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RESEARCH PAPER

The attack of *Etiela zinckenella* Treitschke on soybean varieties

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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; Mulyaningsih, 2017). Yield losses due to sucking pests and soybean pod borer *E. zinckenella* reached 80% (Sari & Suharsono, 2010).

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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., 2011). 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"S102o19'8,42988E" 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= Devatra 1, V10 = Devatra 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/cm^2 and significantly different from soybean varieties (Derap 1, Detam1, Detam 2, Ring 1 with the number of trichomes 65.89–88.54/cm^2. 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 abcdefg
V6	5.08 abc	3.63 abcdefgh	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 abcdefgh	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.

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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.

REFERENCES

Adie MM, Bayu MSYI, & Krisnawati A. 2015. Ragam ketahanan kedelai terhadap hama ulat grayak (*Spodoptera litura* F.) [Soybean resistance variety to armyworm (*Spodoptera litura* F.)]. In: Noerwijati K, Krisnawati A, Rahajeng W, Sutrisno, Sulistyo A, Sucahyono D, Anggraeni DA, & Winarto A (Eds.). *Prosiding Seminar Hasil Penelitian Tanaman Aneka Kacang dan Umbi.* pp. 66–72. Pusat Penelitian dan Pengembangan Tanaman Pangan Badan Penelitian dan Pengembangan Pertanian Bogor, Bogor.

Ahmad M, Sayyed AH, Saleem MA, & Ahmad M. 2008. Evidence for field evolved resistance to newer insecticides in *Spodoptera litura* (Lepidoptera:Noctuidae) from Pakistan. *Crop Prot.* 27(10): 1367–1372. https://doi.org/10.1016/j.cropro.2008.05.003

Andayani WR, Sumardiyono YB, Hartono S, & Yudono P. 2011. Incidence of soybean mosaic disease in East Java Province. *J. Agrivita.* 33(1): 15–22.

Apriyanto D, Yoga OH, & Mulyadi A. 2009. Penampilan penggerek polong kedelai, *Etiella zinckenella* Treitschke (Lepidoptera: Pyralidae), dan pemilihan inang pada kedelai dan kacang tanah [Performance of soybean pod borer, *Etiella zinckenella* Treitschke (Lepidoptera: Pyralidae), and host preference on soybean and groundnut]. *Jurnal Akta Agrosia*. 12(1): 62–67.

Baliadi Y, Tengkano W, & Marwoto. 2008. Penggerek polong kedelai *Etiella zinckenella* Treitschke (Lepidoptera: Pyralidae), dan strategi pengendaliaannya di Indonesia [Soybean pod borer, *Etiella zinckenella* Treitschke (Lepidoptera: Pyralidae), and its control strategy in Indonesia]. *Jurnal Litbang Pertanian*. 27(4): 113–123.

Bayu MSYI, Tantawizal YI, & Prayogo Y. 2016. Tingkat serangan penggerek polong pada genotipe kedelai toleran ulat grayak [The rate of pod borer attack on the armyworm tolerant soybean genotype]. In: Rahmianna AA, Sholihin, Nugrahaeni N, Taufiq A, Suharsono, Saleh N, Ginting E, Rozi F, Tastra IK, Hermanto, Yusnawan E, & Harnowo D (Eds.). *Prosiding Seminar Nasional Hasil Penelitian Tanaman Aneka Kacang dan Umbi Peran Inovasi Teknologi Aneka Kacang dan Umbi tahun 2015.* pp. 310–315. Pusat Penelitian dan Pengembangan Tanaman Pangan. Badan Penelitian dan Pengembangan Pertanian. Bogor.

Birkhofer K, Bezemer TM, Bloem J, Bonkowski M, Christensen S, Dubois D, Ekelund F, Fließbach A, Gunst L, Hedlund K, Mäder P, Mikola J, Robin C, Setälä H, Tatin-Froux F, Putten WHV, & Scheu S. 2008. Long-term organic farming fosters below and aboveground biota: implications for soil quality, biological control and productivity. *Soil Biol. Biochem*. 40(9): 2297–2308. https://doi.org/10.1016/j.soilbio.2008.05.007

Huang S & Han Z. 2007. Mechanisms for multiple resistances in field populations of common cutworm, *Spodoptera litura* (Fabricius) in China. *Pestic Biochem Physiol.* 87(1): 14−22. https://doi.org/10.1016/j.pestbp.2006.05.002

Indiati SW & Marwoto. 2017. Penerapan Pengendalian Hama Terpadu (PHT) pada tanaman kedelai [Application of Integrated Pest Management (IPM) on soybean]. *Buletin Palawija*. 15(2): 87–100. http://dx.doi.org/10.21082/bulpa.v15n2.2017.p87-100

Khojely DM, Ibrahim SE, Sapey E, & Han T. 2018. History, current status, and prospects of soybean production and research in Sub-Saharan Africa. *The Crop Journal.* 6(3): 226–235. https://doi.org/10.1016/j.cj.2018.03.006

Marwoto, Hardaningsih S, & Taufiq A. 2017. Hama dan Penyakit Tanaman Kedelai: Identifikasi dan Pengendaliannya [Soybean Pests and Diseases: Identification and Control]. Pusat Penelitian dan Pengembangan Tanaman Pangan. Badan Penelitian dan Pengembangan Pertanian, Bogor.

Marwoto & Saleh N. 2003. Peningkatan parasitoid telur *Trichogrammatoidea bactrae-bactrae* dalam pengendalian hama penggerek polong kedelai *Etiella* spp. [Increased role egg parasitoid *Trichogrammatoidea bactrae-bactrae* in the control of the soybean pod borer *Etiella* spp.] *J. Litbang Pertan*. 22(4): 141–149.

Marwoto & Suharsono. 2008. Strategi dan komponen teknologi pengendalian ulat grayak (*Spodoptera litura* Fabricius) pada tanaman kedelai [Strategy and technology for controlling armyworm (*Spodoptera litura*) in soybean]. *Jurnal Litbang Pertanian*. 27(4): 131–136.

Minarno EB & Khoiriyah I. 2011. Ketahanan galur kedelai (*Glycine max* L.) terhadap serangan ulat grayak (*Spodoptera litura* F.) berdasarkan karateristik trikoma [Resistance of soybean line (*Glycine max* L.) against armyworm (*Spodoptera litura* F.) attack based on trichome characteristics]. *El-Hayah Jurnal Biologi.* 2(1):7–14. https://doi.org/10.18860/elha.v2i1.1792

Mulyaningsih L. 2017. Pengaruh penggunaan pupuk urea terhadap serangan hama kepik coklat (*Riptortus linearis* Fabricius) pada kedelai (*Glycine max* L.) [Effect of urea fertilizer use on brown ladybug (*Riptortus linearis* Fabricius) attack on soybean (*Glycine max* L.)]. *AGRI-TEK: Jurnal Ilmu Pertanian, Kehutanan, dan Agroteknologi*. 18(1): 30–35.

Pandjaitan AM. 2021. Keragaman Hama pada 15 Varietas Kedelai (*Glycine max* L. Merril) pada Uji Semi-Lapang [Pest Diversity in 15 Soybean Varieties (*Glycine max* L. Merril) in Semi-Field Test]. *Skripsi.* Universitas Bengkulu, Bengkulu.

Pujiwati H, Ginting S, Susilo E, Suharjo UKJ, & Husna M. 2021. Effects of N and P dosages on crop growth, yield, and attack of pod borrer (*Etiela zinckenella*) of soybean c.v. Detam-1 grown at swampy land. *Int. J. Agric. Technol.* 17(5): 1887–1894.

Sari KP & Suharsono. 2010. Trikoma sebagai faktor ketahanan kedelai terhadap hama penggerek polong [Trichomes as a factor of soybean resistance to pod borer pests]. *Buletin Palawija*. 20: 80–83.

Suharsono & Suntono. 2004. Preferensi peneluran hama penggerek polong pada beberapa galur varietas kedelai [Egg borer preference for pod borer in several soybean varieties]. *Jurnal Penelitian Pertanian Tanaman Pangan*. 23(1): 38–43.

Suharsono. 1997. Identifikasi senyawa khemis dan karakter morfologis yang berperan dalam ketahanan tanaman kedelai terhadap hama pengisap polong [Identification of chemical compounds and morphological characters that play a role in soybean plant resistance to pod sucking pests]. *Laporan Hasil Penelitian Tahun 1996/1997.* Balai Penelitian Tanaman Aneka Kacang dan Umbi, Litbang Pertanian, Malang.

Susanto GWA & Adie MM. 2008. Penciri ketahanan morfologi genotipe kedelai terhadap hama penggerek polong [Characteristics of morphological resistance of soybean genotypes against pod borer pests]. *Jurnal Penelitian Pertanian Tanaman Pangan.* 27(2): 1–6.

Tamang S, Venkatarao P, & Chakraborty G. 2017. Varietal screening of mungbean cultivars for resistance/tolerance against insect pest under Terai Agro ecological zone of West Bengal. *Int. J. Plant Prot.* 10(1): 7–13. https://doi.org/10.15740/HAS/IJPP/10.1/7-13

Untung K. 2001. P*engantar Pengelolaan Hama Terpadu* [Introduction to Integrated Pest Management]. Gadjah Mada University Press, Yogyakarta.