The attack of *Etiela zinckenella* Treitschke on soybean varieties

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Manuscript received: 1 November 2021. Revision accepted: 2 March 2022. Available online: 31 March 2022.

ABSTRACT

The attack of *Etiella zinckenella* Treitschke on soybean varieties. Soybean is an important food and source of vegetable protein. One of the problems in soybean cultivation in Indonesia is the presence of pests. Integrated pest control (IPM) techniques are increasing along with the awareness of the importance of environmentally friendly sustainable agriculture. One component of IPM is the use of pest-resistant varieties. This study aimed to examine the effect of the soybean varieties against *E. zinckenella* Treitschke. This research was conducted with a factorial Randomized Completely Block Design (RCBD). The first factor was the type of organic fertilizer with a dose of 10 tons/ha: (P0= control, P1= Bokashi, P2= Vermikompos, P3= cow manure). The second factor is soybean varieties, which were: V1= Dena 2, V2= Dering 1, V3= Deja 2, V4= Deja 1, V5= Devon 1, V6= Devon 2, V7= Derap 1, V8= Derap 2, V9= Devatra 1, V10 = Devatra 2, V11= Detam 1, V12= Detam 2.

The results showed that the interaction between varieties and organic fertilizer significantly affected the percentage of pod borer attack. The interaction between P1 x V8 varieties and between P2 x V6 varieties resulted in the highest percentage of pod borer attack and it was significantly different from other interactions, but not significantly different from P3 x V9, P3 x V5, P2 x V11, P1 x V6, P0 x V11, and P0 x V6.

Key words: attack, *Etiela zinckenella*, fertilizer, soybean, varieties

INTRODUCTION

Soybean (*Glycine max* L.) is a food ingredient, a source of vegetable protein, a raw material for the animal feed and food industry (Khojely et al., 2018). Domestic soybean production is only sufficient for 35–40%, while imports are 60–65%. Pest problems are one of the causes of the decline in soybean production in Indonesia. The main pests of soybeans include: *Riptortus linearis*, *Nezara viridula*, *Ophiomyia phaseoli*, *Etiella zinckenella*, and *Spodoptera litura* (Marwoto & Suharsono, 2008; Mulyaningisih, 2017). Yield losses due to sucking pests and soybean pod borer *E. zinckenella* reached 80% (Sari & Suharsono, 2010).

Recently, the control of *E. zinckenella* on soybeans still relies on the application of insecticides. However, the use of pesticides has not been able to control these pests effectively. This is due to resistance of the pest to several types of insecticides applied (Huang & Han, 2007; Ahmad et al., 2008). The development of pest resistance to insecticides is followed by increasing public awareness of the negative impacts of intensive use of insecticides, thereby encouraging the need for integrated pest control.

Integrated Pest Management (IPM) is an approach or method of pest control based on ecological considerations and economic efficiency in the context of ecosystem management and sustainability (Marwoto & Suharsono, 2008). One component of IPM is pest-resistant varieties. pest-resistant varieties is an effort to change the tolerance of plants to pest attacks, including in ecological resistance (Untung, 2001). Excessive use of pest-resistant varieties can reduce environmental pollution.

The use of pest-resistant varieties is one part of a breeding program that is still being developed, so that the breeding program is carried out more directed, effective and efficient and the use of resistant varieties is a way that is safe for the environment and more economical (Baliadi et al., 2008); (Andayanie et al.,...
Resistance to insects can be tracked through the selection of morphological characteristics. Plant morphology (stems, leaves and pods), among others, has a very diverse hair structure, this is thought to affect the level of soybean resistance to insect pests. The trichome structure, length, and trichome density greatly affect the resistance of soybean plants, which means that the higher the leaf trichome density, the lower the attack intensity, and vice versa (Minarno & Khoiriyah, 2011). The purpose of this study was to examine the effect of soybean varieties against *E. zinckenella* Treitschke.

**MATERIALS AND METHODS**

**Research Site.** This research was conducted from June to October 2021 in Kandang Mas, Kampong Melayu, Bengkulu city, Bengkulu province, with coordinates 3o52'33.24252''S 102o19'8.42988E'' and an altitude of 31.4 m.

**Research Design.** This study used a Factorial Randomized Completely Block Design (RCBD). The first factor was the type of organic fertilizer with a dose of 10 tons/ha: (P0= control, P1= Bokashi (N-total: 1.09 %, C: 15.29%, P: 0.30%, K: 0.72%, pH: 0.72%), P2= Vermikompos (N-total: 1.65%, C: 26.16%, P: 1.08%, K: 2.04%, pH: 7.31%), P3= cow manure (N-total: 0.90 %, C: 17.96%, P: 0.50%, K: 0.46%, pH: 7.00%). The second factor of soybean varieties were: V1= Dena2, V2= Dering 1, V3= Deja 2, V4= Deja 1, V5= Devon1, V6= Devon 2, V7= Derap 1, V8= Derap 2, V9= Devtra 1, V10 = Detam 2, V11= Detam 1, V12= Detam 2. Each experimental unit was repeated 4 times. Experimental observation variables in the field including *S. litura* attack on leaves and soybean pod borer *E. zinckenella*.

**Land Preparation and Planting.** Land preparation began with soil processing using a hoe and then a plot was made with a size of 1.5 × 2 m. Soil processing was carried out at once with the addition of 10 tons/ha of organic fertilizer. In addition, 50 kg/ha urea, 100 kg/ha TSP, and 100 kg KCl were also applied. The application of TSP and KCl fertilizers was carried out at the time of planting. Meanwhile, urea fertilizer was given twice at the time of planting as much as 25 kg/ha and when the plants had flowered as much as 25 kg/ha. Planting was carried out in a single 3 cm depth with 2 seeds per planting hole, then covered with soil. The spacing used was 25 × 30 cm and the distance between plots was 50 cm.

**Observation on the Pod Damage Caused by *E. zinckenella*.** Observations were carried out by directly observing the symptoms on the pods due to the attack of *E. zinckenella*. Symptoms were observed and then photographed using a digital camera. The percentage of *E. zinckenella* attack was calculated using the formula:

\[
I = \left(\frac{a}{b}\right) \times 100\%
\]

*I* = percentage of pod damages (%); 
*a* = number pod attacked; 
*b* = total pods observed.

The level of resistance of soybean plants to *E. zinckenella* attacks using the following scores:

- **Score 1**: 0–20% = resistant
- **Score 2**: 21–40% = partially resistant
- **Score 3**: 41–60% = vulnerable
- **Score 4**: 61–80% = partially vulnerable
- **Score 5**: >80% = very vulnerable

**Data Analysis.** The data of pod damage caused by *E. zinckenella* was analyzed using analysis of variance (ANOVA). If the results show a significant effect, analysis will be continued using Duncan Multiple Range Test with a significance level of 95%.

**RESULTS AND DISCUSSION**

Symptoms of *E. zinckenella* have begun to appear when soybean seeds begin to form. Signs of this pest attack were indicated by the presence of bore holes in the affected pods. The boreholes were irregularly circular in shape and when the pods were opened they found larvae and hoist marks. The larvae were green with a black head. According to Marwoto et al. (2017), *E. zinckenella* larvae were green with a longitudinal red line. The results of the analysis of variance at a significant level of 5% organic fertilizer treatment had no significant effect on *E. zinckenella* pest attack, while varieties had a significant effect and there was an interaction between varietal treatment and organic fertilizer which had a very significant effect on *E. zinckenella* attack, which can be seen from the significance value of 1.58 (Table 1).

Table 2 showed that the average attack on pods caused by *E. zinckenella* was not significantly different between types of organic fertilizers, but different in varieties. The attack *E. zinckenella* was in the range of 0.40–4.36%. The lowest attack intensity was found in
Derap 1, while the highest one was observed in Devon 2 variety at 4.36%.

The percentage of soybean pod borer in all treatments was low. This was due to the low population of soybean pod borer found in plantations so that the damage it causes was also low, i.e. below 5% on average. The resistance of all soybean varieties tested against pod borer was classified as resistant. The pod borer attack is closely related to pod trichomes.

In general, the results showed that an increase in the number of trichomes tended to be followed by a decrease in the attack of the pod borer. According to Susanto & Adie (2008), one of the mechanical inhibiting factors for pod borer when attacking pods was the presence of trichomes with tight and long characteristics. The results of the research by Tamang et al. (2017) showed that the level of pest attack was influenced by the density of trichomes on the plant surface. The density of pod trichomes was one of the factors of resistance to pod borer both imago and larvae in soybean plants (Bayu et al., 2015).

Based on the results of Pandjaitan (2021), varieties Dena 2, Devon 1, Deja 1 produced the highest number of trichomes, compared to other varieties with the number of trichomes 117.96–247.09/cm² and significantly different from soybean varieties (Derap 1, Detam1, Detam 2, Ring 1 with the number of trichomes 65.89–88.54/cm². The difference in the number of trichomes in each variety was influenced by the genetics of each variety. Each variety or line has a different density of trichomes depending on the variety or type of soybean (Sari & Suharsono, 2010). The density of trichomes in soybeans was controlled by a single gene and is recessive (Adie et al., 2015).

Trichomes on plant surfaces were plant organs that directly related to the initial stages of host

| Table 1. Recapitulation of the variance of the percentage of $E.\ zinckenella$ attack on several soybean varieties with different applications of organic fertilizers in Kandang Mas |
|-------------------------------------------------------------|
| Observation variable | Organic fertilizer (P) | Varieties (V) | Interaction (P x V) | Coefficient diversity (%) |
|----------------------|------------------------|---------------|---------------------|--------------------------|
| Percentage of $E.\ zinckenella$ attacks                     | 0.91                   | 5.04 **       | 1.58 *              | 165                      |

The significance level at 5%, * = Significant effect.

| Table 2. The effect of organic fertilizer type and the variety factor on the percentage of $E.\ zinckenella$ attacks |
|-------------------------------------------------------------|
| Treatments | Attacks of $E.\ zinckenella$ (%) |
|-------------|----------------------------------|
| Organic fertilizer (P)                                    |                                   |
| P0 (Kontrol)                                            | 1.67 a                            |
| P1 (Bokashi)                                             | 1.67 a                            |
| P2 (Vermikompos)                                         | 2.14 a                            |
| P3 (Cow manure)                                          | 2.20 a                            |
| Varieties (V)                                            |                                   |
| V1 (Dena2)                                               | 1.00 de                           |
| V2 (Dering 1)                                            | 2.34 bcd                          |
| V3 (Deja 2)                                              | 0.78 de                           |
| V4 (Deja 1)                                              | 1.52 cde                          |
| V5 (Devon1)                                              | 1.36 de                           |
| V6 (Devon 2)                                             | 4.36 a                            |
| V7 (Derap 1)                                             | 0.40 e                            |
| V8 (Derap 2)                                             | 2.29 bcd                          |
| V9 (Devatra 1)                                           | 3.26 ab                           |
| V10 (Devatra 2)                                          | 1.78 bcde                         |
| V11 (Detam 1)                                            | 3.09 abc                          |

The numbers followed by the same letter in the same column, are not significantly different in DMRT test at 5% of significant level.
acceptance. Plant damage by insects was lower with increasing trichome density (Suharsono & Suntono, 2004). Trichoma pods were indirectly a mechanical barrier for the invasion of a pest. One of the mechanical inhibiting factors for pod borers when attacking pods was the presence of trichomes with tight and long characteristics. The morphological characters possessed by plants were used as a defense system so that they can avoid or reduce the intensity of damage by herbivores. Plant resistance was determined by the plant structure or morphological character because the movement or activity, feeding or reproduction of insects was disturbed.

Trichomes can also be an ideal place for some pests to place their eggs so they were not damaged due to environmental disturbances (Susanto & Adie, 2008). Trichomes on soybean pod shells were potential physical characteristics that determine resistance to pod sucking pests (Suharsono, 1997). The more the number of eggs, the more larvae population, the higher the intensity of the attack. Pod borer eggs were found in leaves, flowers, and pods while larvae were only found in pods (Baliadi et al. 2008).

Based on the result of analysis of variance showed that the interaction between organic fertilizers and varieties significantly affected the percentage of *E. zinckenella* attack (Table 3).

Based on the result of analysis of variance showed that organic fertilizer had no significant effect on the attack of *E. zinckenella*, however, significant effect was observed on the soybean varieties. The interaction between organic fertilizers and varieties significantly affected the percentage of *E. zinckenella* attack (Table 3).

The interaction between organic fertilizer and varieties significantly affected the percentage of pod borer attack. The interaction between P1 and 8 varieties and between P2 and 6 varieties resulted in the highest percentage of pod borer attack and it was significantly different from other interactions, but not significantly different from P3 x V9, P3 x V5, P2 x V11, P1 x V6, P0 x V11, and P0 x V6 (Table 3).

Soybeans grown on this land were the first generation which usually less pests’ population. It was also supported by application of chemical insecticide (Profenofos 500g/L). According to Indiati & Marwoto (2017), the components of pod borer IPM technology included sanitation, simultaneous planting, crop rotation and cropping patterns, trapping plants, use of insecticides, resistant varieties, as well as biological and chemical control. Apriyanto et al. (2009), reported that the damage caused by *E. zinckenella* on soybeans was influenced by the density of pests in the field.

The use of organic fertilizers did not have a significant effect directly in reducing the severity of pest attacks, but had an indirect effect on developing healthier plant conditions, which made plants more resistant to pest attacks. According to Birkhofer et

**Table 3. Interaction between organic fertilizers and soybean varieties on the percentage of *E. zinckenella* attacks**

| Varieties soybean | Organic fertilizers (P) |
|-------------------|-------------------------|
|                   | P0          | P1          | P2          | P3          |
| V1                | 0.70 efgh   | 1.53 cdefgh | 0.87 defgh  | 0.91 defgh  |
| V2                | 0.49 fgh    | 1.78 bcdefgh| 2.97 bcdefgh| 4.13 abcdef |
| V3                | 1.94 bcdefgh| 0.18 h      | 0.56 fgh    | 0.42 fgh    |
| V4                | 1.19 defgh  | 1.03 defgh  | 1.08 defgh  | 2.79 bcdefgh|
| V5                | 0 h         | 0 h         | 1.38 defgh  | 4.07 bcdefgh|
| V6                | 5.08 abc    | 3.63 abcd   | 6.80 a      | 1.91 bcdefgh|
| V7                | 0.33 gh     | 0.49 fgh    | 0.23 h      | 0.53 fgh    |
| V8                | 1.82 bcdefgh| 5.29 a      | 0 h         | 2.06 bcdefgh|
| V9                | 2.46 bcdefgh| 3.06 bcdefgh| 2.96 bcdefgh| 4.57 abcd   |
| V10               | 1.62 cdefgh | 1.03 defgh  | 3.09 bcdefgh| 1.38 defgh  |
| V11               | 3.59 abcd   | 1.12 defgh  | 4.40 abcde  | 3.23 bcdefgh|
| V12               | 0.78 efgh   | 0.87 defgh  | 1.29 defgh  | 0.43 fgh    |

The numbers followed by the same letter in the same column, are not significantly different in DMRT test at 5% of significant level. P0= control; P1= Bokashi (N-total: 1.09 %, C: 15.29%, P: 0.30%, K: 0.72%, pH: 0.72%); P2 = Vermikompos (N-total: 1.65%, C: 26.16%, P: 1.08%, K: 2.04%, pH: 7.31%), P3= cow manure (N-total: 0.90 %, C: 17.96%, P: 0.50%, K: 0.46%, pH: 7.00%).
al. (2008), the addition of manure could reduce the disturbance of plant pest organisms because the nutrients in the fertilizer were involved in the tolerance or resistance mechanism of the host plant. The interaction of N and P significantly affected the number of leaves, number of pods, and the percentage of pod borer attack (Pujiwati et al., 2021).

Soybean varieties showed different resistance responses (resistant and moderately resistant) to the pests attack. This was influenced by genetic factors that would influence morphological differences so that caused differences in physical barriers which were formed by each of the varieties. The plant tolerance mechanism according to Untung (2001), occurred due to some factors such as plant vigor, regrowth of damaged tissue, stem rigidity and production of additional branches. One component of the principle of integrated pest control was the health of cultivated plants including the acquisition of sufficient nutrients (Indiati & Marwoto, 2017).

CONCLUSION

The interaction between organic fertilizer and varieties significantly affected the percentage of pod borer attack. The interaction between P1x V8 varieties and between P2 x V6 varieties resulted in the highest percentage of pod borer attack and it was significantly different from other interactions, but not significantly different from P3 x V9, P3 x V5, P2 x V11, P1 x V6, P0 x V11, and P0 x V6.

ACKNOWLEDGMENTS

The author would like to acknowledge the research grant for Unggulan UNIB in 2021 with contract number 1780/UN30.15/PG/2021.

FUNDING

Research grant Unggulan UNIB in 2021 with contract number 1780/UN30.15/PG/2021.

AUTHORS’ CONTRIBUTIONS

HP and BGM, UKJ, considered and planned the experiment. ES performed analysis data. SG collecting data on the plant damage area caused by Etiella zinckenella. I performing analysis and interpreting the plant damage and prepared the manuscript. The authors provided response and comments on the research flow, data analysis and interpretation as well as shape of the manuscript. All the authors have read and approved the final manuscript.

COMPETING INTEREST

I declare no competing interests regarding this publication.

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