

## Response of soybean genotypes against armyworm, *Spodoptera litura* based on no-choice test

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**Abstract.** Armyworm is important polyphagous pest causing economic losses in many agricultural crops including soybean. In Indonesia, there are no soybean varieties which indicated had a resistance against armyworm. The experiment was conducted in Laboratory of Entomology and Green House of Indonesian Legumes and Tuber Crops Research Institute from March to April 2016. The experiment was arranged using randomized block design with a total of 18 soybean genotypes as a treatment in three replicates. The results showed that the difference of soybean genotypes had a significant effect on the leaf damaged intensity. Based on no-choice test and the leaves damaged intensity compared with resistant check genotypes, there was no genotype indicated resistant against *S. litura*. Most of the tested genotype showed moderately resistant and others showed susceptible to highly susceptible. Genotypes that indicated as moderately resistant are G 511 H/Anjs-1-1, G 511 H/Arg//Arg//Arg-30-7, G 511 H/Kaba//Kaba//4-4, G 511 H/Kaba//Kaba//Kaba//Kaba-16-2, G 511 H/Anjs/Anjs//Anjs-3-3, G 511 H/Anjs/Anjs-1-2, G 511 H/Anjs/Anjs-5-5, G 511 H/Anjs/Anjs//Anjs-6-11, and Argomulyo. In conclusion, those nine genotypes indicated have antixenosis resistance against armyworm and can be considered as a source of gene for improving the soybean resistance to armyworm.

**Keywords :** Soybean genotypes, resistance, armyworm

### 1. Introduction

Soybean, *Glycine max* (L.) Merrill, is the main staple food of most Indonesian people. In Indonesia, soybean production in 2010 was about 907.031 ton and in 2013 was 779.992 ton. There was a decrease about 127.039 ton during its three years. The decreasing of soybean production is related to the reducing of soybean harvested area about 110.030 ha during 2010 to 2013 [1]. Moreover, the presence of insect pest can be a major factor that adversely influence the reduction of soybean production [2], [3]. According to [3], soybean yield losses caused by insect pest are difficult to be estimated due to the control technology used which generally by applying chemical insecticide intensively, environmental condition, socio-economic status of the farmers, and the genetic variation of soybean.

Among the insect pests that attack soybean from the early growth up to harvesting time, armyworm, *Spodoptera litura* Fabricius (Lepidoptera: Noctuidae) is the major defoliating pest and responsible for huge yield losses [2], [4]. Soybean yield loss caused by *S. litura* in untreated area was about 68% as compare with the yield in treated area with lambda cyhalothrin [5]. Larva is the most



destructive stage of *S. litura* in which attacked leaves and pods that plays an important role in the early reproductive phases. The presence of this insects pest should be considered because its known to have many host plants including cultivated plant and wild plant [2], [6], [7].

This pest was known to have ability to develop multiple type of resistance rapidly against chemical insecticide due to its short life cycle and the intensive use of the product [8]-[12]. In term of integrated pest management (IPM) programs and to minimize the residues of chemical, the use of resistant variety for controlling this insect pest is important and become valuable strategy [13]-[15]. Beside its environmentally friendly, the use of resistant variety is low cost and compatible with the utilization of natural enemies such as *Oxyopes javanus* and *Coccinellidae* [16]. In Indonesia, an increasing the resistance of soybean plant against armyworm has been a priority in current breeding program.

Most researchers have searched for and identified armyworm-resistance soybean germ plasm to be used as a resistance donor parents. The mechanisms of resistance against armyworm have been identified through morphological and physiological character of soybean plant [14], [17]-[20]. In Indonesia, there was soybean introduction genotype from Brazil namely IAC 100 were shown to exhibit resistance against armyworm [21]-[23]. IAC 100 was confirmed to have resistance to other herbivorous insects including pod sucking bug and soybean pod borer [24], [25]. In addition, one genotype namely G100 H has confirmed as resistant genotype against armyworm [23], [26]. G100 H known as a result from cross breeding between IAC 100 and Himeshirazu, in which Himeshirazu exhibited resistance against armyworm [27]. Identification of host plant resistant against armyworm is highly required in order to minimize the yield losses. Based on this point of view, the objective of this study was to identify the soybean genotypes resistance to armyworm.

## 2. Materials and Methods

The experiment was conducted in the Laboratory of Entomology and green house of Indonesian Legumes and Tuber Crops Research Institute, East Java, Indonesia, from March to April 2016. The experiment was arranged using randomized block design with 18 treatments and four replicates. A total of 18 soybean genotypes were assessed: G 511 H/Anjs/Anjs-2-13, G 511 H/Anjs-1-1, G 511 H/Arg//Arg//Arg-30-7, G 511 H/Kaba//Kaba///-4-4, G 511 H/Kaba//Kaba///Kaba///Kaba-16-2, G 511 H/Anjs/Anjs///Anjs-3-3, G 511 H/Anjs/Anjs///-6-13, G 511 H/Anjs/Anjs-1-2, G 511 H/Anjs/Anjs-5-5, G 511 H/Anjs/Anjs///Anjs-6-11, G 511 H/Anjs/Anjs///Anjs-8-1, G 511 H/Anjs/Anjs-1-3, G 511 H/Anjs/Anjs///Anjs-6-12, G 511 H/Anj//Anj///Anj///Anjs-6-8, Anjasmoro and Argomulyo. G100H and IAC 100 plays as resistant check genotypes.

### 2.1 Experimental site

Each genotype was planted in pot ( $\Phi$  =18 cm) containing 10 kg of soil that was mixed with manure in a ratio of 4:1, two plants/pot, two pots/genotype/replicate. Planting was arranged such a way that the 2<sup>nd</sup> larva available when the plant was at 28 days. Each pot was fertilized with 0,4 g urea and 1,2 g NPK in the sowing date. Irrigation was done as required. The control of been fly was done by using sipermetrin at 8 days after sowing (DAS) with a dosage of 1 ml/l and the control of foliage pest was done at 14 and 21 DAS by using sihalotrin with a dosage of 1-2 ml/l. In order to improve quality of plant, then applied by using gandasil D (at 14, 21, and 28 DAS) and gandasil B (at 21 and 28 DAS) with a dosage of 2 g/l.

### 2.2 *S. litura* culture

Egg populations of *S. litura* originally collected from soybean field in Kendalpayak Experimental Station, Malang, East Java on January 2016. Eggs were kept inside petri dishes (height (h): 2 cm and  $\Phi$ : 20 cm), given by fresh soybean leaves in order to provide feed for new emerged larva. It maintained continuously up to pupae. Pupa was then kept in the test tube (h: 20 cm and  $\Phi$ : 3 cm), given by a piece of yard long been to provide humidity inside the test tube. A new emerged adult were transferred into the cage made from iron frame (h: 50 cm and  $\Phi$ : 26 cm) then were covered with a white fabric. Some of cotton layers that have been given 10% honey solution were hung on the top of

the cage to provide feed for adult. Egg laid by females were collected every day and kept continuously as mention above.

### 2.3 *S. litura* infestation

The resistance evaluation was use no-choice test. At 26 DAS, each pot was enclosed in the screen cage (h: 100 cm and  $\Phi$ : 30 cm). The screen cages were made of nylon fabric that is not translucent to larva *S. litura*. Three individuals of 2<sup>nd</sup> instar larva were infested into each plant within screen cage at 28 DAS at 14.00 am for one week. Parameter measured on the damaged leaf/plant. Damaged leaf was measured by scoring method with scale from 0–4, in which 0: no damaged, 1: 1-25% leaf damaged, 2: 26-50% leaf damaged, 3: 51-75% leaf damaged, 4: >76% leaf damaged. The leaf damage intensity was calculated as follows:

$$P = \sum \frac{(ni \times vi)}{ZN} \times 100\%$$

in which, P = Leaf damaged intensity,  $ni$  = Number of damaged leaf with score I,  $vi$  = Score i (i: 0-4), Z = The highest score (4), N = Total number of leaves.

The criterion of resistance following method by [28]:  $x > x + 2SD$  = HS (Highly Susceptible),  $x > x + 2SD$  = S (Susceptible),  $x > x - 1SD$  = MR (Moderately Resistant),  $x - 1SD > x > x - 2SD$  = R (Resistant),  $x < x - 2SD$  = HR (Highly Resistant).

### 2.4 Statistical analysis

Data were subjected to analysis of variance (ANOVA) and mean values were compared using Tukey's test when significant F values were obtained ( $\alpha = 0.05$ ; SPSS ver. 22).

## 3. Result and Discussion

The result showed that leaf damaged intensity was significantly influenced by the genotypes (Table 1). The average of leaf damaged intensity at 28 DAS was 21.4%/plant (ranged from 5.36 to 36.2%). The lowest leaf damaged intensity was found on Argomulyo, which was 15.68%, followed by genotype G 511 H/Anjs/Anjs-5-5(15.7%). The highest leaf damaged intensity was found on G 511 H/Anjs/Anjs///Anjs-6-12 (36.2%).

**Table 1.** Leaf damaged intensity of 18 soybean genotypes at 28 DAS, Malang, Indonesia, 2016.

Genotype	Leaf damaged intensity (%)	Category
G 511 H/Anjs/Anjs-2-13	25.4	S
G 511 H/Anjs-1-1	19.8	MR
G 511 H/Arg//Arg//Arg-30-7	19.3	MR
G 511 H/Kaba//Kaba///-4-4	20.6	MR
G 511 H/Kaba//Kaba///Kaba///Kaba-16-2	20.6	MR
G 511 H/Anjs/Anjs///Anjs-3-3	19.5	MR
G 511 H/Anjs/Anjs///-6-13	23.2	S
G 511 H/Anjs/Anjs-1-2	18.5	MR
G 511 H/Anjs/Anjs-5-5	15.7	MR
G 511 H/Anjs/Anjs///Anjs-6-11	18.7	MR
G 511 H/Anjs/Anjs///Anjs-8-1	23.5	S
G 511 H/Anjs/Anjs-1-3	29.1	HS
G 511 H/Anjs/Anjs///Anjs-6-12	36.2	HS
G 511 H/Anj//Anj//Anj///Anjs-6-8	30.2	HS
Anjasmore	27.5	S
Argomulyo	15.7	MR

G100 H	17.7	MR
IAC 100	5.4	HR

Based on leaves damaged intensity compared with resistant check genotypes, there was no genotype indicated resistant against *S. litura*. Most of the tested genotype showed moderately resistant and others showed susceptible to highly susceptible. Genotypes that indicated as moderately resistant are G 511 H/Anjs-1-1, G 511 H/Arg//Arg///Arg-30-7, G 511 H/Kaba//Kaba///-4-4, G 511 H/Kaba//Kaba///Kaba///Kaba-16-2, G 511 H/Anjs/Anjs///Anjs-3-3, G 511 H/Anjs/Anjs-1-2, G 511 H/Anjs/Anjs-5-5, G 511 H/Anjs/Anjs///Anjs-6-11, and Argomulyo. The resistant check genotype, IAC 100 showed consistently resistant with the lowest leaf damage intensity (5.4%).

In this research, G100 H showed moderately resistant with the leaves damaged intensity was about 17.7%. In previous study, G100 H exhibited resistance against armyworm based on choice test and preference index [23], [26]. The possible reason to explain this phenomenon is that the different method used on both study. In choice test, larvae have a chance to choose the most preferred genotype to be eaten. Larva will avoid genotypes that potential to inhibit their performance. However, no-choice test does not provide the opportunity for larva to select the most preferred host. It may cause the leaf damaged become high as compared with choice test. In no-choice test, even though larvae were maintained isolated on certain genotypes and have low feeding preference, but larvae should eat for continuing their life. It could generate considerable damaged on soybean [29]. Therefore, no-choice test showed the potential method to obtain resistant genotype against armyworm. This finding is in line with the previous study that the level of leaf consumption on bean genotypes by *Chrysodeixis includes* larva was higher in the no-choice test than that in choice test including in promising resistance genotypes against Lepidoptera, IAC Boreal [30].

Genotypes that indicated as moderately resistant in this study were less preferred by larva of *S. litura* to be eaten. Presumably, leaves of those genotypes are thick so the larva of armyworm could not consume normally. Another reasons maybe due to the presence of organic compound such as methyl salicylate and jasmonic-acid. Methyl salicylate and jasmonic-acid can attract natural enemies to colonize the plant. The existence of natural enemies caused the pest stay away from the plant. Moreover, plant known to have certain chemical compound such as isoflavon that provides detrimental effect on insect behavior especially on their development, mortality, and reproduction. Insect will avoid the plant with such of characteristics.

Generally, the resistance mechanisms of soybean genotype to armyworm are divided into antixenosis or non-preference, antibiosis, and tolerance. Sometimes, it could be a combination of both or various mechanisms of resistance. Antixenosis is the resistance mechanism in which the insect is either repelled by or not attracted to the host plant, as well as for feed, colonize, or laying eggs [13], [14]. It occurred due to the plant morphological structure or secondary metabolites that exhibit from the host plant that play an important role in plant protection against insect pests [31]. Plant morphological structure could include the denser trichomes and the thickness of leaf. Further research to identify the length and density of trichomes as well as the thickness of leaf are required.

#### 4. Conclusion

In conclusion, the findings of these trials are importance for soybean breeders. The genotypes that indicated moderately resistant (G 511 H/Anjs-1-1, G 511 H/Arg//Arg///Arg-30-7, G 511 H/Kaba//Kaba///-4-4, G 511 H/Kaba//Kaba///Kaba///Kaba-16-2, G 511 H/Anjs/Anjs///Anjs-3-3, G 511 H/Anjs/Anjs-1-2, G 511 H/Anjs/Anjs-5-5, G 511 H/Anjs/Anjs///Anjs-6-11, and Argomulyo) can be considered as a source of the gene for improving the soybean resistance against armyworm.

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