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Original Article

The Efficiency of Insecticides against Insects in the Bukit Kor Cultivation Area, Terengganu, Malaysia

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Abstract: The Bukit Kor cultivation area in Terengganu, Malaysia, reflects natural diversity that is vital for agriculture and crop maintenance. The role of insects in agricultural ecosystems as pollinators, pest predators, and maintainers of natural balance is crucial. However, insects can also be a serious threat, prompting farmers to use insecticides as a primary solution. Although effective in controlling pests, insecticide use must be balanced with ecological precautions. Side effects of insecticides on non-target insects, including pollinators and natural predators, can threaten agricultural sustainability. Therefore, a sustainable, integrated pest management approach is critical, considering insecticide selection, dosage, and frequency of use. Educating farmers about sustainable practices such as crop rotation, organic fertilizers, and green technologies can reduce insecticide dependence. The importance of collaboration between government, researchers, and farmers cannot be ignored. Research into local insect ecology, development of pest-resistant crop varieties, and training in sustainable farming practices can form the basis of sustainability at Bukit Kor. With this approach, this region will develop and become an example of sustainability for other areas. Experimental research was carried out at the Bukit Kor cultivation site to evaluate the efficiency of two types of insecticides against certain insect groups. Data analysis revealed variations in response between insecticides, temporal dynamics of insecticide effects, and association of responses with specific insect species. These conclusions have practical implications for agricultural pest management, emphasizing the need for sustainable policies in selecting and using insecticides.

Keywords: Insecticides, Integrated pest management, Agricultural sustainability, Insects, Bukit Kor

1. Introduction

The Bukit Kor cultivation area in Terengganu, Malaysia, indicates rich natural diversity and is the basis for agricultural efforts and plant maintenance (Ambarningrum et al., 2012). As an integral component of farming ecosystems, insects play a key role in pollination, pest predation, and maintaining natural balance

(Muhamat et al., 2012). However, insects can often seriously threaten agriculture, causing significant losses to crop and agricultural production (Abizar & Prijono, 2010). To overcome this challenge, farmers in this region often use insecticides as the main solution (Muhamat et al., 2012). Using insecticides can help control insect populations that are detrimental to plants. However, the side effects of these chemicals on the ecosystem are serious. Insecticides are selective against certain pests and can harm beneficial insects, such as pollinators and natural predators (Gentz et al., 2010; Ndakidemi et al., 2016). These negative effects on non-target insects can threaten the long-term sustainability of agriculture (Ambarningrum et al., 2012). A decrease in positive insect populations in agricultural ecosystems can damage the natural balance, causing a spike in pest populations and harming agricultural production (Balfas, 2009). Therefore, it is important to adopt a sustainable, integrated pest management approach, which includes the wise use of insecticides and pays attention to the ecological factors involved (Dono et al., 2010).

Cultivation on Kor Hill requires technical skills in applying insecticides and serious consideration of environmental and social impacts (Balfas, 2009). In-depth evaluation of the types of insecticides used, doses applied, and frequency of use should be an integral part of the pest control strategy (Saraswati et al., 2004). In addition, educational efforts and involving farmers in sustainable agricultural practices, such as crop rotation, use of organic fertilizer, and application of green technology, can help reduce dependence on insecticides and increase the sustainability of cultivation in Bukit Kor (Hadi, 2008). The importance of collaboration between government, researchers, and farmers should not be ignored (Risnawati, 2022). Active involvement in research on local insect ecology, development of pest-resistant crop varieties, and training on sustainable agricultural practices can form the basis for achieving greater sustainability in cultivation (Siahaya, 2021) in the Bukit Kor Region, Terengganu, Malaysia. With this approach, Bukit Kor's agriculture will develop and become an example of sustainability for other regions.

2. Materials and Methods

This study was conducted at the UMT Bukit Kor Agricultural Complex, Marang Terengganu, Malaysia. The time the study was carried out was from 14 to 21 September 2023. The tools used in this research were a hammer, wooden stakes, neat rope, machete, measuring cup, sprayer, scales, treatment labels, ruler, and writing utensils. Meanwhile, the ingredients used are insects on sweet potato plants, an insecticide with the active ingredient sulfoxaflor, an insecticide with a mixture of ibuprofen and cartap hydrochloride, and water. The research was carried out using a randomized block experimental design (CRD) consisting of 3 treatments and 3 replications: T0 = Control, T1 = Sulfoxaflor 1.5 gr/2 litres of water, and T2 = Buprozen + Cartap Hydrochloride 2 gr/2 litres of water. Observation of the mortality percentage was carried out until the seventh day.

2.1. Insect Groups and Frequency of Observations

1. Orthoptera - Acrididae:
   - Melanoplus differentialis: Frequency data (number of individuals) observed at the 0th, 3rd and 7th DAA.
   - Valanga nigricornis: Frequency data observed at the 0th, 3rd, and 7th DAA.

2. Blattidae: Ectobius pallidus: Frequency data observed at the 0th, 3rd, and 7th DAA.

3. Gryllidae: Metioche vittalicolli: Frequency data observed at the 0th, 3rd, and 7th DAA.

4. Hemiptera - Coreidae:
   - Leptocorisa oratorius: Frequency data observed at the 0th, 3rd and 7th DAA.
   - Sogatella furcifera: Frequency data observed at the 0th, 3rd and 7th DAA.
   - Alezara viridulca: Frequency data observed at the 0th, 3rd, and 7th DAA.

5. Diptera - Luciliinae:
   - Condylostylus sipho: Frequency data observed at the 0th, 3rd and 7th DAA.

6. Coleoptera - Chrysomelidae:
   - Chrysolina coerulans: Frequency data observed at the 0th, 3rd, and 7th DAA.
   - Dolicha derus thoracicus: Frequency data observed at the 0th, 3rd and 7th DAA.

2.2. Data analysis

Insect frequency data in each observation period will be analyzed to evaluate the efficiency of insecticides against each insect group (Diana, 2012). This research complies with research ethics and environmental protection guidelines. All actions taken in this research consider the welfare of insects and the natural environment. This research is expected to provide in-depth insight into the efficiency of insecticides against insects in the Bukit Kor area, Terengganu, Malaysia. It can provide a basis for developing more sustainable and environmentally friendly agricultural practices (Sutrisno, 2013).

3. Results

Table 1. Insecticide Effects on Insect Groups

Classification		Spinetoram Day After Application (DAA)				
Orthoptera	Melanopos Differeantialis	1	1	1	0	0,33
	Valanga Nigricornis	0	0	0	0	0
Blattidae	Ectobius Pallidus	0	0	0	0	1,33
Gryllidae	Metioche Vittalicolli	0	0,66	0	0,66	0,66
Himiptera	Leptocorisa Oratorius	1	0	0	0	0
	Sogatella Gfurcifera	0	0	0	0	0
	Alezara Viridulca	0,33	0	0	0,33	0
Diptera	Condylostylus Sipho	0	0	0	0	0,33
Coleptera	Chrysomelidae	0	0	0	0	0,33
	Dolicha Derus Thoracicus	1,33	0	0	1	0

Table 1. Insecticide Effects on Insect Groups (Cont'd)

Classification		Control		Chlorantraniliprole Day After Application (DAA)	
Orthoptera	Melanopos Differeantialis	1	0	0	0,66
	Valanga Nigricornis	0,33	0	0	0
Blattidae	Ectobius Pallidus	0,66	0	0	0,33
Gryllidae	Metioche Vittalicolli	0,66	0,33	0,33	0
Himiptera	Leptocorisa Oratorius	0	0,33	0	0
	Sogatella Gfurcifera	0	0	0	0
	Alezara Viridulca	0,66	0	0	0
Diptera	Condylostylus Sipho	0	0	1	0,33
Coleptera	Chrysomelidae	0	0	0	0,66
	Dolicha Derus Thoracicus	0	0	0	2,33

Table 1 captures insecticide effects on insect groups.
Orthoptera - Acrididae:

- Melanoplus differentials: In the control, there was an increase in the number of insects in the 3rd DAA. However, in the 7th DAA, the number decreased. In the Spinetoram treatment, there was a decrease in the 3rd DAA, but it increased again in the 7th DAA. Meanwhile, for Chlorantraniliprole, there was a decrease in the 3rd DAA and again in the 7th DAA. This variability reflects the insect's response to the two different insecticides.
- Valanga nigricornis: Controls generally showed a decreasing trend in insect numbers. Spinetoram and Chlorantraniliprole tended to produce better control rates, with low or zero insect numbers at the 3rd DAA and 7th DAA.

Blattidae:

- Ectobius pallidus: Controls showed a decrease in the 3rd DAA and an increase in the 7th DAA. Spinetoram showed a positive effect on the 3rd DAA. However, Chlorantraniliprole showed a more consistent effect with a decrease in the 3rd DAA and 7th DAA.

Gryllidae:

- Metioche vittalicolli: In controls, there was an increase in the 3rd DAA and a decrease in the 7th DAA. Both insecticides showed good control effects, with a decrease in the number of insects in the 3rd DAA and 7th DAA.

Hemiptera - Coreidae:

- Leptocorisa oratorius: Controls showed an increase in the number of insects on the 3rd DAA and 7th DAA. Both Spinetoram and Chlorantraniliprole showed a control effect with a significant decrease in both observation periods.
- Sogatella furcifera: Spinetoram and Chlorantraniliprole showed control effects on the 3rd DAA and 7th DAA, with lower insect numbers compared to the control.
- Alezara viridulca: Control showed an increase in the number of insects on the 3rd DAA and 7th DAA. Both insecticides showed good control effects, with significant reductions in both observation periods.

Diptera - Luciliinae:

- Condylostylus sipho: Controls showed an increase in the number of insects on the 3rd DAA and 7th DAA. Spinetoram controlled the 3rd DAA; however, Chlorantraniliprole showed a more significant reduction in the 7th DAA.

Coleoptera - Chrysomelidae:

- Chrysolina coerulans: Control showed an increase in the number of insects on the 3rd DAA and 7th DAA. Both insecticides showed a control effect with significant reductions in both observation periods.
- Dolicha derus thoracicus: Controls showed significant increases in the 3rd DAA and 7th DAA. Spinetoram showed a controlling effect on the 3rd DAA, while Chlorantraniliprole showed better control on the 7th DAA.

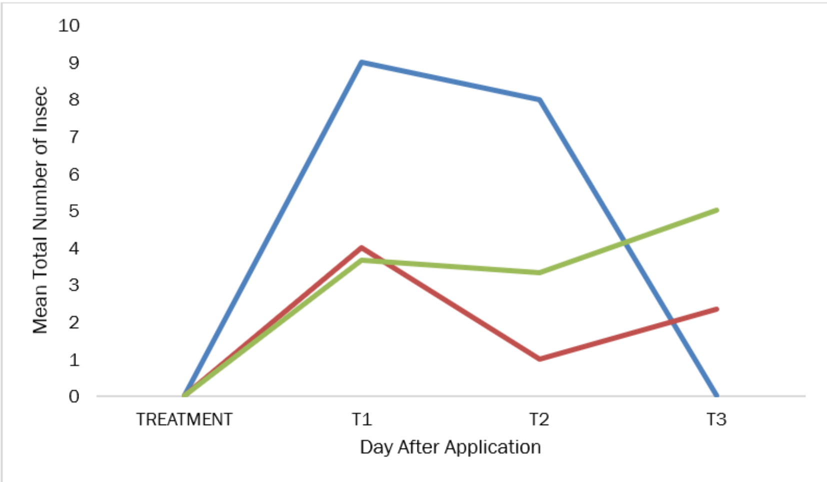

Figure 1. Treatment Effects on Parameters Measured at Various Times (DAA)

Figure 1 displays treatment data with three variations (T1, T2, and T3) on the 0th, 3rd, and 7th Day after Application (DAA); significant changes can be seen in the measured parameters. T1 showed a positive impact at the start of the experiment, with the highest value of 9 at the 0th DAA. However, there was a significant decrease in the 3rd DAA, lowering the value to 4, and a further decrease in the 7th DAA to 3.66. This indicates that the positive effects of T1 may be temporary and diminish over time. This is related to the concentration used. The higher the concentration, the more toxic the effects will also increase. In other words, the higher the concentration used, the higher the pest death rate (Tennekes & Sánchez-Bayo, 2013). T2, initially, shows a fairly good positive impact with a value of 8 on the 0th DAA. However, there was a drastic decrease in the 3rd DAA, shrinking to 1, indicating that the positive effect of T2 could not be maintained in the short term. Despite an increase in the 7th DAA to 3.33, the value was still below the baseline value, indicating that T2 may not have had a significant positive impact on the measured parameters. Syahputra and Endarto (2012) state that various factors can influence a person's successful insecticide in causing death target insects, including types of insecticide, concentration and method of application insecticides, types of insects, phases development and lifespan of insects, as well environmental factors.

T3, on the other hand, shows the most significant positive impact on the 0th DAA, with the highest value being 10.33. Despite a decrease in the 3rd DAA (2.33), T3 recovered significantly in the 7th DAA, with the value again increasing to 5. This indicates that T3 may have a more long-lasting positive impact and recover after a decrease in the period. This matter in accordance with Mossa et al. (2018) which states that it is getting higher insecticide concentration applied the higher the content active so that it can improve metabolic disorders in test animals and causes the death rate to increase.

Table 2. Day After Application (DAA)

	Day After Application DAA											
	1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.33	0.33	0.00	0.33	0.33
1	0.33	0.28	0.00	28.00	1.60	1.60	0.00	47.00	0.47	0.00	0.00	0.00
1	0.38	0.28	66.00	66.00	1.33	1.33	1.33	1.33	0.33	0.00	0.33	0.00
2	0.00	0.33	0.00	0.00	0.33	0.00	0.00	0.33	0.33	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	33.00	0.33	0.33	0.00	0.00	0.33	0.00
3	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.33	0.00	0.00
3	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.57	0.00	0.57	0.00	0.00
3	0.57	0.33	0.33	0.33	0.00	0.00	0.33	0.00	0.66	0.66	0.00	0.00
Total	3.28	1.88	1.30	2.42	2.92	2.92	2.32	3.46	2.45	2.65	1.32	0.99

Table 2 shows the 1st DAA, group 1 has a total frequency of 3.28, the dominant of which comes from values in several sub columns such as 1.0, 0.33, and 0.38. Groups 2 and 3 have totals of 0.33 and 1.24 respectively, with the main contribution coming from the value of 0.33 in certain sub columns. It can be seen from the table above that group 1 has a total frequency of 3.28, showing quite good results from administering insecticides so that the numbers respectively have 0.33 and 1.24 with the main contribution coming from a value of 0.33. Then, in the 2nd DAA, there was a total increase for all three groups. Group 1 experienced a significant increase to 1.88, dominated by values of 0.33 and 0.61. Group 2 has a total of 0.61, with main contributions from the values 0.61 and 0.33. Group 3 also showed a total increase to 0.66, coming from values of 0.33 and 0.33. Furthermore, the 3rd DAA showed higher totals across groups, with group 1 reaching 1.30, group 2 at 0.33, and group 3 having a total of 0.66. This increase is reflected in the variation in values in the sub columns for each group. Further changes were seen in the 4th DAA to the 12th DAA, where the total value for each group experienced fluctuations and variations. Group 1 had the highest total at the 8th DAA (3.46), while groups 2 and 3 achieved the highest totals at the 7th DAA (0.66) and 10th DAA (1.99), respectively.

4. Conclusions

This study concludes that varied Effects of Insecticides and Insects: There are variations in response between the insecticides *Spinetoram* and *Chlorantraniliprole* against certain groups of insects. For example, *Melanopos differentialis* showed a decrease after *Spinetoram* application, while *Chlorantraniliprole* had a different effect. Response Time Dynamics: The temporal dynamics of the insecticide effect can be observed. Several insect groups showed specific decreases or increases in different DAAs, highlighting the complexity of changes in insect populations over time. Relationship Between Insect Type and Response: based on data, insect responses to insecticides tend to correlate with the type of insect itself. For example, the Acrididae group showed different responses than the *Gryllidae* or *Hemiptera* groups, indicating the importance of understanding the specificity of the response for each insect group. Relevance for Agricultural Decisions: These conclusions have practical relevance for agricultural pest management in the region. Considerations for selecting the type of insecticide and scheduling of applications need to be carefully considered, considering the different responses of different groups of insects.

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