Relative Abundance of *Empoasca terminalis* (Homoptera: Cicadellidae), A New Pest of Soybean (*Glycine max* L) in South Sulawesi, Indonesia

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ABSTRACT

The main purposes of the study were to determine: 1) the relative abundance and vertical distribution of *Empoasca terminalis* Distant within plant; and 2) the extent of the damage it causes to soybean in the absence of chemical control. Overall population density in the rainy season was significantly lower than in the dry season. At the end of the rainy season, no plants were killed by direct damage caused by the leafhopper; in contrast, at the end of the dry season an average of 24% of plants were killed by the leafhopper. Within a plant, more than 80% of the leafhopper individuals concentrated on the upper and middle leaves; hence leaf sampling for scouting should be directed towards those leaves.

Key words: *Empoasca terminalis*, soybean (*Glycine max*), Sulawesi, Indonesia.

INTRODUCTION

Empoasca (Distantasca) terminalis Distant (Hemiptera: Cicadellidae: Typhlocybinae) has long been recognized as one of the insects associated with soybean in the Province of South Sulawesi yet it is so far considered a minor pest. However, our survey conducted in 2007 showed that its population reached an outbreak level of more than 10 individuals per leaf and inflicted substantial physiological injury to plants in the form of hopperburns in the Districts of Makassar and Gowa (Nasruddin, 2007, unpublished data). The population level was well above the action thresholds of potato leafhopper (*E. fabae*) on soybean in the USA which are five and nine leafhoppers per plant for vegetative and early bloom stages of the plant growth, respectively (Markell 2007). Since our survey was the first report of leafhopper population outbreak with significant damage to plants in South Sulawesi, the local economic threshold for this insect has not been established.

Since an outbreak of *E. terminalis* on soybean in South Sulawesi had not been reported previously and very limited information is available about this insect pest in Indonesia, the farmers we interviewed did not know if the damage to their plants was caused by leafhoppers. Therefore, it is the purpose of this study to investigate the relative abundance of the leafhopper and the magnitude of its damage to soybean.

MATERIALS AND METHODS

The study was conducted in farmers' soybean fields in the Districts of Gowa and Makassar, South Sulawesi, Indonesia, from February to August 2008 in the form of a survey.

Symptom Confirmation

A greenhouse test was conducted to confirm that the symptoms observed in the fields were caused by *E. terminalis*. Adult leafhoppers were collected from the field using a sweepnet. Ten pairs of leafhoppers were then placed on a three weeks old soybean confined in a 30x-30x60 cm (LxWxH) cage. The cage was made of puralon pipe frame, covered with white fine cloth. In this test, five cages were used for plants infested with leafhoppers and five other cages with plants without leafhopper infestation. Symptom development was observed on both infested and noninfested plants weekly.

Relative abundance of *E. terminalis.*

This survey was conducted in soybean fields on dry land during the rainy season (January to April) and in soybean fields on rice paddy during the dry season (May to August). Farmers choose these times of the year for soybean cultivation based on water availability. Three farmers' soybean fields, about 0.5 ha each, were chosen on each land type to assess the leafhopper population density. For each field, 50 plants were randomly selected throughout the field. On each plant, leafhoppers were counted on two upper leaves, two middle leaves, and two lower leaves. This was done to determine the average number of leafhoppers per leaf and the vertical distribution of the insects within the plant. The leafhopper counts were performed once a week, starting two weeks after plant emergence until three weeks before harvest. Air temperature and rainfall data were obtained from the local Agency for Meteorology and Geophysics in Makassar.

Percentage of field with dead plants

All farmers' fields surveyed were not applied with insecticides to suppress the leafhopper populations. After the last leafhopper count, the percentage of each field's area with dead plants attributed to leafhoppers was determined by measuring the area of dead plants in each field.

The data of leafhopper counts were statistically analysed using ANOVA and if a significant difference was present then the means were separated with the method of least significant difference (Payne *et al*. 2003).

RESULTS

Hopperburn symptoms first appear as yellowish patches starting from the distal end of the leaves. The patches then expand towards the petiole along the leaf margins. This is followed by tissue necrosis also starting from the leaf margin areas (Fig. 1). In the advanced damages, crinkling and cupping symptoms on the leaves also occurred before the whole leaf dried out (Fig. 3A).

Fig. 1. Close up pictures of leafhopper's damage symptoms developed in the greenhouse

Relative Abundance of *E. terminalis*

The average number of *E. terminalis* on soybean recorded during two consecutive planting seasons, dry and rainy seasons, are presented in Fig. 2. In the dry land, the peak population of leafhopper occurred during the fifth to eighth weeks after plant emergence while in the rice paddy, the peak occurred during the sixth to eighth weeks after emergence. Therefore, the population development patterns in both locations were similar relative to the plant age; however, in general, the population in the dry land was significantly lower than the population in the rice paddy ($P<0.05$).

Leafhoppers did not distribute evenly on a plant. About 89% and 84% of the leafhoppers in dry land and rice paddy, respectively, occupied the middle and upper leaves. The numbers of leafhoppers found on the upper and middle leaves were not significantly different from each other ($P = > 0.05$) but significantly different from the number of leafhoppers on the lower leaves ($P<0.05$) (Table 1).

Table 1. Number of leafhoppers per leaf for upper, middle, and lower leaves in both dry land and rice paddy.

Leaf Position	Number of Leafhoppers/Leaf for Each Location	
	Dryland	Rice Paddy
Lower	0.54a*	4.34a
Middle	1.92b	11.50b
Upper	2.56b	12.04b

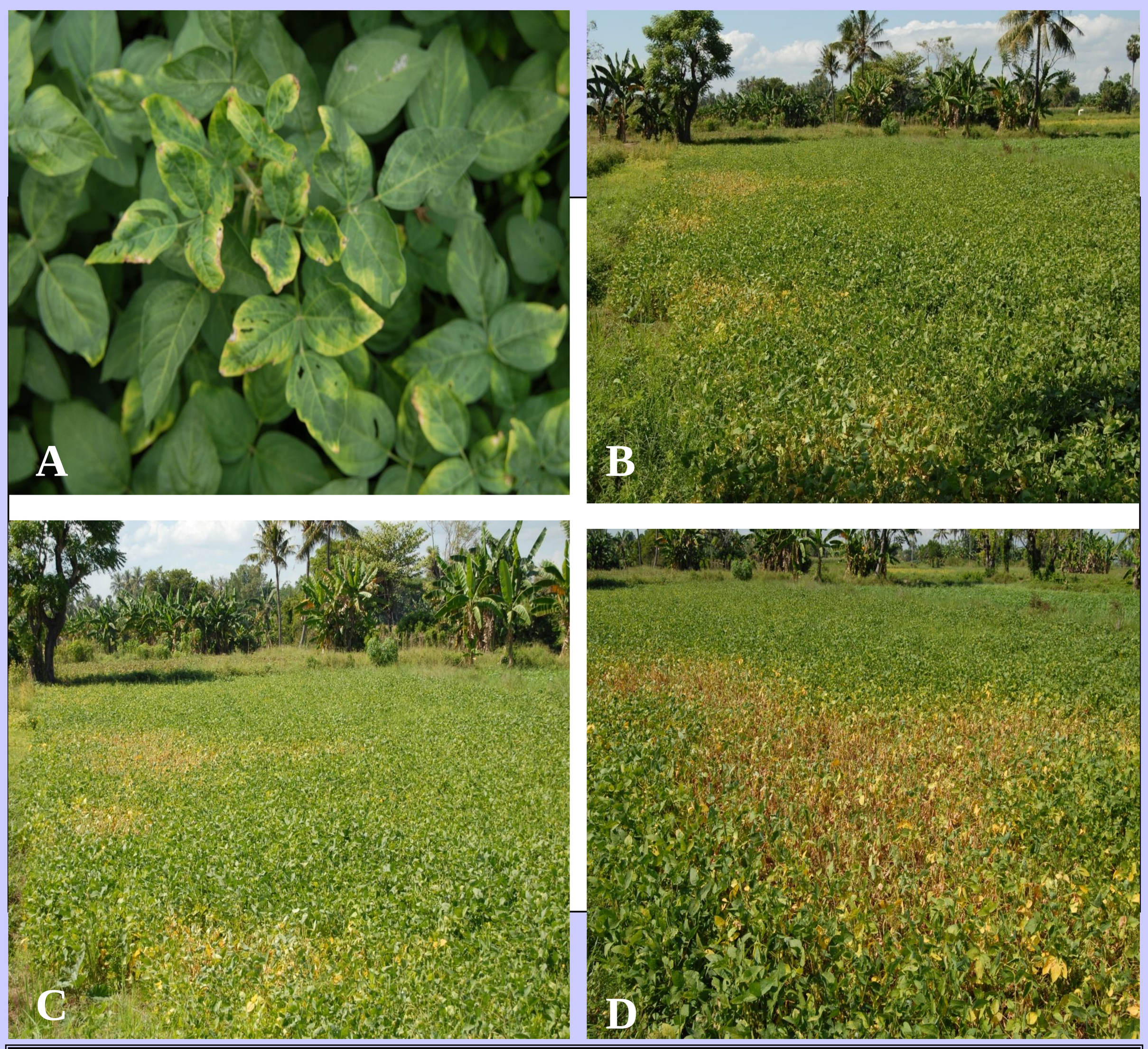

Fig. 3. Field symptoms: close up symptom picture (A), Symptom on plants five weeks (B), seven weeks ©, and nine weeks (D) after plant emergence.

DISCUSSION

In both dry and rice paddy types of land, the leafhopper populations built up gradually from low population levels and then reached a peak between the fifth and the eighth weeks and the sixth and the eighth weeks after plant emergence for dry land and rice paddy land, respectively. During the course of the survey we did not find any sudden and large increase of adult numbers which would indicate an influx of migrants. This suggested that the populations in both locations began with low numbers of individuals, either long distance migrants or individuals occurring on alternative hosts within or around the fields. At the peaks, the leafhopper population reached outbreak levels of more than 10 individuals per leaf during the dry season. This was well above the economic injury levels for *E. fabae* on soybean in the USA, which are five and nine leafhoppers per plant, respectively, for vegetative and early bloom stages of the plant growth (Markell 2007).

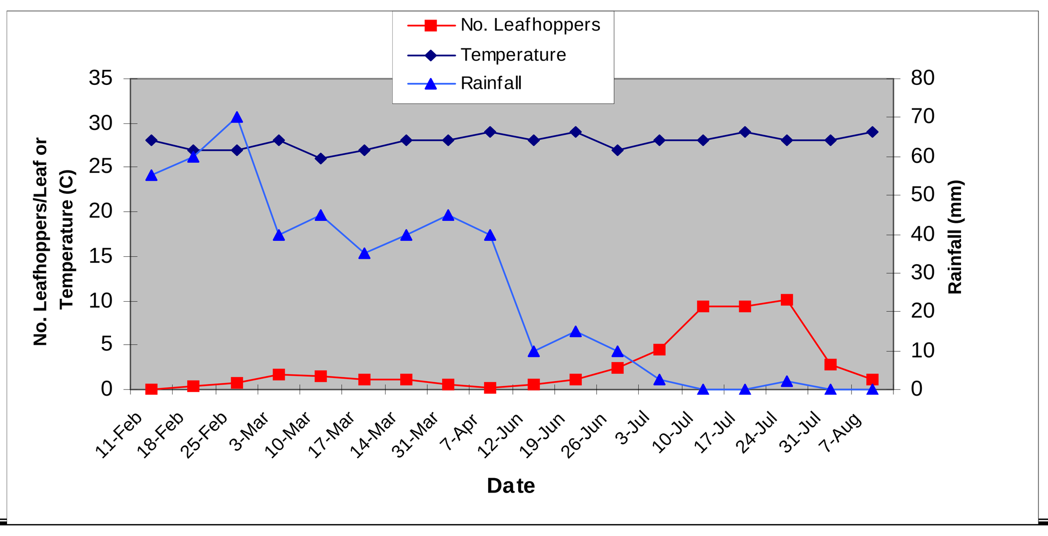

Fig. 2. Average number of of *E. terminalis*, temperatures, and rainfall rates for two consecutive seasons, rainy season on dry land (February to May) and dry season on rice paddy (May to August) 2008.

Overall, there was a significant difference between the leafhopper populations in the rainy and the dry planting seasons. The difference seemed to be attributable to the difference in rainfall rates between both seasons. This is similar to the phenomenon reported by Hasanuddin *et al.* (1997) that rice green leafhopper (*Nephotettix virescens* Distant) population was lower during the rainy season compared to the dry season in South Sulawesi. In the dry season, we found severe injury to the plant, killing about 24% of plants; however, this phenomenon did not occur during the rainy planting season.

More than 80% of leafhopper individuals were found on the middle and upper leaves. Therefore, for scouting, leaf sampling should be directed towards those leaves. For the same reason the use of sweep net aimed at the upper part of plant canopy (Elden & Lambert 1992) should also be appropriate in assessing the relative abundance of the leafhopper.

CONCLUSION

The study results confirmed that *E. terminalis* had the potential to be an important pest on soybean in South Sulawesi with high populations inflicting severe hopperburn symptoms, even killing a high percentage of plants in the fields. This is the first published report of an outbreak of *E. terminalis* causing such significant damage to soybean plants in the province.

ACKNOWLEDGEMENT

I gratefully thank Dr. Murray J. Fletcher, Department of Primary Industries, Orange NSW, Australia, for identifying the leafhopper specimens. I also thank Muhammad Said Baco for the technical assistance he provided during the course of the study.

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