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The Mixture of Soursop Leaf (Annona muricata L.) and Suren Leaf (Toona sureni Merr.) Extracts for Controlling Pests (Plutella xylostella Linn.) on Broccoli

Brassica oleracea L. Plants

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Abstract

Broccoli (Brassica oleracea L.) is an important vegetables that has high economic value and is widely cultivated in Indonesia as a response to demand for this commodity which continues to increase from year to year. Plutella xylostella L. is one of the main pests of this plant. The larvae of these pests damage plants when they are 2-6 weeks old, by eating the undersides of plant leaves to such a degree that the plants cannot grow normally and the results are unfit for sale. This study aims to determine the effectiveness of a mixture of suren and soursop leaf extracts to control Plutella xylostella pests on broccoli plants. This research was carried out from January to April 2023, using a randomized block design (RBD)consisting of 6 concentrations of botanical pesticides, namely P1 = control (without soursop and suren leaf extracts); P2 = 70 g/l soursop leaf extract + suren leaf extract mixture (1:1); P3 = 80 g/l Soursop leaf extract + suren leaf extract mixture (1:1), P4 = 90 g/l Soursop leaf extract + suren leaf extract mixture (1:1), P5 = 70 g/l soursop leaf extract, P6 = 70 g/l suren leaf extract, each treatment was repeated 4 times. The results showed that the botanical pesticides of soursop leaf extract and suren leaf extract, either singly or in a mixture of the two, were able to reduce the intensity of plant damage, larval mortality, and increase the yield of broccoli plants. The application of 90 g/l mixture (1:1) of soursop leaf extract + suren leaf extract was most effective in reducing the intensity of plant damage, larval mortality, and increasing the yield of broccoli plants. At the same concentration, the mixture of soursop leaf extract +

suren leaf extract had no significant effect compared to the single application of the two insecticides.

Keywords
Broccoli, botanical pesticides, Soursop leaves, Suren leaves, Plutella xylostella L.

Broccoli (*Brassica oleracea* L.) is an important vegetables with high economic value and is widely cultivated in Indonesia. Broccoli is beneficial for health because it contains vitamins A, C, B-complex, ascorbic acid, thiamin, riboflavin, calcium, iron and other essential minerals, and contains sulphoraphane which can prevent cancer, and helps digestion, neutralizes acids and does not contain cholesterol (Fonna, 2022).

The demand for broccoli continues to increase every year, especially from modern markets, restaurants and hotels. However, this high demand was not matched by an increase in production. Based on data from the Central Statistics Agency (2023) Indonesia's National Broccoli production fluctuated, in 2018 it was 1,407,932 tons, in 2019 it increased to 1,413,060 tons, in 2020 it decreased to 1,406,985 tons, while in 2021 it increased again to 1,434,670 tons and in 2022 it will increase again to 1,503,798 tons, with yield average ranging from 15.88 to 22.33 tons/ha. Efforts to increase broccoli production and yield need to be continued to respond to the increasing demand (Sitawati, 2021).

One of the causes that inhibits the increase in broccoli yields is the presence of pests and diseases. *Plutella xylostella* L. is one of the important pests that damage broccoli plants. Ginting (2017) also stated that the cabbage leaf-eating caterpillar that often eats cabbage plants is *Plutella xylostella* L. (Lepidoptera: Plutellidae). If no precautions are taken, these pests can cause more damage to the cabbage, and result in more yield losses, both in quantity and quality. Sometimes these pests cause such damage that the plants are unable to produce a crop. Yield losses due to pest attacks can reach 10-90% (Winarno, 2019). Soursop and suren plants can be used as botanical insecticides to control *Plutella xylostella* L. Mawardiana (2022) reported that a concentration of soursop leaf extract of 0.63-5% can reduce the feeding rate of instar V larvae of *Spodoptera litura*. Soursop (*Annona muricata* L.) is a plant that contains acetogenin which can be used as a botanical pesticide. Based on the analysis results of Gajalakshmi et al. (2012) and Gavamukulya et al., (2014), soursop leaves are known to contain alkaloids, flavonoids, terpanoids, lactones, anthraquinones, tannins, phenol glucosides, phytosterols, and saponins. This compound acts as an anti-feedant which works as a stomach poison in insects (Septerina, 2002).

The suren plant (*Toona sureni* Merr.) also has the potential to be used as a botanical pesticide, because it contains flavonoids, polyphenols, alkaloids, tannins, steroids, terpenoids, and limonoids (Sadiah, 2021). According to Salome (1999) suren contains active ingredients such as surenon, surenin, surenolactone, sedrelon, and several carotenoids which are thought to be trans-beta carotene, zeasantin, and lactuxanthin, which act as growth inhibitors, insecticides, and anti-feedants (inhibits the ability to eat).

From the research results of Mawardiana, et al. (2022) it is known that application of soursop leaf extract with a concentration of 15% was able to reduce the intensity of *Plutella xylostella* L. pest attacks by up to 72.22% on lettuce plants. Meanwhile, according to Widyastuti, et al. (2020) the best use of suren leaf botanical insecticide was 2.5%, which had a weak effect on purple leaf caterpillars, while the LC_{50} (Lethal Concentration 50) value was 4.539 mg/l with an LT_{50} (Lethal Time 50) of 5.6 days.

A pesticide formulation will be more effective against insect pests if it is combined with two or more plant extracts that are synergistic compared to extracts of only one type of plant (Taufik et al., 2021). It is recommended to use botanical

pesticides in the form of a mixture of several types of plants so that they are more effective and the doses can be lower (Liansyah, et al., 2018).

Soursop and suren leaf extracts, each of which can be used as a botanical pesticide, as has been reported by previous researchers, whether they can provide a synergistic effect if the two are combined to control *Plutella xylostella* L. pests on broccoli plants. For this reason, it is necessary to conduct research to determine the effectiveness of a mixture of soursop and suren leaf extracts to suppress damage by *Plutella xylostella* L. on broccoli compared to using both in alone.

Research Method

This study was conducted on community-owned agricultural land located in Pagerwangi Village, Lembang District, West Bandung Regency, West Java Province, at an altitude of about 1,230 meters above sea level, with an average daily temperature of 19-20 °C, relative humidity 39-90%, and Andisol soil type. The study was conducted from January until April 2023. The materials used included broccoli seeds, water, soursop leaves and suren leaves. The tools used consisted of digital scales, blender, measuring cup, filter paper, stirrer, scissors, hand sprayer, knife, ruler, and camera.

This experiment used a randomized block design (RBD) consisting of 6 treatments and 4 replications so that 24 experimental units (plots) were required. In each plot, 16 plants were planted with a spacing of 50x40 cm. The treatments were as follows: P1 = control (without soursop and suren leaf extracts); P2 = 70 g/l soursop leaf extract + suren leaf extract mixture (1:1); P3 = 80 g/l soursop leaf extract + suren leaf extract mixture (1:1), P4 = 90 g/l soursop leaf extract + suren leaf extract mixture (1:1), P5 = 70 g/l soursop leaf extract, P6 = 70 g/l suren leaf extract.

The application of the botanical pesticides was carried out at intervals of 3 days starting from 3 days after transplanting. Variables observed included the intensity of plant damage due to *Plutella xylostella* L. pest, the percentage of larvae mortality, plant height, number of leaves, and yield of broccoli. Observations of plant damage intensity and percentage of larval mortality were carried out at 4, 6, 8, and 10 weeks after trnsplanting (WAT), whereas plant height and number of leaves were carried out at 2, 4, 6, and 8 weeks after trnsplanting (WAT), and observations of broccoli yields was carried out at harvest time.

Observational data were analyzed using one-way analysis of variance (ANOVA), followed by Duncan's multiple range test at the 5% level (Gaspersz, 2005).

Results and Discussion

Plant Damage Intensity due to Plutella xylostella L.

Observation of the intensity of the plant damage caused by *Plutella xylostella* L. was carried out after the symptoms of pest attack on the plants appeared, starting from 4, 6, 8, and 10 weeks after transplanting (WAT). The average intensity of plant damage due to Plutella xylostella L. at 4 to 10 WAP is presented in Table 1.

The intensity of plants damage due to pest attacks was observed at 4, 6, 8 and 10 WAT in all soursop and suren leaf extract treatments (P2, P3, P4, P5, and P6) significantly lower than on the control (P1). But between treatments that applied soursop leaf extract and suren leaf extract, either the mixture of the both or in alone, did not differ significantly, except at 6 WAT, where the intensity of plant damage was in the treatment of 90 g/l mixture of soursop leaf extract + suren leaf (P4) significantly lower (30.67%) compared to the mixed treatment of soursop leaf extract + suren leaf at lower concentrations (P2 and P3) or compared to the 70g/l treatment of soursop leaf extract alone (P5) or suren leaf extract alone (P6).

Table 1. Average Intensity of Plant Damage due to Plutella xylostella L.

Treatments	Average Intensity of Plant Damage (%)

	4 WAT	6 WAT	8 WAT	10 WAT
P1	4.05a	4.88a	5.25a	5.71a
P2	2.40b	3.18b	4.28b	3.46b
P3	2.29b	2.76b	4.27b	3.26b
P4	2.27b	2.85b	3.64c	3.32b
P5	2.50b	2.81b	4.55b	3.56b
P6	2.92b	3.02b	4.34b	3.64b

The results of this study indicate that both soursop leaf extract and suren leaf extract were each able to reduce the intensity of damage by the larvae pest of *Plutella xylostella* L., and this is in accordance with what has been reported by Mawardiana (2022). However, the intensity of plant damage in the 70 g/l treatment of a mixture of soursop leaf extract + suren leaf extract (P2) was not significantly different from the 70 g/l treatment of soursop leaf extract alone (P5) or the suren leaf extract treatment alone (P6), which means that at the same concentration it is not proven that mixing soursop leaf extract and suren leaf extract is more effective in suppressing the intensity of plants damage due to *Plutella xylostella* L. Which also means that the interaction between the active ingredients contained in soursop leaves and suren leaves is not mutually synergistic in suppressing pest attack *Plutella xylostella* L. on broccoli plants

Explaination

- The mean scores in the same column followed by the same letter are not significantly different according to Duncan's multiple range test at the 5% level.
- WAT = Weeks after transplanting.
- Treatment P1 = 0% control (without soursop and suren leaf extracts); P2 = 70 g/l Mixture of soursop leaf extract + suren leaf (1:1); P3 = 80 g/l Soursop leaf extract + suren leaf mixture (1:1), P4 = 90 g/l Soursop leaf extract + suren leaf mixture (1:1), P5 = 70 g/l soursop leaf extract, P6 = 70 g/l suren leaf extract.

Several previous studies have reported that suren leaf solution was able to limit the ability of caterpillars to eat rather than kill them directly. This can be seen from the results of the phytochemical profile test for the content of alkaloids, flavonoids, steroids/triterpenoids, and saponins. According to Harmileni (2022) this substance is toxic to various types of insects, including the larvae of *Plutella xylostella* L.

Mawardiana (2022) has also reported that soursop seeds and leaves function as contact and stomach poisons as well as insecticides, larvicides, repellent and antifeedants. The phytochemical compounds contained in soursop leaves are absorbed by the intestinal walls of insects after entering the digestive tract through food, which allows the active ingredients of the extract, tannins and acetogenins, to start functioning as soon as they reach the intestine. The tannins prevent some digestive enzymes from working properly, while the chemical acetogenin damages the cells of the digestive tract, which causes the insect to eventually die. Acetogenin has the distinction of being an antifeedant at high doses. In this case, the insect stops eating the desired part of the plant. Meanwhile, it is a gastrointestinal poison that often causes insect pests to die in low numbers. Because the chemical composition of soursop and suren leaf extracts is almost the same, the use of the two extracts together has a synergistic effect that can inhibit insect attacks effectively (Luqman and Yuliani, 2023).

Mortality of Plutella xylostella L. Larvae

The results of the observation in percentage mortality of Plutella xylostella L. larvae at 4, 6, 8 and 10 WAT is presented in Table 2.

The observation results at 4, 6, 8, and 10 WAT showed that the percentage of *Plutella xylostella* L. larvae mortality in all applications of soursop leaf extract (P2, P3, P4, P5, and P6) were significantly

higher than the control (P1), either application alone or a mix of both. This shows that the active ingredient content in soursop leaf extract and suren leaf extract effectively functions as a poison for the larvae of *Plutella xylostella* L.

Table 2. Percentage of Larvae Mortality of Plutella xylostella L.

Treatments	Average Larvae Mortality of *Plutella xylostella* L. (%)			
	4 WAT	6 WAT	8 WAT	10 WAT
P1	0.00b	0.00c	0.00c	0.00c
P2	21.00a	43.00b	60.75b	74.75b
P3	22.50a	49.50b	67.25ab	83.75a
P4	26.25a	55.75a	73.25a	86.00a
P5	19.25a	43.50b	63.75b	73.50b
P6	24.00a	44.25b	59.75b	73.25b

Explanation

- The mean scores in the same column followed by the same letter are not significantly different according to Duncan's multiple range test at the 5% level.
- WAT = Weeks after transplanting.
- Treatment P1 = 0% control (without soursop and suren leaf extracts); P2 = 70 g/l Mixture of soursop leaf extract + suren leaf (1:1); P3 = 80 g/l Soursop leaf extract + suren leaf mixture (1:1), P4 = 90 g/l Soursop leaf extract + suren leaf mixture (1:1), P5 = 70 g/l soursop leaf extract, P6 = 70 g/l suren leaf extract.The result observations at 4 WAT showed no significant difference in the percentage of mortality of *Plutella xylostella* L. larvae between the treatments of soursop leaf extract and suren leaf extract, but the results observations at 6, 8 and 10 WAP showed mortality of pest larvae in the 90 g/l soursop leaf extract + suren leaf extract mixture (P4) was significantly higher than the treatment with 70 g/l soursop leaf extract alone (P5) or 70 g/l suren leaf extract alone (P6). Even at 10 WAT observation, larval mortality in the 80 g/l treatment of a mixture of soursop leaf extract + suren leaf extract (P3) was significantly higher compared to the 70 g/l treatment of soursop leaf extract alone (P5) or 70 g/l leaf extract. suren only (P6). This fact indicates that a mixture of soursop leaf extract and suren leaf extract at a slightly higher concentration is more effective in poisoning Plutella xylostella L. larvae than using them individually. Observations at 6 WAT also indicated that the use of a mixture of soursop leaf extract and suren leaf extract increased its effectiveness with higher application concentrations from 70 to 90 g/l (P2-P3-P4) in poisoning *Plutella xylostella* L. larvae.

The percentage of pest larvae mortality in Table 2 shows that pest mortality with soursop and suren leaf extract treatment increased from 4 WAT to 6 WAT to 8 WAT to 10 WAT. Alkaloid substances are antifeedants, because they can damage the nervous and digestive systems, slow down development, and prevent pupae from developing into imago (Mawardiana 2022). The waxy coating on the cuticle layer on soursop leaves contains saponin compounds which can damage the cuticle of the caterpillar, causing it to lose a lot of water and eventually die. The presence of the active ingredient in these components resulted in a high mortality rate of Plutella xylostella L. larvae after application of a soursop leaf-based vegetable insecticide. Purnamasari (2021) also stated that soursop leaves contain active compounds in the form of annonain, flavonoids, glycosides, saponins and tannins which can act as contact poisons. This type of poison can damage the digestive system of the larvae, causing the function of the digestive system to be disrupted. Disturbance in the digestive system causes the larvae to die due to lack of nutrition.

Based on other studies, suren leaf extract has shown an effect on mortality of *Plutella xylostella* L. pests with a concentration of 10% can increase mortality by 85% (Harmileni, 2022). Mortality of *Plutella xylostella* L. also increased according to the higher concentration used. According to Hidayati (2022), the greater the treatment dose, the more chemical metabolites contained in the extract, increasing its toxicity and thus the death of the larvae (Harmileni, 2022).

Broccoli Plant Height

Observation of broccoli plant height was carried out to determine the impact of the intensity of damage caused by *Plutella xylostella* L. on plant height growth. Observations were made starting from 2 WAT. The average height of broccoli plants at 2, 4, 6, and 8 WAP is presented in Table 3.

Table 3. Effect of Soursop and Suren Leaf Extract on Broccoli Plant Height

Treatments	Average of Plant Height (cm)			
	2 WAT	4 WAT	6 WAT	8 WAT
P1	9.33a	20.20a	34.05a	45.55a
P2	9.43a	18.33a	29.25a	42.43a
P3	8.95ab	16.95a	32.00a	45.10a
P4	8.30b	16.20a	30.73a	44.98a
P5	8.75ab	16.48a	30.58a	40.08a
P6	8.73ab	16.80a	29.63a	40.73a

Explanation

- The mean scores in the same column followed by the same letter are not significantly different according to Duncan's multiple range test at the 5% level.
- WAT = Weeks after transplanting.
- Treatment P1 = 0% control (without soursop and suren leaf extracts); P2 = 70 g/l Mixture of soursop leaf extract + suren leaf (1:1); P3 = 80 g/l Soursop leaf extract + suren leaf mixture (1:1), P4 = 90 g/l Soursop leaf extract + suren leaf mixture (1:1), P5 = 70 g/l soursop leaf extract, P6 = 70 g/l suren leaf extract.
- Observations at 2 WAT when the plants were still in their early growth phase indicated that the application of 90 g/l mixture of soursop leaf extract + suren leaf extract (P4) had a negative effect on plant height growth, where plant height in the P4 treatment was significantly lower compared to the control (P1). This may be a direct effect of the high concentration spray on young plants, not through its effect on pest infestation. Observations at 4 WAP, 6 MST and 8 WAT showed that plant height between all treatments did not differ significantly.

The absence of a significant difference in plant height indicated that there was no positive correlation between the intensity of plant damage due to *Plutella xylostella* L. and the broccoli plant height. This may be as a result of the broccoli plant being able to recover from the damage caused by the pest attack. The good plant growth performance meight because the plants receive an adequate and balanced supply of nutrients, so that the plant's metabolic processes can run well and the plants are able to carry out the process of forming new organs, especially the formation of new leaves and shoot growth, as a compensation for organs damaged by pest attack. According to Winarno (2019), the right amount of nitrogen will support plant metabolism, encourage tissue growth including stems, leaves and roots. The nutrients needed by plants to grow vegetatively are taken up by the roots which cause the plant stems to elongate and have an impact on the number of leaves.

Leaves Number of Broccoli Plant

Observation of the number of broccoli leaves was carried out to determine the intensity of the

damage caused by *Plutella xylostella* L. It can affect the growth and increase in the number of leaves. The average number of broccoli leaves at 2 MST to 8 MST observations is presented in Table 4.

Table 4. Effect of Soursop and Suren Leaf Extract Application on Number of Leaves

Treatments	Average Number of Broccoli Leaves (strands)							
	Total Leaves Number				Number of Healthy Leaves			
	2 WAT	4 WAT	6 WAT	8 WAT	2 WAT	4 WAT	6 WAT	8 WAT
P1	4.13a	5.30a	9.13a	13.65a	5.33a	8.18a	11.55a	11.93a
P2	4.13a	5.45a	9.08a	12.35ab	5.40a	8.10a	11.25ab	12.20a
P3	3.88a	5.03a	9.78a	11.65b	5.25a	8.50a	10.55bc	12.38a
P4	3.90a	5.58a	9.98a	12.68ab	5.43a	8.13a	11.13ab	11.93a
P5	3.85a	4.73a	9.65a	10.75b	4.85a	8.30a	9.78c	10.70a
P6	3.85a	4.93a	7.95a	11.68b	4.73a	7.03b	10.43bc	11.50a

Explanation

- The mean scores in the same column followed by the same letter are not significantly different according to Duncan's multiple range test at the 5% level.
- WAT = Weeks after transplanting.
- Treatment P1 = 0% control (without soursop and suren leaf extracts); P2 = 70 g/l Mixture of soursop leaf extract + suren leaf (1:1); P3 = 80 g/l Soursop leaf extract + suren leaf mixture (1:1), P4 = 90 g/l Soursop leaf extract + suren leaf mixture (1:1), P5 = 70 g/l soursop leaf extract, P6 = 70 g/l suren leaf extract.
- The results of observing the average total number of leaves at 2 WAP, 4 MST and 6 MST showed that all treatments were not significantly different. While the average total number of leaves at 8 WAT in the treatment of 80 g/l mixture of soursop leaf extract + suren leaf extract (P3), 70 g/l soursop leaf extract (P5), and 70 g/l suren leaf extract (P6) significantly lower than the control (P1), while the other treatments were not significantly different compared to the control.

The results of observing the average number of healthy leaves in general showed that the soursop and suren leaf extract treatments had no significant effect, except at 6 WAP. The average number of healthy leaves at 6 WAP in the treatment of 80 g/l mixture of soursop leaf extract + suren leaf extract (P3), 70 g/l soursop leaf extract (P5), and 70 g/l suren leaf extract (P6) was significant lower than the control (P1), while the other treatments were not significantly different compared to the control.

The number of healthy leaves, which in general did not differ significantly between different treatments, is evidence that strengthens that plants are able to recover from the damage caused by caterpillar pest attacks. The good performance of plant growth, as stated above, is a consequence of fulfilling plant nutrition properly, so that plants are able to carry out plant metabolic processes well and in turn are able to quickly form new leaves as a compensation for damaged leaves. Optimum availability of nutrient elements has a positive impact on plant growth (Tandirerung, 2020). Nitrogen nutrients function in encouraging plant vegetative growth. The process of photosynthesis carried out by leaves can run well in plants that have met their nitrogen needs (Yani, 2020).

Broccoli plants require optimum nutrition at the beginning of their vegetative growth, and for that the availability of macro and micro nutrients in the soil must be in sufficient and balanced quantity. Optimum availability of nitrogen elements is very important, especially with regard to the formation of chlorophyll in the leaves, which functions in carrying out the photosynthesis process, which in

turn will encourage plant growth (Soepriyanto, 2021). Nitrogen is also needed to synthesize various kinds of protein and enzymes needed for the formation of new cells and in catalyzing various biochemical reaction processes in the plant body (Tando, 2018).

Yield Weight of Broccoli

The application of soursop leaf extract and suren leaf extract was able to significantly increase the yield of broccoli plants compared to the control (P1), except for the 70 g/l soursop leaf extract treatment only (P5) (Table 10). The highest yield of broccoli plants was achieved in the application of 90 g/l mixture of soursop leaf extract + suren leaf extract (P4), but not significantly different from the application of 70 and 80 g/l mixture of soursop leaf extract + suren leaf extract (P2 and P3), and application of 70 g/l suren leaf extract (P6). There seems to be a tendency that the higher the concentration of the application of the mixture of soursop leaf extract and suren leaf extract the higher the increase in broccoli yields, or the more effective it is in suppressing yield loss. Likewise, the application of a mixture of soursop leaf extract and suren leaf extract tends to be more effective in suppressing broccoli crop yield losses than the application of soursop leaf extract alone.

Broccoli plant yields at 90, 80, and 70 g/l treatment of mixed soursop leaf extract + suren leaf extract were 25.4, 23.3 and 16.4% higher than the control, respectively. While the yield of broccoli plants at 70 g/l of suren leaf extract was 14.2% higher than the control.

There is something interesting to note here, namely that even though the Plutella xylostella L. pest control measures using soursop and suren leaf extracts did not significantly affect the growth of plant height and number of leaves, because the plants were able to recover by forming new leaves to compensate for damaged leaves. , it turns out that the damage that had occurred still had a negative effect on crop yields. The crop yield is closely related to the total photosynthate that can be allocated for the process of forming the broccoli crop. The low yield of plants in the control treatment, which experienced the highest intensity of damage due to this pest, indicates that during the period the plants were in a damaged condition and during the recovery process the net photofintat product produced by the plants decreased, so that what was allocated and accumulated in the crop crop was cumulatively reduced and the yield weight becomes lower. While in the treatment with control measures using soursop and suren leaf extracts, where the intensity of the damage that occurred was relatively mild, the decrease in net photosynthetic product was also relatively less compared to the control, so that the effect on decreasing crop yields was also relatively lower.

Table 10. Effect of Soursop and Suren Leaf Extract Treatment on Broccoli Yield Weight

Treatments	Yield Weight of Broccoli (kg/plot)
P1	9.59b
P2	11.16a
P3	11.82a
P4	12.03a
P5	10.77ab
P6	10.95a

Explanation

- The mean scores in the same column followed by the same letter are not significantly different according to Duncan's multiple range test at the 5% level.
- WAT = Weeks after transplanting.
- Treatment P1 = 0% control (without soursop and suren leaf extracts); P2 = 70 g/l Mixture of soursop leaf extract + suren leaf (1:1); P3 = 80 g/l Soursop leaf extract + suren leaf mixture (1:1), P4 = 90 g/l Soursop leaf extract + suren leaf mixture (1:1), P5 = 70 g/l soursop leaf extract, P6 = 70 g/l suren leaf extract

The significant effect of the application of botanical pesticides from soursop and suren leaf extracts on broccoli yields is in line with what has

been reported from the results of Mawardiana's research (2022), which states that pest attacks have an adverse impact on crop yields. The findings of Pasaribu and Siburian (2019) also emphasize that crop yields per plot provide a linear response to the concentration of botanical pesticide applications, or crop yields increase with higher concentrations of botanical pesticide applications.

Conclution

From the results of this study it can be concluded as follows:

1. The application of vegetable pesticides from soursop leaf extract and suren leaf extract, either singly or in a mixture of the two, can reduce the intensity of plant damage, mortality of Plutella xylostella L. larvae and increase broccoli crop yields.
2. Application of 90 g/l mixture of soursop leaf extract + suren leaf extract (1:1) can reduce the intensity of damage due to attacks by up to 30.67%, increase the mortality of Plutella xylostella L. larvae by up to 86.0%, and increase crop yields broccoli up to 25.4% compared to control.
3. At the same concentration level, a mixture of soursop leaf extract and suren leaf extract was not proven to be more effective in suppressing the intensity of plant damage, increasing the mortality of Plutella xylostella L. larvae and the yield of broccoli plants.

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