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Effect of Liquid Smoke Applications on the Predator Populations

Menochilus Sexmaculatus and Paedorus Fuscipes in Soybean Plants

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Abstract

In soybean culture the pest infestation that attacked in soybean crop occurs since the start germinate until harvest. The continued use of synthetic pesticides and improper application can lead to pest resistance and resurgence, in addition to increased production costs also negatively impacting the environment and killing of natural enemies. Liquid Smoke is a natural insecticide that works not killing of pest. The purpose of this study was to determine the population of predators *Menochilus sexmaculatus* and *Paedorus fuscipes* in soybean crops that sprayed liquid smoke and synthetic insecticide. The research was conducted on farmer's land with wetland agro-ecosystem in Bumi Setia village, Seputih Mataram sub-district, Central Lampung regency, Lampung Province, Indonsia. The study was conducted from April to June 2015. Research in a stretch of 0.25 ha of soybean plant with a treatment sprayed with liquid smoke of coconut shell and 0.25 ha sprayed with synthetic insecticide with active ingredients of pirifos and sidametrin. The used Randomized Block Design with 2 treatments and 16 replications. Plants was sprayed biweekly until the plants was formed pods. Dosage of liquid smoke 15 ml/lt of water and dose of synthetic insecticide as recommended.

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The observed variables were the intensity of armyworms (*Spodoptera sp*.) attack, pod borer (*Etiela sp*.) attack and predator population *Menochilus sexmaculatus* and *Paedorus fuscipes* since plant age 24 to 66 days after planting with interval of seven days, so the observation was done six times. The results showed that spraying of natural insecticides such as liquid smoke did not reduce the presence of predators of *M. Sexmaculatus* and *P. fuscipes* in soybean crops, so that liquid smoke should be considered as alternative insecticides for replacement synthetic insecticides that are very harmful to human health and the environment.

Keywords: Soybean; liquid smoke; main pests; natural enemies.

1. Introduction

Soybean is a raw material of Indonesian food such as tofu and tempeh, so that soybeans are one of the most needed food crops in Indonesia. The cultivation of soybean plants is experiencing obstacles because of the attack of plant pest organisms. In soybean culture the pest infestation that attacked in soybean crop occurs since the start germinate until harvest. Main pests of soybean crops among other are pod borer and armyworms. Until now farmers still rely on synthetic insecticides to control pests in soybean crops. The continued use of synthetic pesticides and improper application can lead to pest resistance and resurgence, in addition to rising production costs also negatively impacting the environment and killing of natural enemies [5,6]. Natural enemies are organisms found in nature that can kill insect pests or simply weaken insect pests, thereby reducing the reproductive phase of insect pests. One of the environmental factors that control the pest population is natural enemies in the form of predators, parasitoids and pathogens [23]. Predators are insects that include natural enemies that feed on plant pests. Examples of predatory insects are *Menochilus sexmaculatus* and *Paedorus fuscipes*. Both of these predators are often find in soy plants. *Menochilus sexmaculatus* (Fabricius) are the Coccinellidae family of the Coleoptera order. *M. sexmaculatus* is a black-spotted lady beetle. Head of *M. sexmaculatus* is bent down. The position will help him eat small animals such as aphids. In his head there is a pair of lower jaws to help him hold his prey while eating. In his head there is a pair of lower jaws to help him hold his prey while eating. *M. sexmaculatus* will eat the lice by sucking the bodily fluids of his prey. Throughout his life, a *M. sexmaculatus* can deplete 1,000 head aphids, therefore the insect *M. Sexmaculatus* is known as a farmer's best friend [13,21]. Various larger species of Coccinellidae attack caterpillars and other beetle larvae. Several genera feed on various insects or their eggs, its species are significant predators of the eggs and larvae of moths such as species of *Spodoptera* and the *Plutellidae*. M. Sexmaculatus is one predator that has several advantages, including high reproductive ability, has a long life cycle and high predation rate. However, its ability to spread and killing power is relatively slow and very sensitive to the use of insecticides [2]. *Paedorus fuscipes* is to the Staphylinidae family of the Coleoptera order. *P. fuscipes* actually is to a useful insect as a natural enemy because it acts as an active predator on some rice plant disturbing insects, such as brown planthoppers, green leafhoppers and soybean pests are widely found in tropical climates [3,11,22]. These insects also feed on *Helicoverpa armigera* eggs, armyworm eggs (*Spodoptera sp*.) and pod borer eggs (*Etiela zinckenella*) found in beans and pepper crops [1,7,8]. A natural enemy is important for the success of any biological control program [4]. The use of natural enemies is one of the most environmentally friendly ways to control pests. But the presence of natural enemies is often extinct if plant pest control by spraying synthetic insecticides. Efforts to reduce the impact of synthetic insecticides can be used liquid smoke. Liquid smoke is a

result of condensation or pyrolysis of material which contains lignin, cellulose, hemicellulose and other carbon compounds that availability is plentiful as agricultural waste [10,18,20]. Crude liquid smoke contains a variety of compounds include phenol, carbonyl, acids, furans, alcohols, lactones, hydrocarbons, and polycyclic aromatic that are anti-microbial and toxic to insect pests so the opportunity was developed as a natural pesticide [9,19,24,25]. Liquid Smoke is a natural insecticide that works not killing of pest. The purpose of this study was to determine the population of predators *Menochilus sexmaculatus* and *Paedorus fuscipes* in soybean crops that sprayed liquid smoke and synthetic insecticide.

2. Material and Methods

The research was conducted on farmer's land with wetland agro-ecosystem in Bumi Setia village, Seputih Mataram sub-district, Central Lampung regency, Lampung Province, Indonsia. The study was conducted from April to June 2015. Research in a stretch of 0.25 ha of soybean plant with a treatment sprayed with liquid smoke of coconut shell and 0.25 ha sprayed with synthetic insecticide with active ingredients of pirifos and sidametrin. Plants fertilized with 25 kg of urea + 50 kg SP36 + 50 kg KCl + 1 ton of organic fertilizer per hectare. Aplication of organic fertilizers and dolomite were when processing the soil 2 weeks before planting. Urea, Sp36 and KCl fertilizers are given when the plants were 7 days old. Spacing was 40cm x 15cm. How to plant in 2 seeds per planting hole. Area of observation plot 1m x 1m randomly made by 16 plots each treatment, so the design used was Randomized Block Design with 2 treatments and 16 replications. Plants was sprayed biweekly until the plants was formed pods. Dosage of liquid smoke 15 ml/lt of water and dose of synthetic insecticide as recommended. The observed variables were the intensity of armyworms (*Spodoptera sp*.) attack, pod borer (*Etiela sp*.) attack and predator population *Menochilus sexmaculatus* and *Paedorus fuscipes* since plant age 24 to 66 days after planting with interval of seven days, so the observation was done six times.

The intensity of pest attack leaves (armyworms) calculated using the formula:

$$I = \frac{\sum_{i=0}^{z} (n \times v)}{Z \times N} \times 100\%$$

Remarks: I = The intensity of the attack (%)

n = Score

v = Total infected plant at every score

Z = The highest score (5)

N = Total plants per plot

While the intensity of pod pest attacks were calculated using the formula:

$$I = \frac{A}{B} \times 100\%$$

Remarks: I = The intensity of the attack (%)

A = Number of pods attacked

B = Total number of pods observed

Observations of *M. sexmaculatus* and *P. fuscipes* populations were performed directly (visual), pitfall traps and captured manually by hand and plastic. The data were analized by anova and then Duncan's Multiple Range Test (DMRT).

Table 1: Scoring system [12]

Score	Crop Damage Level (%)
0	No attack symptoms
1	> 0 - 20
2	> 20 - 40
3	> 40 - 60
4	> 60 - 80
5	> 80 - 100

3. Results and Discussion

Based on observations and cumulative identification results, the population of *M. Sexmaculatus* was significantly different between plants sprayed with liquid smoke and sprayed with synthetic insecticides, seen more predatory populations in plants sprayed with liquid smoke. So was the population of *P. fuscipes* (Table 2). Predator populations data obtained with observational limitations were only once a week and within approximately one hour of each observation.

Table 2: Predator populations *M. Sexmaculatus* and *P. fuscipes*

Treatments	*M. sexmaculatus* populations (tail)	*P. fuscipes* populations (tail)
Liquid Smoke	16.20 a	10,27 a
Synthetic Insecticide	1,53 b	2,88 b

Numbers was significantly different according to Duncan Multiple Range Test (DMRT) 5%.

The intensity of armyworm attack and pod borer attack were not significantly different between treatments, This it showed the ability of liquid smoke to be the same as synthetic insecticide in controlling pest attack on soybean crop (Table 3).

Table 3: Average of intensity of armyworm attack and pod borer attack

Treatments	Intensity of armyworm attack (%)	Intensity of pod borer attack (%)
Liquid Smoke	5,63 a	22,63 a
Synthetic Insecticide	3,86 a	20,77 a

Numbers followed by the same letter in the same column was not significantly different according to DMRT 5%.

The use of natural insecticides such as liquid smoke does not kill pests but only expels, this is very beneficial to natural enemies may be not killed too, so the existence of natural enemies in the field can be maintained because it does not damage the natural enemy's ecosystem. Results [26] showed that the coconut-cell liquid smoke (CCLS) was relatively safe against natural enemies complex. The CCLS application did not significantly reduce number of the natural enemies species. The observed predator groups comprised of Order Odonata, Orthoptera, Hemiptera, Coleoptera, Arachnida, and ants. Meanwhile, the parasitoid group comprised of Order Diptera and Hymenoptera. In contrast to synthetic insecticides that can kill all insects both pests and natural enemies.

The existence of natural enemies is very important to control the pest population, so the intensity of damage to the plant is not to the detriment. The use of natural enemies has advantages over other means of control because many natural enemies are specific to certain prey. Natural enemy density was positively correlated with the number of insect pests that predators ate, the more number of natural enemies the more the insect pests that predators eat [16].

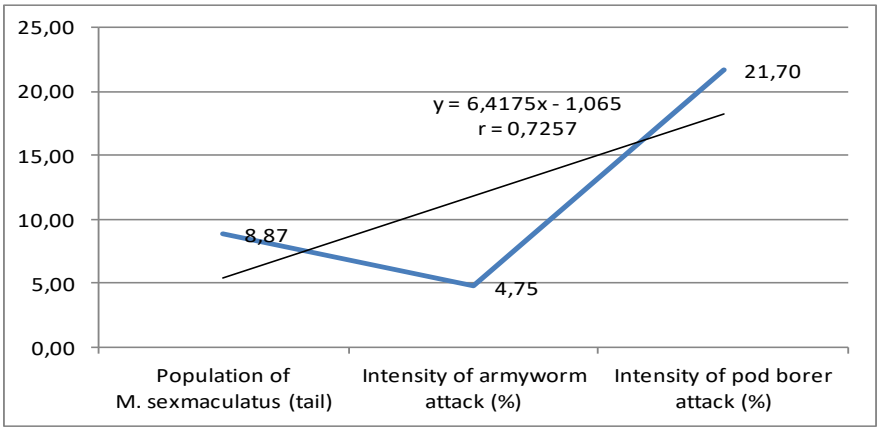

Figure 1: Correlation between population of *M.sexmaculatus* with intensity of pest attack

The correlation between population of *M.sexmaculatus* with the intensity of pest attack with regression equation y = 6,4175x - 1,065 and r = 0.7257, this indicates the population of *M. Sexmaculatus* strongly correlate to decrease intensity of armyworm attack and pod borer attack on soybean crop (Figure 1). While the correlation between population of *P. fuscipes* with the intensity of pest attack with regression equation y = 7,56x - 4,1117

with r = 0,8125, it shows population of *P. fuscipes* correlated very strong decrease intensity of attack of armyworm and pod borer attack in plant soybean (Figure 2). The value of r determines the level of closeness of each equation, the value r = 1 indicates perfect correlation [15,16].

In the principles of Integrated Pest Management (IPM), plant pests control is more emphasis on the prudence of pesticide risks to health and the environment including the sustainability of natural enemies [17]. In IPM, management of agricultural and horticultural pest that minimizes the use of chemical and emphasizes natural and low-toxicity methods (such as the use of crop rotation and beneficial predatory insects) [14].

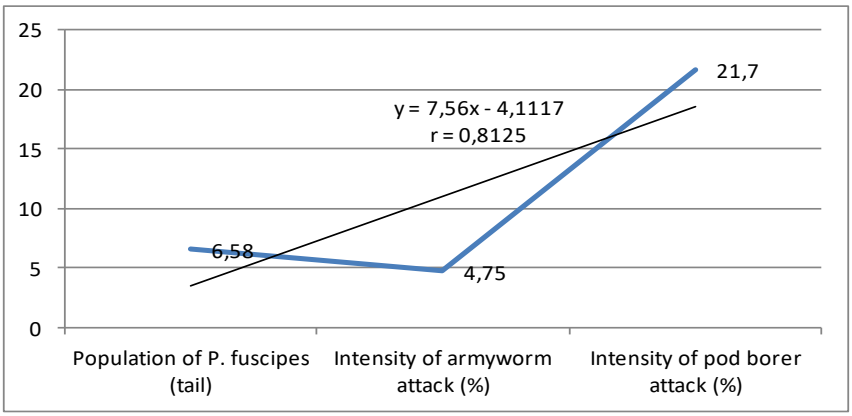

Figure 2: Correlation between population of *P. fuscipes* with intensity of pest attack

4. Conclusion

Natural spraying of insecticides such as liquid smoke does not reduce the presence of predators of *M. Sexmaculatus* and *P. fuscipes* in soybean crops.

5. Recomendation

The liquid smoke should be considered as an alternative insecticide for replacement synthetic insecticides that are very harmful to human health and the environment.

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