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Screening of soybean genotypes for resistance to pod sucking bug, *Riptortus linearis*

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Abstract. *Krisnawati A, Bayu MSIY, Adie MM. 2017. Screening of soybean genotypes for resistance to pod sucking bug,* Riptortus linearis. *Nusantara Bioscience 9: 181-187.* Pod sucking bug, *Riptortus linearis,* is potentially harmful pest of soybean in Indonesia. The development of resistant variety is one of the major goal in soybean breeding. The research aimed was to identify the resistance of soybean genotypes to pod sucking bug. The experiment was conducted in Indonesian Legumes and Tuber Crops Research Institute's screen house from March to June 2015. The experiment was arranged in Randomized Complete Block Design using 10 soybean genotypes with three replicates. The resistance was evaluated by choice and no-choice test. Data collected on some agronomic characters, number of damaged pod/plant, and number of damaged seed/plant. The resistance criteria determined by using the method from Chiang and Talekar (1980). The results showed that the lowest percentage of pod and seed damage was found on G511H/Anjasmoro//Anjasmoro-2-8 in both no-choice and choice test. In the no-choice test, the lowest percentage of pod and seed damage were 25.83% and 19.12%, respectively. In the choice test, the lowest percentage of pod and seed damage were 25.02% and 20.02%, respectively. The grouping of resistance genotypes based on the no-choice test as well as choice test, the genotype G511H/Anjasmoro//Anjasmoro-2-8 showed a consistently resistant. This genotype could be used as a resistant donor in the soybean breeding program for resistance to pod sucking bug.

Keywords: *Glycine max, Riptortus linearis*, resistance, screening

INTRODUCTION

Soybean (*Glycine max* (L.) Merrill) is major legume crop in tropical and subtropical areas, which contribute to the half of global demand for oil and vegetable protein (FAO 2013). The annual soybean production during 2015 was reported around 313.26 million tons (USDA 2016), and losses caused by incidence of insect pest is one of the important factors leading to the reduced soybean production and productivity (Oerke and Dehne 2004; Massoni and Frana 2005; Oliveira et al. 2014). The accurate estimates of soybean yield losses caused by insect pests are difficult to be obtained due to environmental conditions, the susceptibility of genotype, the socio-economic conditions of farmers, and the level of technology used (McPherson and McPherson 2000; Oliveira et al. 2014). However, the total global potential soybean loss due to pests for the period of 2001-2003 was varied from 26-29% (Oerke 2006).

Among many insect pests, pod sucking bug is the most significant threat to soybean plant in Indonesia which causing serious economic damage to soybean yield (Asadi 2009; Bayu 2015). There are three most dominant species of pod sucking bug with different morphologies and distributions in Indonesia, namely *Riptortus linearis* F., *Nezara viridula* L. and *Piezodorus rubrofasciatus* (Tengkano et al. 1988; Bayu and Tengkano 2014). Of the three soybean pod suckers, *Riptortus linearis* was the most common species distributed in Indonesia and also become most harmful pest that may causes up to 79% yield reduction (Prayogo et al. 2005; Arifin and Tengkano 2008; Asadi 2009), especially when the insect attacked at 45-55 days after planting (DAP) (Winoto 1986). *R. linearis* attack soybean seed by inserting their stylets into the seeds, and it sucked the liquid nutrient of young seeds (Bae et al. 2014). This pest begins to attack soybean plant since the pods formation stage (Naito 2008) and reached high densities when the plant reaches the R5-R6 stage (Acle and Rolim 1994; Musser et al. 2011). The damages caused by this infestation led to significant reductions in germination rate, seed quality, and yield (Correa-Ferreira and Azevedo 2002; Leonard et al. 2011; Bayu 2015).

In terms of pests' control, the use concept of integrated pest management (IPM) is recommended for sustainable crop management, such as using resistant varieties, cultural techniques, the use of natural enemies, the use of bio pesticides and synthetic insecticides (Chandler et al. 2011; Panizzi 2013). In fact, one of the ideal methods to control soybean pod sucking bug is to cultivate resistant variety. The use of the resistant plant is proposed to be stabilized the yield and has significant advantages over the use of chemical insecticides. It is also proved to be environmentally friendly, minimize the production costs, does not involve the transfer of new technologies and is considered compatible with other control methods used in insect management (Pinheiro et al. 2005; Suharsono and Sulistyowati 2012).

A total of 85 soybean varieties have been released in Indonesian during 1918-2016, but none of them were reported to be resistant to pod sucking bug. However, the previous study revealed that soybean genotypes IAC-100, IAC-80-596-2, IAC-80-569-2, and G100H consistently had less damaged by *R. linearis* (Suharsono 2001; Suharsono and Sulistyowati 2012). IAC 100 was derived from crosses between genotype IAC-12 and IAC 78-2318, which showed resistance to leaf-eating pest and pod sucker (Veiga et al. 1999; Suharsono 2004). In addition, to resistant to pod sucking bug, IAC 100 also reported has a strong defense against stress caused by biological factors such as wound caused by insect pests (McPherson et al. 2007; Timblo et al. 2014). Those genotypes could be used as a source of resistance to pod sucking bug, which is integrated with others consumer's preference in the soybean breeding program. Pinheiro et al. (2005) performed partial diallel crosses between insect-attack susceptible and resistant soybean genotypes to check the possibility of joining favorable alleles both of insect resistance and high seed yield in the same genotype. The result showed that IAC 100 presented the highest general combining ability, involving insect resistance and yield traits, thus, being considered an important source of genes for those characteristics. In addition, the crossing of Davis × IAC-100 showed a higher potential for specific combining ability to seed yield and resistance to sucking and chewing insects.

Varietal screening is a continuous activity which plays an important role in increasing the chances of discovering resistant genotypes (Pinheiro et al. 2005). The most common methodologies employed for testing the resistance are no-choice and choice tests (Van Driesche and Murray 2004). Since the resistance to pod sucking bug was indicated to be controlled by genetic factors (Cardoso de Codoi and Pinheiro 2009; Asadi et al. 2012), therefore, the possibility to obtain resistant genotypes were considered would be higher. The objective of this research was to identify the resistance of soybean genotypes to pod sucking bug, *Riptortus linearis,* F.

MATERIALS AND METHODS

Collecting and Rearing *R. linearis*

Riptortus linearis adults were originally collected from soybean fields in Kendalpayak Research Station (Malang) and were reared in the Laboratory of Entomology, Indonesian Legumes and Tuber Crops Research Institute (ILETRI). The adults were reared in acrylic cages (50 cm in height and diameter of 26 cm) that were ventilated using a fine mesh on its lateral sides. Fresh soybean pods were provided inside the cage as a food source for *R. linearis*. The egg was collected daily and was used for mass rearing of the insect. *R. linearis* nymphs were reared in separate cages and provided with soybean seeds and red kidney bean pod (*Phaseolus vulgaris* L.) until used in the experiment.

Soybean Planting

The research materials, which consisted of ten soybean genotypes (G511H/Anjasmoro//Anjasmoro-2-8, G511H/Arg//Arg///Arg///Arg-12-15, G511H/Anj//Anj///Anj-6-3, G511H/Arg//Arg///Arg///Arg-19-7, G511H/Anjasmoro-1-7, G511H/Anj//Anj///Anj////Anjs-6-7, G511H/Anjasmoro-1-4, Anjasmoro, Grobogan, and G100H), were grown in the screen house of ILETRI, from March to June 2015. The experiment was arranged in Randomized Completely Block Design in triplicates. Each genotype was planted in a plastic pot (Φ =18 cm) containing 10 kg of soil which was mixed with manure in a ratio of 4:1, two plants/pot. Planting was arranged in such a way that ten soybean genotypes can be simultaneously flowering. NPK fertilizer 5 g/pot was applied prior before sowing. Pests and diseases were controlled optimally until flowering time, and after that the pest and disease were uncontrolled.

Choice test

In this experiment, ten soybean genotypes were arranged randomly and placed in a meshed cage (with replicates for each). The meshed cage (length = 120 cm, width = 120 cm, and height = 100 cm) was made from a material that is not translucent to adult *R. linearis*. Newly emerged adult *R. linearis* (n=2 per plant or 20 per cage) were released into each cage during the R5 stage of the soybean.

No-choice test

Each soybean genotype was enclosed in a meshed cage (50 cm in height and diameter of 26 cm), and arranged randomly according to per replication. A pair of newly emerged adult *R. linearis* were infested into each cage during the R5 stage of the soybean.

Soybean harvest and damage classification

Soybean pods were harvested after attained full maturity. Seeds were retained from the pods manually, and then seeds were visually inspected for the damage intensity caused by *R. linearis* under a binocular microscope. The observations were also made for plant height, number of branches/plant, number of node/plant, number of punctures on seed, number of attacked seed/plant, number of seed/plant, and seed weight/plant.

The intensity of damaged seed was calculated as follows:

$$\text{Damaged seed} = \frac{\text{Number of attacked seed}}{\text{Number of total seeds}} \times 100\%$$

The criterion of resistance following method by Chiang dan Talekar (1980):

$x > \bar{x} + 2SD$ = HS (Highly Susceptible)
$\bar{x} > x > \bar{x} + 2SD$ = S (Susceptible)
$\bar{x} > x > \bar{x}-1SD$ = MR (Moderately Resistant)
$\bar{x}-1SD > x > \bar{x}-2SD$ = R (Resistant)
$x < \bar{x}-2SD$ = HR (Highly Resistant)

Data analysis

Data were subjected to analysis of variance using a general linear model, and continued with DMRT at 5% significance level.

RESULTS AND DISCUSSION

Pod sucking bug is one of the most damaging pests of soybean crops in Indonesia. These pest has spread widely and become a very serious pest across the soybean planting season. Identification of soybean genotypes tolerant to pod sucking bug has significance role for sustainability of soybean production in Indonesia. In this study, screening of soybean genotypes to pod sucking bug was using two methods, i.e. choice and no-choice test. No choice test has been widely used to complement the choice test to both identify and confirm the presence or absence of insect resistance in plants. The use of choice and no-choice screening methods to maximize the identification and measurement of insect resistance was suggested to provide reliable results (Smith et al. 1993).

Choice test

Analysis of variance showed that plant height was significantly different between genotypes, whereas other parameters were not significant (Table 1). Choice test provides the opportunity for insect pests to determine and select the most preferred host. Based on the choice test, the average number of punctures on seed was 38.66 (range 18.67-51.17 punctures), the average number of attacked seed was 26.87 seeds (range 16.00-37.33 seeds), the average number of seed per plant was 79.55 seeds (range 61.50-97.67 seeds), and the average intensity of damaged seed was 34.18% (range 20.02-41.04%) (Table 2).

Based on the number of attacked seed per plant, there were two genotypes showed the lowest attacked seed, namely G511H/Anjasmoro//Anjasmoro-2-8 and G511H/ Anj//Anj///Anj-6-3. Those genotypes showed a different number of punctures on seed, which are 18.67 and 30.75 spots, respectively. This means that each genotype has different characters that mainly effect on the ability of the pest to injure the plant. This differences in the number of punctures seed may be related to physical factor such as the distance that separates the seed from the wall of the pod, which making the stylet of pod sucking bug cannot reach the seed (Pannizi and Silva 2009). Not only the adult stage who attacked the soybean pod, but also the nymph which has a shorter stylet. The lowest intensity of damaged seed was found on genotype G511/Anjasmoro//Anjasmoro-2-8 (20.02%), followed by G511/Anj//Anj///Anj-6-3 (24.84%). The highest intensity of damaged seed was found on G511H/Anjasmoro-1-7 (41.04%). This genotype also has the highest number of punctures on seed (47.17 punctures) (Table 2). According to Suharsono and Sulistyowati (2012), damage from pod feeding insects by stylet punctures of pod sucking bug and direct feeding by pod feeders cause considerable yield loss of soybean. The performance of some agronomic characters of ten soybean genotypes on the choice test was presented in Table 3. The average of plant height was 71.759 cm, number of branches was 3.777, number of nodes was 18.83, and seed yield per plant reached 17.299 g. Based on seed yield, G 511 H/Anjasmoro-1-4 produced the highest yield (19.758 g).

No-choice test

The analysis of variance for some agronomic characters and resistance to pod sucking bug using no-choice test was presented in Table 4. The genotype effect was significant for all observed characters, except number of nodes per plant, number of seed per plant, and seed weight per plant.

No-choice test means that the insects were given no-choice access to another host plants. In the no-choice test, the average number of punctures on seed was 38.68 (range 21.33-84.83 punctures), average number of attacked seed was 29.18 (range 15.33-62.67 seeds), average number of seed per plant was 84.76 (range 54.33-113 seeds per plant), and average intensity of damaged seed was 34.24% (range 19.123-57.33%.) (Table 5). Genotype G511H/Anjasmoro// Anjasmoro-2-8 had relatively low punctures on seed (22 punctures), also followed by a low number of attacked seed (15.33 seeds) and resulted in more moderate intensity of damaged seed (19.123%). In this method, Grobogan variety showed comparable damaged seed with G511H/ Anjasmoro//Anjasmoro-2-8, that is 20.203%. Interestingly, genotype G511H/Arg//Arg/// Arg///Arg-12-15 with the lowest punctures on seed (21.33), turn out to have the intensity of damaged seed up to 24.927%. In comparison with the intensity of damaged seed obtained by choice test, the no-choice test showed the high intensity of damaged seed on several genotypes. The possible reason is that when the pod sucking bug is maintained isolated on certain genotypes, even though the genotype has low feeding preference, but this pest could causing considerable damage (Cunningham and Zalucki 2014).

Based on the no-choice test, G511H/Anjasmoro// Anjasmoro-2-8 categorized as resistant to pod sucking bug. This genotype produced yield 18.67 g/plant, plant height 54.50 cm, and a relatively few on number of pod and branches (Table 6). The number of punctures on seed and intensity of damaged seed were higher in no-choice test compared to choice test. A similar result also reported by Morando et al. (2015), who investigated the antixenosis of bean genotypes to *Chrysodeixis includens* by using choice and no-choice test. The author revealed that the level of leaf consumption was higher in the no-choice test than that in choice test in several bean genotypes including 'IAC Boreal', which promising for resistance against Lepidoptera. However, in the cowpea cultivar, no significant difference in percentage seed damage was found between the free-choice and the no-choice tests (Olatunde et al. 1991). The no-choice test ensures an even distribution of the test on all test plants (Smith et al. 1993). No-choice test does not provide the opportunity for insect pests to select the preferred host, may cause the number of punctures on seed and the number of attacked seeds to be higher. Thus, the no-choice test has the potential to obtain resistant genotype to pod sucking bug compared to those of choice test.

Table 1. Analysis of variance of ten soybean genotypes on choice test (Malang, East Java, Indonesia 2015)

Parameter	Mean Square		CV (%)
	Replication	Genotype	
Plant height (cm)	136.517157^{ns}	265.945171**	10.85
Number of branches/plant	0.05147059^{ns}	2.54693174^{ns}	34.97
Number of nodes/plant	0.4215686^{ns}	22.2912128^{ns}	21.11
Number of punctures on seed	332.208333^{ns}	314.513889^{ns}	54.61
Number of attacked seed/plant	175.531863^{ns}	165.115105^{ns}	54.49
Number of seed/plant	378.264706^{ns}	379.256354^{ns}	24.39
Intensity of damaged seed	166.500699^{ns}	143.148909^{ns}	42.86
Seed weight per plant (g)	0.73103162^{ns}	9.16341289^{ns}	20.11

Note: CV= coefficient of variation, ** = significant at 1% probability level ($p < 0.01$), ns = not significant

Table 2. Number of punctures on seed, number of attacked seed, number of seed, and intensity of damaged seed from ten soybean genotypes on choice test (Malang, East Java, Indonesia 2015)

Genotypes	Number of punctures on seed	Number of attacked seed/plant	Number of seed/plant	Intensity of damaged seed (%)
G511 H/Anjasmoro//Anjasmoro-2-8	18.67	16.00	79.33	20.02
G511 H/Arg//Arg///Arg///Arg-12-15	28.67	18.00	72.33	24.84
G511 H/Anj//Anj///Anj-6-3	30.75	16.00	61.50	28.02
G511 H/Arg//Arg///Arg///Arg-19-7	28.50	21.00	78.00	29.07
G511 H/Anjasmoro-1-7	47.17	37.33	97.67	41.04
G511 H/Anj//Anj///Anj////Anjs-6-7	33.00	25.25	64.00	40.70
G511 H/Anjasmoro-1-4	51.17	37.17	86.33	39.39
Anjasmoro	38.00	27.25	69.50	38.06
Grobogan	32.17	21.83	76.33	28.86
G100H	33.83	24.83	96.00	27.36
Average	34.19	24.46	78.09	31.73

Table 3. Agronomic characters of ten soybean genotypes on choice test (Malang, East Java, Indonesia 2015)

Genotypes	Plant height (cm)	No. of branches/ plant	No. of nodes/ plant	Seed weight/ plant
G 511 H/Anjasmoro//Anjasmoro-2-8	62.500 bc	3.333	17.667	14.018
G 511 H/Arg//Arg///Arg///Arg-12-15	75.667 ab	4.500	18.833	16.260
G 511 H/Anj//Anj///Anj-6-3	71.000 ab	2.500	14.500	16.420
G 511 H/Arg//Arg///Arg///Arg-19-7	80.167 a	5.167	19.500	17.713
G 511 H/Anjasmoro-1-7	78.833 a	3.500	21.500	19.100
G 511 H/Anj//Anj///Anj////Anjs-6-7	54.250 c	3.250	17.500	16.193
G 511 H/Anjasmoro-1-4	80.500 a	3.833	21.000	19.758
Anjasmoro	60.750 bc	2.500	12.500	15.503
Grobogan	61.667 bc	3.000	18.833	18.747
G100H	82.500 a	5.167	22.500	18.018
Average	71.759	3.777	18.8333	17.299

Note: Value within the same column followed by the same letter are not significantly different at the 0.05 level according to Duncan's Multiple Range Test (DMRT).

Table 4. Analysis of variance of ten soybean genotypes on no-choice test (Malang, East Java, Indonesia 2015)

Parameter	Mean Square		CV (%)
	Replication	Genotype	
Plant height (cm)	226.258333ns	182.689815*	11.24
Number of branches/plant	1.10833333ns	6.59259259*	42.49
Number of nodes/plant	4.0750000ns	45.3342593ns	27.11
Number of punctures on seed	272.13333ns	1726.78611**	54.42
Number of attacked seed/plant	74.058333ns	814.526852**	44.25
Number of seed/plant	722.633333ns	1108.522222ns	31.05
Intensity of damaged seed	3.565290ns	554.647826**	32.96
Seed weight per plant (g)	3.30596083ns	6.90660222ns	14.13

Note: CV = coefficient of variation, * = significant at 5% probability level ($p < 0.05$), ** = significant at 1% probability level ($p < 0.01$), ns = not significant.

Table 5. Number of punctures on seed, number of attacked seed, number of seed, and intensity of damaged seed from ten soybean genotypes on no-choice test (Malang, East Java, Indonesia 2015)

Genotypes	Number of punctures on seed	Number of attacked seed/plant	Number of seed/plant	Intensity of damaged seed
G 511 H/Anjasmoro//Anjasmoro-2-8	22.00 b	15.33 b	74.67	19.123 c
G 511 H/Arg//Arg///Arg///Arg-12-15	21.33 b	17.83 b	73.33	24.927 bc
G 511 H/Anj//Anj///Anj-6-3	25.33 b	19.50 b	54.33	39.610 abc
G 511 H/Arg//Arg///Arg///Arg-19-7	29.50 b	23.50 b	98.33	23.357 bc
G 511 H/Anjasmoro-1-7	27.83 b	22.67 b	89.00	24.550 bc
G 511 H/Anj//Anj///Anj////Anjs-6-7	30.83 b	24.67 b	62.33	38.703 abc
G 511 H/Anjasmoro-1-4	42.33 b	31.67 b	84.33	44.637 ab
Anjasmoro	84.83 a	62.67 a	110.33	57.330 a
Grobogan	22.33 b	18.50 b	88.00	20.203 c
G100H	80.50 a	55.50 a	113.00	50.030 a
Average	38.68	29.18	84.76	34.24

Note: Value within the same column followed by the same letter are not significantly different at the 0.05 level according to Duncan's Multiple Range Test (DMRT).

Table 6. Agronomic characters of ten soybean genotypes on no-choice test (Malang, East Java, Indonesia 2015)

Genotypes	Plant height (cm)	No. of branches/ plant	No. of nodes/ plant	Seed weight/ plant
G 511 H/Anjasmoro//Anjasmoro-2-8	54.500 b	1.667 cd	14.833	18.670
G 511 H/Arg//Arg///Arg///Arg-12-15	69.833 a	3.667 abc	18.667	18.837
G 511 H/Anj//Anj///Anj-6-3	77.667 a	0.833 d	12.500	17.503
G 511 H/Arg//Arg///Arg///Arg-19-7	75.000 a	5.167 abc	23.333	19.540
G 511 H/Anjasmoro-1-7	79.500 a	2.500 bcd	17.833	19.240
G 511 H/Anj//Anj///Anj////Anjs-6-7	66.500 ab	4.333 ab	17.333	15.197
G 511 H/Anjasmoro-1-4	79.333 a	3.167 abcd	17.500	17.753
Anjasmoro	66.833 ab	3.333 abcd	19.667	16.673
Grobogan	66.667 ab	3.000 abcd	16.833	20.167
G100H	75.000 a	5.667 a	26.000	19.387
Average	71.083	3.333	18.450	18.296

Note: Value within the same column followed by the same letter are not significantly different at the 0.05 level according to Duncan's Multiple Range Test (DMRT).

Table 7. Resistance criteria of ten soybean genotypes based on choice and no-choice test (Malang, East Java, Indonesia 2015)

Genotypes	Choice test		No-choice test	
	Damaged seed (%)	Category	Damaged seed (%)	Category
G 511 H/Anjasmoro//Anjasmoro-2-8	20.02	R	19.12	R
G 511 H/Arg//Arg///Arg///Arg-12-15	24.84	MR	24.92	MR
G 511 H/Anj//Anj///Anj-6-3	28.02	MR	39.61	S
G 511 H/Arg//Arg///Arg///Arg-19-7	29.07	MR	23.35	MR
G 511 H/Anjasmoro-1-7	41.04	S	24.55	MR
G 511 H/Anj//Anj///Anj////Anjs-6-7	40.70	S	38.70	S
G 511 H/Anjasmoro-1-4	39.39	S	44.63	S
Anjasmoro	38.06	S	57.33	S
Grobogan	28.86	MR	20.20	R
G100H	27.36	MR	50.03	S
Average	31.73		34.24	
	7.44		13.59	

Note: R = resistant, MR = moderately resistant, S = susceptible

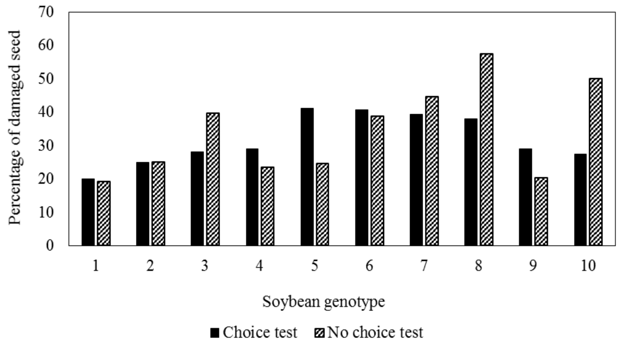

Figure 1. Percentage of damaged seed of ten soybean genotypes (Malang, East Java, Indonesia 2015)

Resistance of soybean genotypes

Grouping of resistance by percentage of damaged seeds using choice and no-choice tests showed different resistance among genotypes (Table 7). G511H/Anjasmoro// Anjasmoro-2-8 showed consistently less damaged seed based on both of choice and no-choice test, with damaged seed 20.02% and 19.12%, respectively. G511H/ Arg//Arg///Arg///Arg-12-15 and G511H/Arg// Arg///Arg/// Arg-19-7 showed moderately resistant in the both methods.

Resistance to pod sucking pests was reported to be associated with pod morphological factors (antixenosis) as well as antibiosis factors (War et al. 2012; Permana et al. 2012). Our study revealed that G511H/Anjasmoro// Anjasmoro-2-8, G511H/Arg//Arg///Arg///Arg-12-15 and G511H/Arg//Arg///Arg///Arg-19-7 showed consistent resistance on choice test as well as no-choice test than others. It means that those lines exhibit antixenosis and antibiosis resistance. Antixenosis is the resistance mechanism employed by the host plants, deters the insects from oviposition, feeding, seeking shelter, and colonization (Afzal et al. 2009; Morando et al. 2015) which is exhibited by the plants may be due to certain plant structural traits or allelochemicals, or various interactions among those factors (Gogi et al. 2010). The antixenosis resistance by those three lines may be due to the plant morphological characteristics (trichome density, trichome length, or thin pod wall), or secondary metabolites and proteins that have toxic, repellent, and/or antinutritional effects on the insects. According to War et al. (2012), plant morphological structures play a leading role in plant protection against insect pests as the first line of defense. Previous studies have found resistant genotypes (IAC-100, IAC-80-596-2, and IAC-596-2) which showed consistently less damaged by *R. linearis* due to longer and denser trichomes, higher crude fiber content and fewer stylet punctures. Denser and longer trichomes were thought to interfere with stylet piercing of the pod shell (Suharsono 2001; Suharsono et al. 2006; Suharsono and Sulistyowati 2012). Another study found soybean line of K4 as resistant genotype by non-preference (antixenosis) mechanism (Bayu and Tengkano 2014).

Antibiosis resistance affects biological processes of insects, such as survival, growth, generation time, fecundity, and longevity (van Emden 1997). The quantity and quality of primary and secondary plant metabolites are frequently associated with antibiosis (Pedigo 1999). G511H/Anjasmoro//Anjasmoro-2-8, G511H/Arg//Arg/// Arg///Arg-12-15 and G511H/Arg//Arg///Arg///Arg-19-7 were also considered had chemical compound that in which the *R. linearis* feeds on the plant that in turn provides an adverse effect on some stage of the insect development, such as immature mortality, reduction on size or weight, alteration of sex proportion, and life time, among others. According to Samira et al. (2011), each plant produces primary and secondary biochemical compounds which that attract and/or deter the insect pest.

In conclusion, G511H/Anjasmoro//Anjasmoro-2-8 had the lowest percentage of pod and seed damage based on both on choice as well as no-choice test, thus categorized as resistant. This line could be used as a source of genes for varietal improvement of soybean resistance to pod sucking bug, *R. linearis*. Knowledge of the mechanism of resistance will doubtlessly help in the development of soybean variety with improved pest resistance, especially for *R. linearis*, and may result in reduced insecticide use.

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