The Safety of Mixed Extracts of Piper Aduncum Fruit and Tephrosia Vogelii Leaf Against Parasitoid Diadegma Semiclausum

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Abstract: The mixed Piper aduncum fruit and Tephrosia vogelii leaf extracts processed to form emulsifiable concentrates (EC) or wettable powder (WP) that actively control the cabbage pest Plutella xylostella. The objective of this study was to determine the effect of EC and WP formulations on the parasitoid Diadegma semiclausum. Their effects on parasitoid D. semiclausum can be seen from the mortality, life time, parasitization ability, and sex ratio of the parasitoid. Completely randomized design was used with 4 treatments and 6 replications. The thin layer residue method was used with EC and WP at twice the LC_{95} value determined for P. xylostella (appropriate controls were used). The EC and WP formulations had not effect on the mortality, the life time, parasitization ability or the sex ratio of the parasitoid D. semiclausum. These EC and WP formulations can be used to control the cabbage pest P. xylostella in field related to an integrated pest management system.

Index Terms: Botanical insecticide, emulsifiable concentrate (EC), wettable powder (WP), Diadegma semiclausum

I. INTRODUCTION

Leaf caterpillar *Plutella xylostella* is one of the main pests in cabbage plants caused 50-100% yield loss without control effort (Winarto and Nazir, 2004). The presence of natural enemy decrease attack rate of *P. xylostella* 71% - 82%. Unfortunatelly The population of natural enemy parasitoid *D. semiclausum* significantly decrease due to intensive use of synthetic insecticides (Mukholifah *et al*., 2014).

All problems above meet to environmental friendly control technique called botanical insecticides. Lina *et al*., (2014) develop formulations of mixture *T. vogelii* leaf and *P. aduncum* fruit (1:5). Formulations were strong synergistic action against *C. pavonana* and were safe against its natural enemies *Eriborus argenteopilosus.* Both formulations do not cause phytotoxic symptoms in broccoli plants. Lina *et al.*, (2018) determine the same formulations killed another main pest of cabbage plant *Plutella xylostella.* The values of LC_{95} EC and WP formulations were 0.35 % and 0.37% respectively. The safety of formulations against natural enemies. Of *P. xylostella*, parasitoid *D. semiclausum* was very important to know before the formulations are used in field.

The purposes of this research to determine the effect of *emulsifiable concentrates* (EC) or *wettable powder* (WP) formulations of mixed *Piper aduncum* fruit and *Tephrosia vogelii* leaf extracts on the mortality, life time, parasitization ability or the *sex ratio* of the parasitoid *D. semiclausum.*

II. METHODOLOGY

This research conducted at the Insect Bioecology Laboratory and wire house of Plant Pests and Diseases Department, Faculty of Agriculture, Andalas University, Padang from August to October 2017.

Botanical insecticides formulations from mixture extract of *P. aduncum* fruit and *T. vogelii* leaf in the form of formulations *emulsifiable concentrate* (EC) and *wettable powder* (WP) were tested at concentration 2 x LC_{95} against parasitoid *D. Semiclausum.* This study used a Completely Randomized Design (CRD) with 4 treatments and 6 replications as follows:

A= ControlEC
B= EC formulation (0.70%)
C= ControlWP
D= WP formulation (0.74%)

Preparation of formulations refer to Lina(2014). Determination of concentration was obtained from previous research which had been carried out by Widhianingrum (2017). Thin layer residues method on the surface of the test tube used to examine formulations safety against parasitoid *D. semiclausum*. Each test included a pairs of imago *D. semiclausum*. Mortality and *sex ratio* data of parasitoid *D. semiclausum* were observed, while the data of life time and parasitization ability of parasitoid *D. semiclausum* were analyzed by variance (Test F) at 5% significance level and continue with *Least Significant Different* (LSD) at the 5%.

III. RESULT

A. Mortality of imago Diadegma semiclausum

Mixture extract of *P. aduncum* fruit and *T. vogelii* leaves in form EC and WP formulations at a concentration2 × LC_{95}did not cause mortality of male and female of *D. semiclausum* parasitoidat 24 hours after treatment compare to control.

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Table. 1 Imago mortality D. semiclausum at a concentration of 2 × LC_{95} EC and WP formulation

Treatment	Number of individuals	Mortality (%)	
		Male	Female
EC Control	6	0	0
WP Control	6	0	0
2×LC_{95} EC	6	0	0
2×LC_{95} WP	6	0	0

B. Live Time of Imago Diadegma semiclausum

Life time of male and female of parasitoid *D. semiclausum* after treated with EC and WP formulations of mixture extract from *T. vogelii*and *P. aduncum* can be seen on Table 2. There is no significant different (P_{male}= 0.9805 and P_{female}= 0.9818) between the life time of treated parasitoid and control.

Table. 2 The average of Life Time imago *D semiclausum* after treated with botanical insecticides in the form of EC and WP formulations

Treatment	Life Time imago *D. semiclausum* (X ± SD) (Day)	
	Male	Female
EC Control	6,00 ± 3,40	6,16 ± 3,65
WP Control	6,00 ± 1,54	6,00 ± 1,54
2×LC_{95} EC	5,83 ± 3,76	6,33 ± 3,66
2×LC_{95} WP	6,50 ± 2,34	6,66 ± 2,25

An average life time value of male and female of treated imago parasitoid with EC and WP formulations were 6.33 ± 3.01 days, while in EC control and WP control 6.04 ± 2.53 days.

C. Parasitization ability of Diadegma semiclausum

The ability of parasitization of *D. semiclausum* to larvae *P. xylostella* was not significantly different (P = 0.9814) between control of EC and WP formulations and treatment of EC and WP formulation. The average ability of parasitization of parasitoid*D. semiclausum* can be seen from the number of parasitic pupae that appear from parasitized larvae (Table 3).

Table. 3 Average number of pupae parasitized by female imago *D. semiclausum* after treatment of vegetable insecticides in the form of EC and WP formulation

Treatment	Number of parasitic pupae (X ± SD)
EC Control	28,00 ± 22,04
WP Control	30,33 ± 8,64
2×LC_{95} EC	26,50 ± 21,54
2×LC_{95} WP	29,16 ± 9,74

An average number of parasitized pupae in control EC was 28.00 tails and the number of parasitized pupae in EC formulation treatment was 26.50 tails while the number of parasitized pupae in control WP was 30.33 and the number of parasitized pupae inWP treatment was 29.16 tails. Sample of parasitic pupae can be seen in Figure 1.

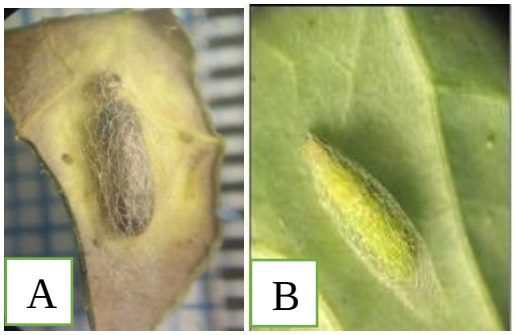

Fig. 1 The shape of the pupae: a) parasitized pupae, b) healthy pupae

In Figure 1. the parasitized pupae is distinguished by the shape and colour of the healthy pupae of *P. xylostella*. The parasitized pupae of*P. xylostella*has blackish brown colour and tube shape whilehealthy pupae of *P. xylostella*has yellowish green colour and ellipse shape Comparison of *D. semiclausum* male: female (*sex ratio*) that appears in the EC formulation treatment and WP formulation also on EC and WP control can be seen in Table 4.

Table. 4 Comparison of male and female imago (sex ratio) generated by imago D. Semiclausum

Treatment	Male : Female
EC Control	3 : 2
WP Control	2 : 1
2×LC_{95} EC	3 : 2
2×LC_{95} WP	3 : 2

Descendants of parasitoid *D. semiclausum* appearing from *P. xylostella* parasitized larvae tend to be male imago then female imago. In EC control treatment, 2 × LC_{95} ECand 2 × LC_{95} WP has the same ratio of males and females there were 3:2 whereas in WP control has a comparison of males and females2: 1. The imago form of male and female *D. semiclausum* can be seen in Figure 2.

Fig. 2 Imago D. semiclausum: a) Female Imago, b) Male Imago

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IV. DISCUSSION

Residue of EC and WP formulations of mixture extract of *Piper aduncum* fruit and *Tephrosia vogelii* leaves (5: 1)caused mortality of *Plutella xylostella* larvae (Widhianingrum, 2017). Same formulations did not cause the death of the parasitoid *Diadegma semiclausum*after 24 hours treatment (Table 1). The result shows that the active ingredients were contained on *P. aduncum* fruit and *T. vogelii* leaves have selective activity against *P. xylostella*and its natural enemy parasitoid *D. Semiclausum.*

EC and WP Formulations worked more as stomach poisons than contact poisons, this pattern can be seen from the mortality of *P. xylostella* which consume leaf contain residue of formulation. Different from its parasitoid *D. semiclausum* where it was only contact with EC and WP formulation residues.Lina *et al*., (2017) reported that EC and WP formulations of mixture extract from *P. aduncum* fruit and *T. vogelii* leaves didnot cause death of the natural enemy of *Crocidolomia pavonana,* parasitoid *Eriborus argenteopilosus*.

The life time of treated male and female of imago parasitoid *D. semiclausum* was not significantly different from life time of control male and female (Table 2). This shows that the residues of EC and WP formulations besides do not causing mortality of parasitoid *D. semiclausum* also do not affect the physiology of parasitoid *D. semiclausum*. Lina *et al*., (2015) stated that EC and WP formulations cause physiological interference to *C. pavonana* include food inhibition, food assimilation, and cytochrome P450 enzyme activity.This is prove a selective properties on active ingredients of EC and WP formulations as described above. Tarwotjo (2015) reported that at LC_{25} (85.99 ppm) the mixture of leaves and twigs *Aglaia odorata* had no effect on the longevity of *Apantheles sp*.

Insecticides were used in pest management have to fulfil several criteria such as save to untarget organism for example predator, ground arthropods, parasitoid etc. Zarkani *et al*., (2009) reported that the fraction of liquid vacuum chromatography of *Piper retrofractum* caused death of imago *D. semiclausum* more than 50%. Application of insecticide Abamectin for 30 minutes caused 85-100% mortality of egg parasitoid of *Anagrus nilaparvatae* (Sasmito *et al*., 2017). Meilin and Praptana (2014) stated that the use of deltamethrin insecticide can shorten the life time of many parasitoids.

Parasitization ability of parasitoid *D. semiclausum*was not affected by the treatment of EC and WP formulations. The number of pupae parasitized in EC and WP treatment were not significantly different to EC and WP controls according to statistical analysis (Table 3). This shows that the fitness of parasitoid *D. semiclausum*is not affected by EC and WP formulations. Sidauruk *et al*., (2013) reported that the parasitization process is way to continue the off spring of the parasitoid. In order to maintain the balance of parasitoid populations in field, the parasitoid must be able to parasitize the host. The use of botanical insecticides EC and WP formulations of mixture extracts of *P. aduncum* and *T. vogelii* (5:1) are recomended as environmental friendly control technique, because they do not affect the parasitization process of the host larvae *P. xylostella*. As well as research Tarwotjo (2015) states that the LC_{25}(85,99ppm) mixture of leaves and a twigs. *odorata* does not affect the parasitization process of *Apantheles sp* parasitoid.. Yudha *et al*., (2017) reported that the insecticide active ingredient emamectin benzoate 5.7% at a concentration of 0,25-1,00 ml / l did not affect the parasitization level of *D. semiclausum* parasitoid in cabbage cultivation . The use of insecticides that can affect the process of the parasitoid unfit parasitisasi used as a control, such as in research Sasmito *et al*. (2017) application of insecticides abamectin administered to the egg parasitoid *A*contact. *nilaparvatae* can reduce parasitization rate by 86.34% at a concentration of 2.28 ppm.

Comparison of male and female imago of *D. semiclausum* as parasitoid a whole was dominated by male imago (Table 4). *Sex ratio* in EC control treatment, 2 × LC_{95} EC and 2 × LC_{95} WP has the same comparison value, whereas different comparison on WP control. The difference in comparison on WP control and the higher comparison of appearing male than female imago can be influenced by environmental and food factors. This is no different from Fahrizal's (1998) study which states that *D. semiclausum* parasitoid tends to appear male sex ratio in laboratory conditions. According to Tampubolon *et al.,* (2015) the sex ratio of insects can be influenced by internal factors and external factors such as population density and food conditions. The use of a formulation mixture of fruit extract *P. aduncum* and leaves *T. vogelii* (5: 1) with a concentration of 2 × LC_{95} did not significantly affect the *sex ratio* imago *D. semiclausum* because there was still a female imago that appeared.

The mixture of fruit extract *P. aduncum* and leaf *T. vogelii* form of EC and WP formulation as a whole is selective against *D. semiclausum* parasitoidbecause it does not cause the death of *D. semiclausum* parasitoid, does not affect the life time *D. semiclausum* parasitoid, does not affect parasitization and *sex ratio ofD. semiclausum* parasitoid. So that it can be used as an alternative environmentally friendly control. This is in line with research Lina (2014) mixture of EC and WP formulations fruit *P. aduncum* and leaves of *T. vogelii* not cause death to the natural enemies against E. *argenteopilosus* which is a pest parasitoid of *C. pavonana*.

V. CONCLUSION

EC and WP formulations mixed fruit extract *Piper aduncum* and leaves *Tephrosia vogelii* with a concentration of 2 × LC_{95} safe against parasitoid *D. semiclausum*. This is indicated by the absence of influence on life duration, parasitization ability and *sex ratio* and 0% mortality of parasitoid *D. semiclausum*.

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