The Role of Weeds in the Spread of...

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THE ROLE OF WEEDS IN THE SPREAD OF VECTOR OF PEANUT STRIPE VIRUS (PSTV)

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ABSTRACT

Peanut stripe virus (PStV) is the most serious disease in peanut production in the world. It is mainly vectored by *Aphis* spp. Intensive application of insecticides is ineffective and also costly. Various weeds species in peanut plantation areas are suggested to be alternative hosts of the vectors. Research on the preference of *Aphis cracivora* on the various weeds is needed for completing an integrated PStV disease management program. Five dominant weeds identified from vegetation analysis were arranged randomly in circular fashion inside the nylon mesh cage, and 50 *A. cracivora* adults, which had previously been starved for 24 h, were released in the middle of the arena. The position and the number of *A. cracivora* were recorded after 24 h. Some weeds could take a role in spreading the vector of PStV, as alternative hosts. *Cyperus iria, Pertulaca oleraceae*, and *Boerhavia erecta* can be served as alternative hosts for aphids. Most of *A. cracivora* stayed for feeding on *C. iria* (71.20%) and were able to multiply their population up to ~350 individuals in 17 days. It was significantly different to *Pertulaca oleraceae* (22.00%), and also to *Boerhavia erecta* (6.80%), *Digitaria longiflora* (0.00%), and *Oxallis barrelieri* (0.00%).

Keywords: Preference, Alternative host, *Aphis cracivora* , Disease management

INTRODUCTION

Peanut production in Indonesia in 2009 was 777,888 tons, with the area of 622,616 Ha (BPPS, 2011). The productivity was 1.249 ton/Ha, much lower than the potential yield (2.5 ton/Ha). One of the obstacles was the peanut stripe disease caused by peanut stripe virus (PStV). Peanut stripe disease is the most serious disease in Indonesia. Yield loss due to stripe disease ranges from 10 to 60% depending on the varieties of peanuts, season and plant age at infection (Saleh and Baliadi, 1992; Obopile, 2006). This disease is also widespread in Malaysia, Philippines, Thailand, Vietnam, Korea, Japan and United States (Demski et al., 1993).

Spread of the virus in the field is mainly vectored by *Aphis craccivora*, although mechanical and seed transmission may also occur. It is also vectored by *A. glysines*, *A. porii*, *Rhopalosiphum maydis*, *R. rice*, *Trichosiphonaphis sp.*, *Hysteroneura setariae* and *Mycus persicae* (Soeprapto, 1991). Given its role as an insect vector, the basic strategy in PStV management is the vector control. Various weeds in peanut areas could serve as alternative hosts of the vector that escaped from PStV vector control efforts. In

order to complement an integrated program of peanut stripe disease management, the assessment of the weeds role in the spread of insect vectors of PStV is required.

MATERIALS AND METHODS

A. cracivora culture

Aphids were maintained on the shoots of peanuts, planted in pots covered by nylon mesh cages (1 m long, 1 m wide, and 1 m high).

1. Vegetation analysis of weeds in peanut areas

Vegetation analysis was conducted on five peanut areas to determine the dominant weeds. Ten samples per area, totally 50 samples, were gained by throwing ring samples (1 m x 1 m) randomly on the peanut areas.

2. The preference of *A. cracivora* on various weeds

Choice tests and no-choice test were performed on five most dominant weeds. Choice test was conducted by planting five most dominant weeds in small pots (Ø 50 mm, high 80 mm), covered by cylindrical nylon mesh cage (Ø 600 mm, height 300 mm) and arranged randomly in circular fashion. Fifty *A. cracivora* adults, which had previously been starved for 24 h, were released in the middle of the arena. The number and position of aphids on each of the weed were recorded after 24 h. No-choice test was conducted by using the five most dominant weeds planted in pots as used in the choice test. Each weed was covered with cylindrical nylon mesh cage (Ø 100 mm, height 300 mm) and 50 aphids which had previously been starved for 24 hours, were released on the buds of each weed. The number of aphids was recorded every 48 h. Analysis of variance was performed by using SPSS 10.0.5 (SPSS, 1999), and the level of significance was set at $P < 0.05$.

RESULTS AND DISCUSSION

The vegetation analysis of 19 species of weeds found at peanut areas is presented inTable 1Based on the vegetation analysis results, the five most dominant weeds were chosen for choice and non-choice tests. *Digitaria longiflora* (grass group) was the most dominant weed in peanut areas followed by *Boerhavia erecta*, *Pertulaca oleraceae*, and *Oxallis barrelieri* (broadleaf groups), *Cyperus iria* (sedge group) with the Summed Dominance Ratio (SDR) value of 15.09%, 8.69%, 10.51%, 8.96%, and 11.38%, respectively.

All aphids fed on the leaves of some tested weeds in the choice test (Figure 1). The most preferred weed was *Cyperus iria*. The average percentage of aphids feeding was 71.20%, significantly different from *Pertulaca oleraceae* (22.00%), *Boerhavia erecta* (6.80%), while *Digitaria longiflora* and *Oxallis barrelieri* were not chosen by aphids for feeding. These differences may be caused by nutritional similarity of the weed and aphids' host plant (peanuts) or by the presence of certain substances that were attracting

aphids to feed. The substances could be various alcohol and aldehyde compounds in the leaves that were specific and volatile. Those were used by aphids for finding their host plants (Visser, 1986, Petterson et al., 1998). Similar results were obtained on Gemini virus vector *Bemecia tabaci* (Sudiono and Purnomo, 2008) and also on spreading Peanut Stripe Virus (PStV) (Hardiastono, 2001). *B. tabaci* was able to live on the broadleaf weed *Ageratum conyzoides*. Weeds could also serve as a source of gemini virus inoculum. While the weeds *Amaranthus spinosus*, *Bidens pilosa*, *Crotalaria incana*, and *Physalis angulata* were able to be potential alternative hosts and sources of PStV inoculum.

Aphids were able to multiply rapidly in *C. iria* (Figure 2.) in a choice test. The average population was 347.60 on day 17, significantly different from *P. oleraceae* (63.20), *B. erecta* (45.80), *D. longiflora* (0.00) and *O. barrelieri* (0.00) (Table 2.). The ability to increase their population on non host plants indicated the existence of the nutrients contained in weeds that resemble their host plant nutrition. The population began to decline on *C. iria* after day 17 due to the limited ability of weeds to sustain the aphids' population. However, population on *P. oleraceae*, *B. erecta* was still rising despite lower than *C. iria* (Figure 2.). The abundant population led to aphids' migration from weeds into the main host plant (peanut).

Table 1. Vegetation analysis of weeds at peanut plantation areas (n: 50)

No	Weeds species	SDR (%)
1	*Cleome rutidosprema*	2.38
2	*Digitaria longiflora*	*15.09
3	*Eleusin indica*	4.29
4	*Hibanthus attenuatus*	6.17
5	*Hedvontis carimbasa*	7.30
6	*Boerhavia erecta*	*8.69
7	*Ageratum conyzoides*	3.87
8	*Pertulaca oleraceae*	*10.52
9	*Euphorbia hirta*	1.53
10	*Spegelia antelmia*	1.73
11	*Synedrella nodiflora*	6.42
12	*Oxallis barrelieri*	*8.96
13	*Imperata cylendrica*	2.28
14	*Cyperus iria*	*11.38
15	*Dactyloctenium aegyptim*	2.02
16	*Ipomea triloba*	2.12
17	*Phylanthus neruri*	1.73
18	*Tridax procumbent*	1.75
19	*Euphorbia prunifolia*	1.73
	Total	99.96

* Five most dominant weeds for choice and non-choice test

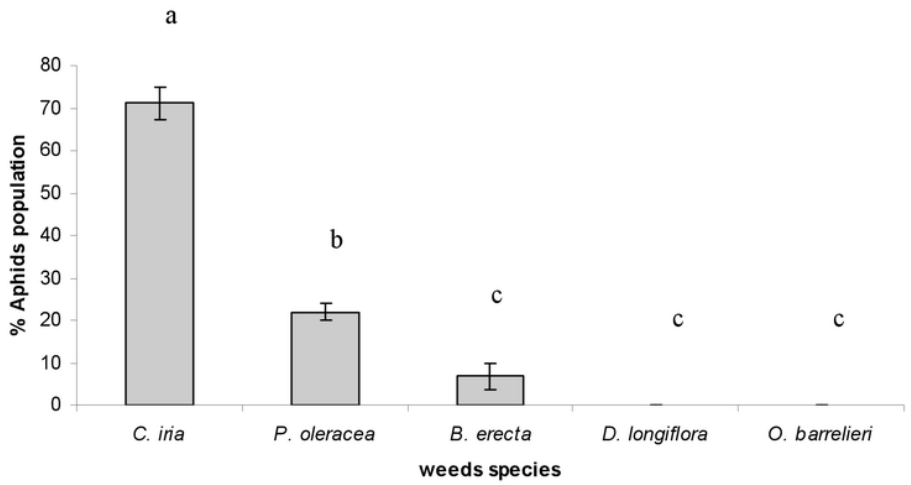

Figure 1. The preference of *A. cracivora* in various weeds of peanut conducted in choice mode with initial population 50, recorded after 24 h. Bars followed by the same letter are not significantly different (P < 0,001). n: 10

All aphids on *P. oleraceae*, and *B. erecta* were not able to feed on weeds but stayed on the cages. This behaviour indicated that aphids were not able to recognize those two species of weeds as alternative host plants that can be used as food source. While the slow-growing population of aphids on *P. oleraceae* and *B. erecta* was probably due to the amount of water contained in the weeds that were structurally very different from its host plants (peanuts). The high water content also caused low content of volatile compounds, and was unable to attract aphids to feed and breed on those weeds (Table 2.).

The implications of preferences and breeding ability of aphids on species of weeds are the presence of alternative hosts for aphids when peanut plants are not available, either because there are no peanut plants or when the plants are treated with pesticides. The presence of alternative hosts would cause the population of aphids to be available throughout the season and to serve as the initial population for the next generation. The role of aphids as vectors of PStV will also make disease inoculum to be always available in the field throughout each season. This will further complicate the control measures against the disease on peanut plants, because the transmission of disease by insect vectors of disease, especially PStV is highly dependent on the availability of disease inoculums and insect vectors in the field (Chen, 1998, Zeyang et al., 1996, Soleh, 2003).

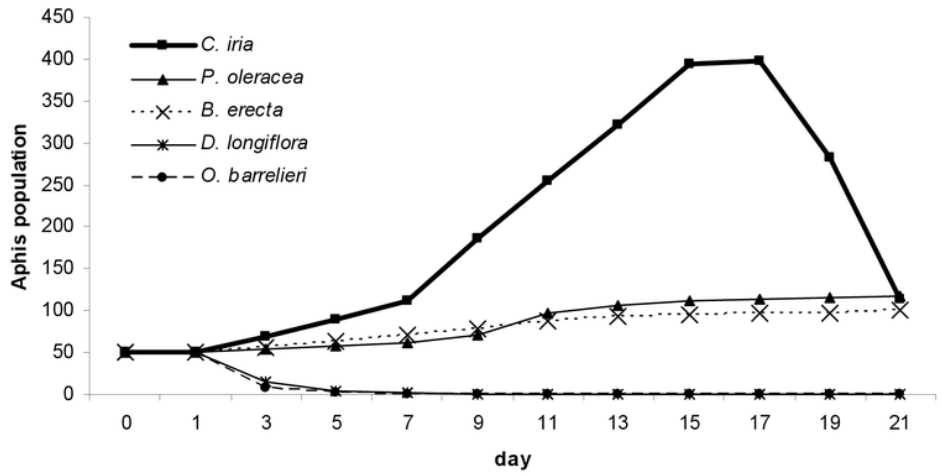

Figure 2. Population dynamic of *A. cracivora* per plant of various weeds species for 21 days. (n: 10)

Table 2. Average population of *A. cracivora* in various weeds species in day 17 (n: 10)

No.	Weeds species	Population in day 17
1	*Cyperus iria*	347,60 a
2	*Pertulaca oleraceae*	63,20 b
3	*Boerhavia erecta*	45,80 b
4	*Digitaria longiflora*	0,00 c
5	*Oxallis barrelieri*	0,00 c

Numbers followed by the same letter are not significantly different ($P < 0,001$)

CONCLUSION

C. iria, P. oleraceae, and *B. erecta* can be served as alternative hosts for aphids, vector of PStV, with *C. iria* as the most preferred alternative host

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