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Short Communication: Abundance of corn planthopper (*Stenocranus pacificus* Kirkaldy 1907, Hemiptera: Delphacidae) on five new corn varieties

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Abstract. *Syahrawati M, Nelly N, Hamid H, Efendi S. 2018. Short Communication: Abundance of corn planthopper (*Stenocranus pacificus *Kirkaldy 1907, Hemiptera: Delphacidae) on five new corn varieties. Biodiversitas 19: 1029-1034.* Both local and hybrid corn varieties have been attacked by *Stenocranus pacificus* or corn planthopper frequently grown in West Sumatra. So, the basic aim of the study is to know about the abundance of *S. pacificus* on major five corn varieties that will be intermittently released *viz.,* N35, N37, NT10, NT104, and NT105. The study was conducted around palm plantation in Dharmasraya District using Randomized Block Design in 5 replications. The observations were made at weekly intervals throughout the season after planting up to 8 weeks. Number of *S. pacificus* were collected from 16 hills by using simple aspirator, selected randomly from each unit. The measurement of leaf length, leaf width, stem diameter and trichome length were also performed to confirm the physical effect of *S. pacificus* preferences. LSD test at 5% level of significance was done to determine the influence of different varieties on insect population. The *S. pacificus* preferably effect to NT10 variety as compared to other varieties from the early growth of corn, but the *S. pacificus* abundance was higher at the generative phase than the vegetative. There was a very rapid increase in its population from week to week. Physical factors of the plant, as like as trichome, affected the insect abundance.

Keywords: Corn planthopper, population, new varieties of corn, physical barrier

INTRODUCTION

Corn (*Zea mays*) is one of the most important crops around the world after rice and soybean, and it also becomes the most important and staple food crop of Indonesia (Suarni 2009), which is also used as animal feed and for other industrial needs (Suarni and Yasin 2011). So for the same purpose, the corn demand, is steadily increasing. But, data from MoA (2016) showed that the development of the national corn trade in 2005-2014 tended to be negative, because the demand of corn was very high yet not fulfilled by increasing domestic production.

One of the several ways to increase domestic corn productivity is plant breeding program. Germplasm of high genetic diversity is required to obtain many superior varieties of corn. The widely used technique is a single cross method because it is the most efficient in the utilization of plant heterosis ability and is often a reference for plant breeders to get a better cross than their parents (Falconer, 1981). Besides that, synthetic varieties are the result of random crossing using multiple cross models through open pollination between several inbred until stable offspring is obtained. Synthetic varieties have a more diverse genetic composition impart greater level of resistance to environmental stress as well as certain pests and diseases (Subandi 2003).

During 2011-2016, the area planted to corn was about 22% of the total area to food crops, which was planted on an area of 3, 958 ha, with total production reaching 19,941 tons (Nuryati et al. 2016). We predicted that the trend would continue to increase in 2017, related to the great support from government to increase planting area and use of new hybrid varieties that able to multiply the corn yield in "*Upsus dan Siwab 2017*" Program (MoA 2017). In order to corn, cultivation runs well, so the superior varieties must also resist pest and pathogen attacks, including corn planthopper.

There are three mechanisms of plant resistance to insects, namely antixenosis, antibiosis, and tolerance. Antixenosis is the ability of plants to block the presence of insects prior to the attack, and then the insects respond by not using the plant to eat, lay eggs, and shelter. Antibiosis is the ability of plants to block insects for exploiting parts of plant; then the insect will not develop well, for example, low fecundity, small size, long life cycle and high mortality. Meanwhile, tolerance is a genetic character of plant that protects it from pests; there is no shortage of results in quantity and quality. The plant resistance to insect pests is not present suddenly but due to several things, such as genetic, morphological and chemical factor as well as ecology. Genetic factor is resistance managed by inherited genetic traits. Morphological and chemical factors are resistance caused by the form and presence of certain substances in plants that harm pests. Then, ecological factor is resistance caused by the influence of environmental factor (Price 1997; Emden 2002; War 2012).

There was not any authentic information regarding *S. pacificus* population on the varieties of corn in the field condition. Five varieties of corn manufactured by local company were tested, namely N35, N37, NT10, NT104 and NT105, recently known for the resistance against the main pathogens of corn such as *Peronosclerospora maydis* (downy mildew), *Helminthosporium turcicum* (leaf blight), *Diplodia maydis* (ear rot) and *Puccinia maydis* (rust), but not known yet its resistance to pest attack. So, keeping this view in mind, the present study was aimed to know about the abundance of *S. pacificus* and their effect on five new varieties of corn during one planting season.

MATERIALS AND METHODS

The experiment was carried out around oil palm and rubber plantation area of Dharmasraya District, West Sumatra, Indonesia (-0.94539' S, 101.43931' E, 150 m above sea level), during February until May 2017. The monthly rainfall experienced was 151 mm, 179 mm, 303 mm, and 282 mm, respectively.

The study followed the randomized block design with five treatments; each replicated five times. The five varieties of corn that were tested, namely: N35, N37, NT10, NT104, and NT105 (manufactured by PT. Citra Nusantara Mandiri, a local private company). The description of the corns indicates in Table 1.

The experiment was conducted within five experimental units each having no barriers. The plant spacing among experimental unit was 70 x 30 cm to achieve 32 hills along with two kinds of fertilizers for each variety of corn, namely; organic and inorganic fertilizers. The organic fertilizer used was cow manure (20 tons/ ha) and the inorganic fertilizers used were 350 kg/ha Urea, 100 kg/ha SP-36 (36% P_20_5) and 100 kg/ha KCl (45% K_2O). The organic fertilizer was applied at the beginning of planting, but Urea was given one-third at 7 weeks after planting, along with SP-36 and KCl. Two-third of the urea was delivered at 4 and 6 weeks after planting. The recommended agronomic practices were followed to grow the corns.

The observations were made at weekly intervals throughout the season after planting up to 8 weeks. Number of *S. pacificus* were selected and collected randomly from 16 hills by using simple aspirator, selected randomly for each unit. The measurement of leaf length, leaf width, stem diameter and trichome length were also performed to confirm the physical effect of corn on *S. pacificus* preferences. However, there was no pesticide applied in crop until harvesting. LSD test at 5% level of significance was done to determine the influence of different varieties on insect population along with the regression analysis was performed to find out the type of *S. pacificus* growth.

RESULTS AND DISCUSSION

Abundance of *Stenocranus pacificus* in five corn varieties

The abundance of *S. pacificus* varied in five varieties of corns. The highest abundance was found in NT10 (57.6 individuals/hill), significantly different with N35 which had the lowest abundance of *S. pacificus* (22.6 individuals/ hill) (Figure 1).

The abundance of *Stenocranus pacificus* on five corn varieties per weeks

The NT10 had a high risk of *S. pacificus* attack from early growth, although the abundance of *S. pacificus* did not show any difference in first week after planting, but in the second week, there was an increase in population till the fifth week which tended to be significantly different as compared to other varieties. In the sixth to the eighth week, the abundance of *S. pacificus* showed no significant difference with all varieties (Table 2).

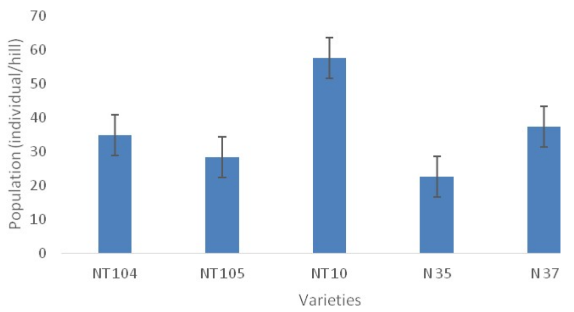

Figure 1. Abundance of *Stenocranus pacificus* on five new varieties of corn (individuals/hill). The bar chart is followed by small letter is significantly different according to LSD test at 5% significance level

Table 1. General descriptions of five new varieties of corn developed in West Sumatra, Indonesia

Varieties	Crossing	Type	Resistant to
N35	FSX 6379 x MIL 0277 hybrid x pure strain	Three ways cross	*P. maydis, H. turcicum, D. maydis*
N37	BTX7735 x NMO4311 hybrid x pure strain	Three ways cross	*P. maydis, H. turcicum, H. Maydis*
NT10	FIL 2603 x MIL 0277 pure x pure strain	Single way cross	*P. maydis, H. turcicum, D. maydis*
NT104	NFM2931 x NFM77860 pure x pure strain	Single way cross	*P. maydis, H. turcicum, H. Maydis*
NT105	NMO4311 x NFM7220 pure x pure strain	Single way cross	*P. maydis, H. turcicum, H. Maydis*

Table 2. The abundance of *Stenocranus pacificus* on five new varieties of corn per weeks

Varieties	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
N35	0 a	0 b	2.8 ab	0.6 b	3.2 abc	17.8 a	22.4 a	29.6 ab
N37	0 a	0 b	0 b	0 b	2.2 bc	12.0 ab	18.4 a	30.8 ab
NT10	0.4 a	3.8 a	6.4 a	3.4 a	8.2 a	11.2 ab	30.6 a	44.6 a
NT104	0 a	0 b	0 b	0 b	0 c	5.4 b	15.2 a	27.6 b
NT105	0 a	0 b	1.4 b	0 b	7.4 ab	2.4 b	20.4 a	33.6 ab

Note: The number is followed by small letter is significantly different according to LSD test at 5% significance level

Population fluctuation of *Stenocranus pacificus* in five corn varieties

Population fluctuation of *S. pacificus* was observed up to 8 weeks after planting. The results showed that there were differences in time attendance and population abundance of *S. pacificus* on the five varieties of corn (Figure 2). The presence of *S. pacificus* on NT10 had been seen since the first week and continues to increase until 8 weeks was completed after planting, showed the highest population at each and every observation. In case of N37 and NT104 varieties, *S. pacificus* presence was only seen only up to the 3 weeks after planting, declining in the 4th week after planting, and then continues to increase at 5th week after planting until 8 weeks were completed after planting. In NT105 variety, its presence was only seen at 5th week after planting, continuing to increase until the 8th week after planting. The presence of *S. pacificus* in N35 variety was seen only at 6th week after planting and continues to increase until the 8th week after planting.

The abundance of *Stenocranus pacificus* in different phases of five corn varieties

The abundance of *S. pacificus* in five varieties of corn was higher in the generative phase as compared to vegetative phase (Figure 3). The highest abundance was found in NT10, at both phases, i.e., vegetative phase (6.7 individuals/hill) and generative phase (11.7 individuals/hill), whereas the lowest abundance was found in N35, both at vegetative (0.4 individuals/hill) and generative phase (2.9 individuals/hill).

Regression equation for the trend of *Stenocranus pacificus* abundance on five corn varieties

The regression equation for the trend of *S. pacificus* abundance on five corn varieties belongs to cubic regression overall, which means that there was a very rapid increase in its population from week to week (Table 3, Figure 4).

Physical appearance of five corn varieties associated with *Stenocranus pacificus* abundance

No significant differences were found among five varieties related to leaf length, leaf width, stem diameter, and trichome length. But, trichome length of NT10 tends to look shorter than other varieties (Figure 5).

Discussion

Five varieties of corn that produced by local company newly known for the resistant to the main pathogens of corn, but not known for the resistance to pest attack. The results revealed that the highest abundance of *S. pacificus* was found on NT10 (Figure 1), started from first week until last week of observation (Figure 2) in vegetative and generative phases, but the highest abundance was found in generative phase (Figure 3). Population growth classified as cubic regression (Figure 4). Those showed that *S. pacificus* preferred to NT10 compared to other varieties from early growth of corn. There was a very rapid increase in its population from week to week, so that, the NT10 was most at risk of being attacked by *S. pacificus.* Breeder of NT10 stated that the male ancestor of NT10 has high glucose content (Setyawan, personal communication 2017), that's why test insect preferred it. The higher preference of an insect, the higher susceptibility of the plant to attack, otherwise the low preference of an insect indicates resistance of the crop by avoiding the attack.

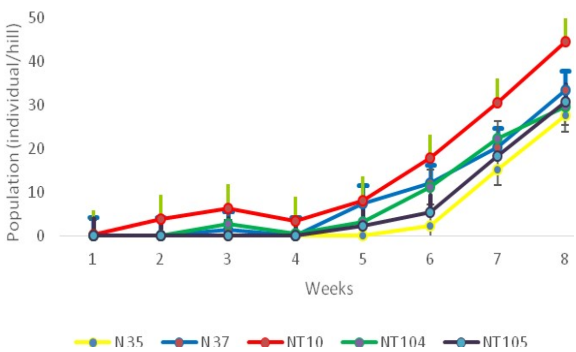

Figure 2. Population fluctuation of *Stenocranus pacificus* on five new varieties of corn (individuals/hill)

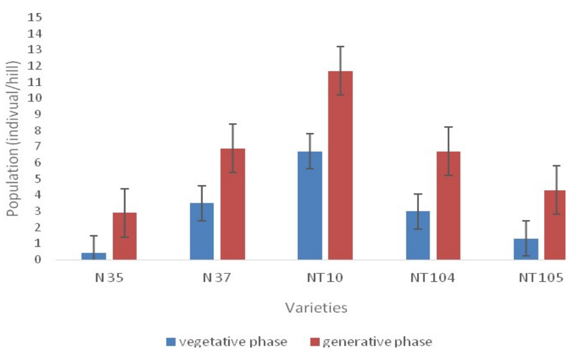

Figure 3. The abundance of *Stenocranus pacificus* at different phases of five corn varieties

Table 3. Regression equation for the trend of *Stenocranus pacificus* abundance on five corn varieties based on R values

Varieties	Regressions	R values	Equations
N35	Linear	0.782	$Y = 2.784-1.113X+0.1278X2-1.871X3$
	Exponential	-	
	Logistic	-	
	Logarithmic	0.618	
	Quadratic	0.968	
	Qubic	**0.994**	
N37	Linear	0.898	$Y = -0.145-0.096X+0.046X2+0.257X3$
	Exponential	-	
	Logistic	-	
	Logarithmic	0.753	
	Quadratic	0.993	
	Qubic	**0.996**	
NT10	Linear	0.898	$Y = 2.291-0.733X+0.102X2-1.029X3$
	Exponential	0.926	
	Logistic	0.926	
	Logarithmic	0.766	
	Quadratic	0.986	
	Qubic	**0.993**	
NT104	Linear	0.886	$Y = -0.591+0.014X+0.036X2+0.807X3$
	Exponential	-	
	Logistic	-	
	Logarithmic	0.742	
	Quadratic	0.985	
	Qubic	**0.987**	
NT105	Linear	0.83	$Y = 1.551-0.735X+0.1X2-0.9X3$
	Exponential	-	
	Logistic	-	
	Logarithmic	0.67	
	Quadratic	0.983	
	Qubic	**0.996**	

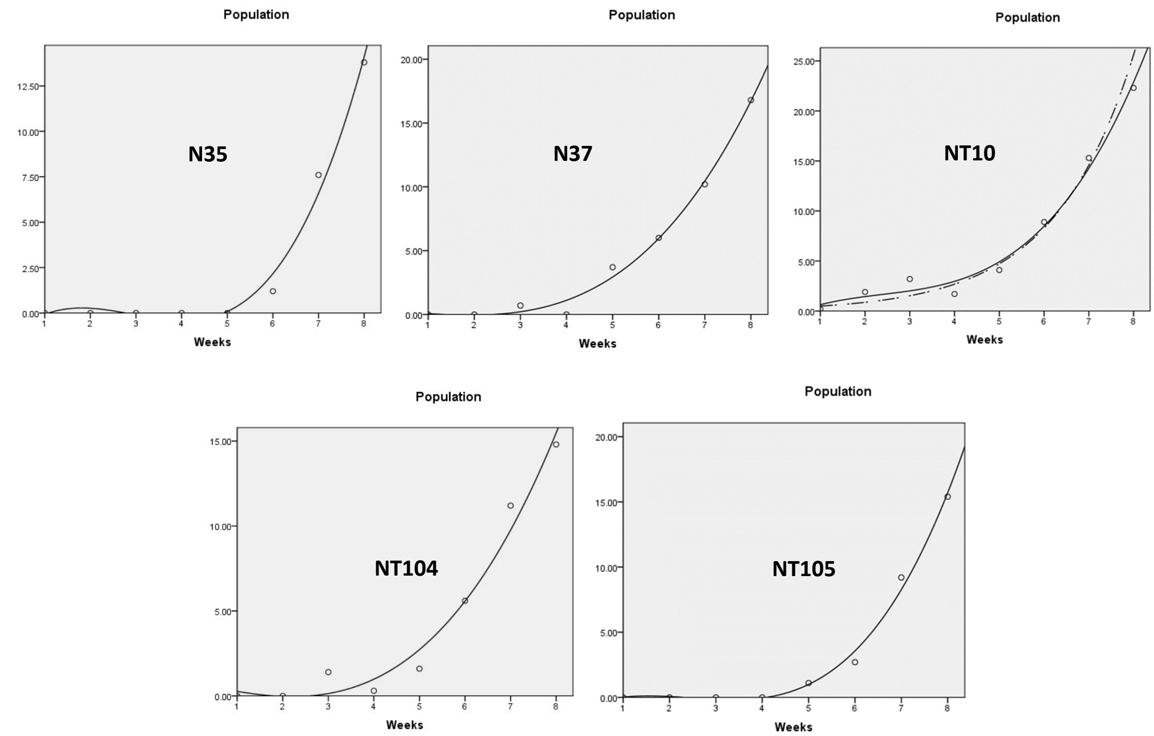

Figure 4. Curve estimation for population fluctuation of *Stenocranus pacificus* in five new varieties of corn, i.e., N35, N37, NT10, NT104, and NT105

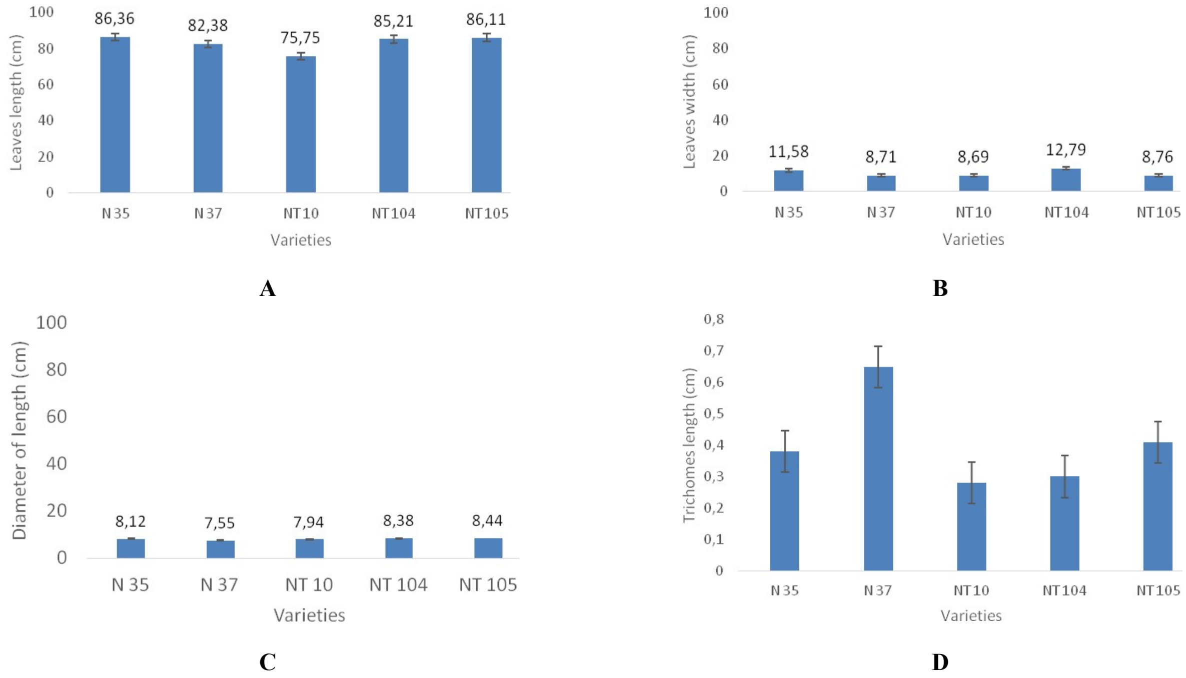

Figure 5. A. Leaves length, B. Leaves width, C. Diameter of stem, and D. Trichomes length of five corn varieties

There is some corn planthopper reported in many countries of the world. In The United States of America, the corn planthopper, *Peregrinus maidis*, is a major pest of corn (Yao et al. 2013). In Canadian, the corn planthopper**,** *Stenocranus Fieber* is recognized by external characters correlated with genitalic organ (Hamilton 2006). Meanwhile, corn planthopper or *Stenocranus pacificus* Kirkaldy (Hemiptera: Delphacidae) was reported attacking corn in West Sumatra (Nelly et al. 2017), it was a pest invasive on corn in the Philippines before (Cayabyab et al. 2009). The white waxy substance in the abdomen is characteristic of female (Dumayo et al. 2007). The nymph and adult attacked the corn by sucking plant sap from young leaves and leaf sheaths which could lead to stunted plant growth. The honeydew caused galls along veins and underneath leaf surface that decreased corn vigor and stunting (Cayabyab et al. 2009).

There are three mechanisms of plant resistance to insects, namely antixenosis, antibiosis, and tolerance. One of the antixenosis mechanisms from morphological factor of plant was affected by the length of leaf trichomes and stem diameter. The results showed that trichome length of NT10 tends to look shorter than other varieties, but the leaf length, leaf width, and stem diameter did not show any significant difference (Figure 5). This is estimated that the varieties having shorter trichome are more prone to insects to attack and taking advantage from host plant. Based on research by Sulistyo and Inayati (2016), the plant that has a long trichome was more resistant to insect pests. Lu et al. (2007) stated that there were several physical appearances of the plants, such as color, size, shape, texture, and toughness, play important roles in host selection by insect pest before attack. Variations in the physical appearance of the host plant may affect the acceptance of insects against its host. Besides that, Markgren (2012) reported that the trichome density positively correlated with glucosinolate level.

According to Sunjaya (1970), taste, odor, nutritional quality and appropriate structure affected insects to choose their host. If there is availability of nutrients needed by insects without any toxic compounds, the insects will complete the process of eating. Insect preference to host plants related to their need to eat, shelter and to lay their eggs. According to Schaper (2016), there were three components that are involved: *sensory input* from the environment (e.g., visual or olfactory), *internal/ motivational states* (e.g., hunger or mating status) before translated into an observable behavioral output, such as the host plant selection and oviposition processes; and *evolutionary history*.

In conclusion, the *S. pacificus* preferred to NT10 compared to other varieties from early growth of corn, but the *S. pacificus* abundance was higher in generative phase as compared vegetative phase. There was a very rapid increase in its population from week to week. In addition to plant chemical factors, physical factors of the plant such as length or shortness of trichome are estimated as insect preference, furthermore increasing insect abundance.

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