each treatment was repeated 3 times for a total of 48 experimental units. Each experimental unit consisted of 4 plants, 2 of which were used as samples, so the total number of research plants was 192.

The combinations of insecticide treatments and application time intervals are as follows:

The first factor consisted of various insecticides (P) consisting of 4 levels, e.g., P1 = Betel leaf extract 100 cc/l, P2 = Neem leaf extract 100 cc/l, P3 = Lime leaf extract 100 cc/l, P4 = Isoprocarb 2 g/l l. The second factor is the application time interval (W) consisting of 4 levels:

W1 = once in 3 days, W2 = once in 6 days, W3 = once in 9 days, and W4 = once in 12 days.



Gambar 1. Ilustrasi kerangka pemikiran

3. RESULT AND DISCUSSION

The Odds of Flower Becoming Fruit (%)

Based on the results of the observations, it was shown that the overall average percentage of flowers appearing on each plant and the percentage of flowers turning into fruit showed that the interaction between application time intervals and various insecticides had no significant effect. The average percentage of interest turns into curly red chilies after further testing the Honest Significant Difference (Tukey Test) at the 5% level.

Table 1. The average percentage of curly red chili plants by applying various insecticides (%).

Various Pesticide (P)	Application Time Interval (W)				Mean (P)
	once every 3 days (W1)	once every 6 days (W2)	once every 9 days (W3)	once every 12 days (W4)	
Betel leaf extract (P1)	76.67	87.67	86.67	91.00	85.50
Neem leaf extract (P2)	87.00	88.33	86.67	88.33	87.58
Lime leaf extract (P3)	85.33	86.67	87.33	90.00	87.33
Isoprocarb (P4)	85.00	86.67	86.33	90.00	87.50
Mean (W)	83.50	87.33	87.25	89.83	86.98
CC = 6.97 %					

The results of the observations in table 1 show that interactively the time interval of application and application of various types of insecticides does not play a significant role in the percentage of flowers to fruit. Plants treated with P1W4 betel leaf extract had the highest number of fruits, 91.00. At the same time, plants with P1W1 treatment of betel leaf extract were the lowest treatment with 76.67 fruits.

Chili plants are included in the day-neutral plant group, namely plants that can flower throughout the year on short

days and long days. The duration of irradiation when carrying out an 5-6 hours average of sunlight influences plant growth through forming chlorophyll, the opening of stomata, forming anthocyanins (red pigments), changes in leaf or stem temperature, nutrient absorption and transpiration, and protoplasmic movement.

Sutoyo (2011) said that sunlight affects plant growth through the length of irradiation or day length. It also affects plant flowering through three factors, namely quality, intensity, and photoperiodism. Indonesia has a tropical climate, so the length of day and night is almost the same, i.e., the light duration reaches 12 hours.

In addition to sufficient sunlight, plants also need nutrients for plant growth and development. Dwidjoseputro in Azmi (2017) states that plants will thrive if the nutrients needed are fulfilled. These nutrients are available in a form that can be absorbed by plants, including The element Phosphate (P) has a function in the formation of flowers, influencing the formation of flowers and fruit size. Then phosphate can encourage the formation of flowers and fruits. Then Azmi (2017) added that a lack of potassium would produce few flowers and fruit; the benefits of potassium for plants include helping plants fight disease. Still, if a plant is deficient in potassium, it will look unhealthy.

Age of First Harvest (Days)

From observing the curly red chili harvesting age, the interaction of application time intervals with various insecticides showed that the two treatments did not significantly affect curly red chili plants' harvesting age. It was followed up using Test Results for Significant Differences (BNJ) at the 5% level.

Table 2. The average age of the first harvest of curly red chili plants with the application of various types of insecticides (Hari).

Various Pesticide (P)	Application Time Interval (W)				Mean (P)
	once every 3 days (W1)	once every 6 days (W2)	once every 9 days (W3)	once every 12 days (W4)	
Betel leaf extract (P1)	83.00	81.33	81.00	82.67	82.00
Neem leaf extract (P2)	80.67	79.67	81.33	82.00	80.92
Lime leaf extract (P3)	82.67	83.33	81.67	81.33	82.25
Isoprocarb (P4)	82.00	83.33	81.33	81.33	82.00
Mean (W)	82.08	81.92	81.33	81.83	81.79
CC = 2.37 %					

The data in table 2 shows that the interaction of applications with time intervals and various insecticides does not significantly affect the first harvest of curly red chili plants. Giving neem leaf extract (P2) with application intervals every 6 days (W2) P2W2 was the best treatment, with an average age of the first harvest 79.67 days after planting. It is significantly different from other treatments, where curly red chili plants were harvested the longest for the first harvest, namely at the age of 83.33 days after planting (DAP); the P3W2 treatment

of lime leaf extract (P3) every 6 days interval (W2). Yield data in units of the number of fruits per one sample plant generally indicate that the various insecticides applied to get good results.

The average age of harvesting curly red chili plants in the research corresponds to the packaging description. This is presumably because the profit f1 seeds have to resist. The provision of insecticides inhibited fruit flies, affecting the yield of red chili peppers in this study. Even so, the administration of various insecticides was considered unable to overcome fruit fly pest attacks. Presumably, there were factors carrying fruit flies, such as the presence of plants guava and jackfruit, coupled with the weakness of vegetable insecticides which have relatively slow action compared to synthetic insecticides.

Fruit Weight per Plant (g)

Observing the fruit weight of curly red chilies per plant with time intervals of application and various types of insecticides after fingerprint analysis showed that the interactions of the two treatments did not significantly affect fruit weight per plant. The average fruit weight per plant of curly red chili after further testing Honest Significant Difference (BNJ) was at 5% level.

Table 3 below shows that the application time interval and administration of various insecticides had no significant effect on fruit weight per plant. The highest fruit weight per plant was 386.33 g in the P1W2 treatment of betel leaf extract, and the lowest fruit weight was 346 .67 g was found in the P1W1 treatment. If converted into tons/ha, the heaviest fruit yield is 15.4 tons/ha, while the lowest fruit weight is 13.8 tons/ha. Compared with the results of the description of the F1 curly red chili plant with a potential yield of 18-20 tons/ha, it is very different because, in this study, only 8 harvests were harvested from beginning to end.

Table 3. Average fruit weight per plant of curly red chilies with the application of various types of insecticides (g).

Various Pesticide (P)	Application Time Interval (W)				Mean (P)
	once every 3 days (W1)	once every 6 days (W2)	once every 9 days (W3)	once every 12 days (W4)	
Betel leaf extract (P1)	346.67	386.33	346.67	386.33	366.50
Neem leaf extract (P2)	361.67	358.67	383.67	349.67	363.42
Lime leaf extract (P3)	350.33	375.00	350.33	373.33	362.25
Isoprocarb (P4)	378.33	358.33	370.00	363.33	367.50
Mean (W)	359.25	369.58	362.17	368.67	364.92
CC = 8.19 %					

There was no significant difference in weight per plant in this study due to sufficient additional plant nutritional needs. Such treatments were use natural goat Kohe fertilizer and Ketapang leaf compost as well as additional fertilizer NPK 16.16.16 and Gandasil D and B so that the fruit produced is uniform.

From the data in the table above, based on the numbers, shows that there is no significant difference between the

various insecticide treatments on the fruit weight of chili plants, this is because the elements of Potassium, Nitrogen, Calcium, and Phosphorus for growth in chili plants are sufficient. According to research by Golcz et al. (2012), compared to other horticultural crops, chili plants have the greatest need for potassium (40%) and nitrogen (31%), lower for calcium (20%) and phosphorus (11%) concerning the total amount of absorbed nutrients. This is in line with research (Ariani 2009; Hapsoh 2017) that the number of fruits and fruit weight per plant increased along with the high dose of NPK fertilizer (16:16:16) given to chili plants with a treatment dose of 250 kg/ha.

The Odds of Fruit Attacked by Fruit Fly (%)

The results of observing the percentage of fruits attacked by fruit flies in the application time interval treatment and various insecticides after analysis of variance showed that the interaction between the two treatments had no significant effect on the percentage of fruits attacked by fruit fly pests on red curly chili peppers. Also, it was based on the Honest Significant Difference (BNJ) test results at the 5% level.

Observation of the administration of lime leaf extract vegetable insecticide (P3) applied once every 9 days (W3) P3W2 treatment was the best treatment which resulted in the smallest percentage of fruit attacked by fruit fly pests, namely 5.63%. The highest percentage of fruit fly pest attacks occurred in the P2W2 treatment of the application of neem leaf extract (P2), which was applied every 6 days (W2) at 14.00%. Observational data were analyzed using regression analysis, which can be seen in Figure 1.

Based on the results of observations, the percentage of fruit fly infestation was influenced by several factors, such as the level of ripeness and availability of fruit. Fruit fly pests prefer ripe fruit to lay eggs over still green fruit. The more fruit, the higher the attack rate of fruit fly pests. This is also due to the availability of curly red chili plants in the study area more than other fruit and vegetable plants.

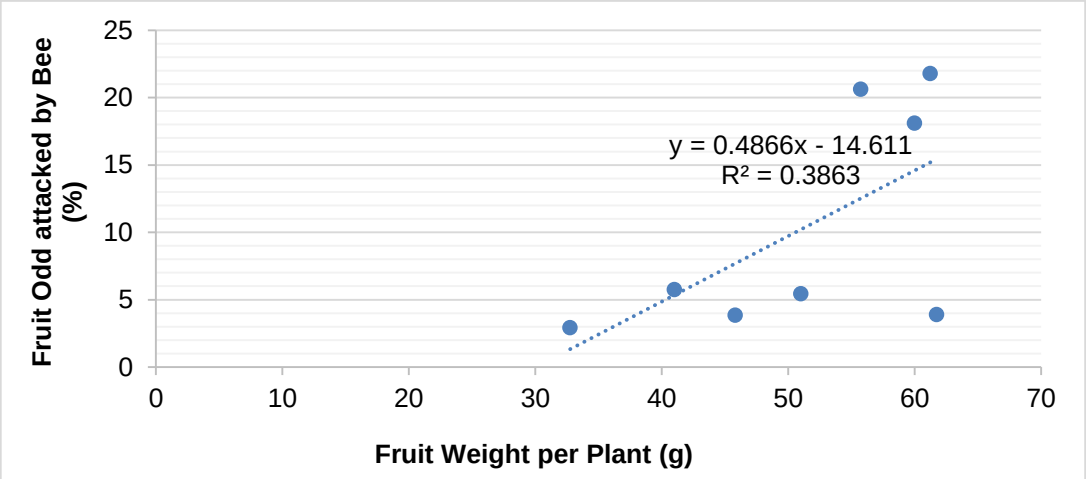


Figure 2. Regression of the relationship between fruit weight per plant and the percentage of fruit attacked by fruit flies.

A regression analysis was performed to examine the relationship between fruit weight per plant (X) and the percentage of fruits attacked by fruit flies (Y). The analysis results obtained the line equation Y = 0.4866×-14.611 with the correlation coefficient R^2 = 0.3863. The results of the attack level R show that the ability of fruit fly pests to attack chili plants is in the moderate category (Figure 2). Regression results show a decrease in fruit fly pest attacks on fruit weight with the percentage of fruit fly pest attacks.

The phenomenon of the relationship above was alleged because, in the agricultural ecosystem, some factors play a role in the occurrence of fruit fly pest attacks. So the application of various insecticides is considered less effective due to several influencing factors. The dose applied is too low, and the natural and easy way of working with vegetable pesticides decomposes natural factors such as rainfall. And also it is influenced by the time interval of application which is relatively close to the application time of other insecticides.

It is undeniable that the fruit fly pest attack has a very significant impact on fruit that cannot be utilized because it is rotten. According to Maysarah (2014), fruit fly pests are detrimental to red chili farmers because they directly attack agricultural products, namely red chilies. Symptoms of fruit fly pest attack are characterized by the presence of black spots on the fruit caused by the female insect's piston injection when she lays her eggs in the fruit. Furthermore, these eggs develop into larvae inside the chilies and eat the fruit flesh, which causes infection and causes the fruit to rot and fall.

Based on the results of observations in research, temperature dramatically influences the high and low attacks of fruit fly pests. Insects have a specific temperature range for their survival and development. Generally, the minimum effective temperature range is 15 ºC, the optimum temperature is 25 ºC, and the maximum temperature is 45 ºC. At the time of field research, the temperature in Pekanbaru in the study area ranged from 24-31 ºC to an average of 28.50-29.50 ºC.

Symptoms of attack are usually fruit fly pests, often coming on young fruit, the fruit stalk will turn yellow, and the fruit drops. If you see small black spots where the fruit fly has laid eggs at the end of the fruit then the fruit will rot and be a little wet and fall off. The attack of fruit flies on chili plants does not only occur during the dry season but will also increase during the rainy season, where the rainy season becomes the breeding season for fruit flies.

Melin et al. (2014) suggested that severe infestations occur during the rainy season caused by the ovipositor puncture site of the female fruit fly being contaminated by a fungus so that the infected fruit rots and falls to the ground.

Other Types of Attacking Pest

The results of observations of other types of pests that attack the growth of curly red chili plants include aphids (Aphids sp), trips (Thrips sp), and whitefly (Bemicia tabaci). Based on the results of observations of pests that can be quantified in this study, e.g., aphids and bauah flies. After analysis of variance for the average number of populations of aphids, the application time interval and various types of insecticides did not have a significant effect. After further testing Honest Significant Difference (BNJ), the average number of whitefly pest populations was 5%.

Table 4. Data has been transformed on the average of other types of pests that attack curly red chili plants by applying various insecticides (√×+1).

Various Pesticide (P)	Application Time Interval (W)				Mean (P)
	once every 3 days (W1)	once every 6 days (W2)	once every 9 days (W3)	once every 12 days (W4)	
Betel leaf extract (P1)	1.28	1.14	1.00	1.00	1.10
Neem leaf extract (P2)	1.14	1.00	1.00	1.00	1.03
Lime leaf extract (P3)	1.14	1.00	1.00	1.00	1.03
Isoprocarb (P4)	1.00	1.00	1.00	1.00	1.00
Mean (W)	1.14	1.03	1.00	1.00	1.04
CC = 11.46 %					

Note: Data has been transformed (√×+1)

The application of various insecticides (betel leaf extract, neem leaf, lime leaf, and insecticides with the active ingredient isoprocarb) did not significantly reduce the number of whitefly populations. It is suspected that insecticides made from natural ingredients are not very effective. According to Indiati (2012), the application of chemical insecticides has higher effectiveness in suppressing the population and intensity of leaf-sucking pests compared to the application of vegetable insecticides and no treatment.

Based on the variance results for the average number of other types of pests that attack curly red chili plants, the time intervals for applying various insecticides showed that the interaction of the two treatments had no significant effect. The average appearance of other pests that attacked was in the P1W2 treatment 0.67, which was the highest compared to the other treatments. This study's low attack of other pests was allegedly due to the application of well-integrated pest control (IPM) in the research area. And there were no horticultural crops in the same family or other vegetable plants around the research area, so good environmental factors provide added value to the plants so that they have good growth.

The observational data above show that the dominant pests are thrips and whitefly pests that attack P1W1 and P1W2 because the betel leaf extract was sprayed in the field at a dose of 100 cc/l of water. This insecticide follows the target pest. This type of insecticide is considered unable to overcome the attack of fruit fly pests, and it is suspected that it is weak to vegetable insecticides which have the power to decompose quickly and work slowly compared to vegetable insecticides.

According to Indiati (2012), the application of chemical insecticides has a higher effectiveness in suppressing leaf-sucking pest populations than vegetable insecticides. Based on Indian research, plant-based insecticides do not affect suppressing pest populations because natural-based insecticides are ineffective. After all, they are easy and quickly biodegradable. Therefore it is necessary to have integrated pest management (IPM).

Meanwhile, according to Moekasan et al. (2014), the application of integrated

pest control (IPM) is not only focused on control measures on cultivated plants that have been attacked by pests or diseases, which is called control (curative). It also takes preventive measures before attack symptoms occur, called preventive control. Preventive actions start from planting, planning, selecting varieties, planting, fertilizing, maintaining plants, and harvesting to post-harvest; curative actions are carried out if the population or intensity of pest and disease attacks has reached the threshold of control.

Age Attacked by Disease (Days)

The analysis of variance for the age parameter for disease emergence on curly red chili plants with application time intervals and various types of insecticides showed that the interaction between the two treatments had no significant effect. Meanwhile, the main effect of applying various types of insecticides had a little significant effect on the age of curl disease. The average chili plants were attacked by curly disease and fusarium fungus after further testing the Honest Significant Difference (BNJ) at the 5% level.

The data in table 5 shows that the average age for disease attack on red chili plants is 24 days after planting, and the lowest average age of symptoms of curly disease occurs at plant age 23 after planting.

Table 5. The average age of curly red chili plants is attacked by applying various insecticides (Days).

Various Pesticide (P)	Application Time Interval (W)				Mean (P)
	once every 3 days (W1)	once every 6 days (W2)	once every 9 days (W3)	once every 12 days (W4)	
Betel leaf extract (P1)	23.67	24.00	24.33	38.00	27.50
Neem leaf extract (P2)	24.33	24.00	23.67	23.67	23.92
Lime leaf extract (P3)	24.00	24.33	23.67	24.67	24.17
Isoprocarb (P4)	23.67	23.67	24.00	24.67	24.00
Mean (W)	23.92	24.00	23.92	27.75	29.90
CC = 23.84 %					

The emergence of curly disease was suspected because, during the research, the plants were not prevented to minimize the appearance of curly disease and were not given treatment. The research was the age of the plants 16-28 days after planting when they were left home due to an unfortunate event (the researcher's parent's death), so 2 weeks were not carried out optimally. The treatment is carried out when the plants are 30 days old after planting or have entered the generative phase intending to reduce fruit fly pest attacks. The plants were attacked by fusarium fungus at the age of 38 HST because they were not given acaricidal fungal bacteria, so the plants withered and dried out.

The percentage of curly red chili plants attacked by curly disease is relatively low, around 20%. Based on observational data on fruit weight per fruit yielded relatively high yields on the first fruit. The low occurrence of curly disease allows plants attacked by curly disease to grow normally and greatly affects the

number of fruit and yields.

According to Sakti (2020), the curly disease attacks curly chili plants and is influenced by leaf-sucking pests. The faster the leaf-sucking pests, the greater the potential for plants to suffer from the curly disease, and attacks by the three leaf-sucking pests show different early symptoms of curling. Aphids show wrinkled leaves, trips pests show curved leaves like silvery spoons while mite pests also show curved leaves like an upside down spoon and silvery copper color, meanwhile, according to Moekasan et al. (2014). Aphid attack causes symptoms of wrinkled, twisted, yellowish leaves and causes stunted growth. It then dies, thrips show symptoms of silvery curly leaves on the underside of the leaves.

Efforts are being made to prevent high rates of curly disease attacks, namely by carrying out natural prevention by observing physical research so that the rate of curly disease attacks does not appear. The treatment effort at the time of the study was by spraying an insecticide with the active ingredient diafentiuron, which works as a contact poison by working directly on the target pest. According to Hasibuan (2015), stomach poison disrupts the metabolic system in pests through the food eaten by pests, enters the digestive system, poisons stomach cells, and affects the respiratory system of pests that eat them.

4. CONCLUSION

1. The main effect of various types of vegetable insecticides betel leaf extract, neem leaf extract, and lime leaf extract, as a whole, did not significantly affect the control of fruit fly pests on curly red chili plant production.
2. The interaction effect of application time intervals (once 3 days), (once 6 days), (9 days), and (once 12 days) has no significant effect on the control of fruit fly pests on curly red chili plant production.
3. The main effect of the chemical insecticide P4 (isoprocarb) had no insignificant effect in controlling fruit fly pests on curly red chili plant production.

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