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STUDY OF THE USE OF MAIZE AS BARRIER CROP IN CHILI TO CONTROL *Bemisia tabaci* (Gennadius) POPULATION

STUDI PEMANFAATAN JAGUNG SEBAGAI TANAMAN PEMBATAS UNTUK MENGENDALIKAN POPULASI Bemisia tabaci *(Gennadius) PADA TANAMAN CABAI*

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ABSTRACT

This study was conducted to determine the effect of maize as barrier crop to prevent the spread of *Bemisia tabaci* (Gennadius), the yellow virus vector in pepper farming. The research was conducted in the field at Pakem, Sleman, during two cropping seasons from October 2014 to February 2015 as first planting period and in April to August 2015 as second planting period. The escalation of *B. tabaci* (Gennadius) populations was directly correlated with virus yellow peppers increment. The result indicated that planting barrier was effective in reducing the spread of *B. tabaci* (Gennadius) in pepper plants. The population of *B. tabaci* (Gennadius) in plots with pepper surrounded by maize was lower compared to plots without maize barrier, showed that the yellow virus spreads on pepper can be minimized, and hence the incidence of yellow disease was also decreased.

Keywords: barrier crop, *Bemisia tabaci*

INTISARI

*Penelitian ini dilakukan untuk mengetahui pengaruh penanaman jagung sebagai pemberian tanaman pembatas (*barrier*) untuk mengatasi penyebaran* Bemisia tabaci *(Gennadius) yang merupakan vektor virus kuning pada tanaman cabai. Penelitian dilakukan di lahan pertanaman cabai di Pakem, Sleman. Penelitian dilaksanakan selama dua musim tanam dari bulan Oktober 2014 sampai dengan bulan Februari 2015 pada periode tanam I dan bulan April 2015 sampai dengan bulan Agustus 2015 pada periode tanam II. Meningkatnya populasi* B. tabaci *(Gennadius) berbanding lurus dengan meningkatnya virus kuning pada cabai. Hasil penelitian ini menunjukkan bahwa penanaman tanaman pembatas (barrier) cukup efektif mengurangi penyebaran* B. tabaci *(Gennadius) pada ke dalam petak tanaman cabai. Populasi* B. tabaci *(Gennadius) pada petak tanaman cabai yang dikelilingi tanaman jagung lebih rendah jika dibanding dengan petak tanaman cabai yang tidak dikelililing tanaman jagung, sehingga secara tidak langsung penyebaran virus kuning pada cabai dapat diminimalisir.*

Kata kunci: Bemisia tabaci*, tanaman pembatas*

INTRODUCTION

Indonesia as an agricultural country relies on agriculture sector as one of its economic sources because it gives major contribution to government revenues. Hence, in Indonesia the agricultural sector become a potential market especially for agricultural produces. Pepper is a horticultural produce in high demand, especially in Indonesia. Public consumption reaches 900 tons/year, or about 4 kg/capita. Since domestic production is only 76% of the total demand, pepper then imported from Malaysia and Australia. For the last ten years, pepper production centers in Central Java and Yogyakarta came through a decline in production due to a virus disease known as Pepper Yellow Leaf Curl Virus (PYLCV) or pepper yellow virus. Sudiono *et al*. (2001) suggested that the disease is caused by Gemini virus, which is transmitting by whitefly (*Bemisia tabaci*). Yellow disease is mostly found in bird chilies, peppers, bell peppers and tomatoes. According to Sudiono *et al*. (2001) yellow disease symptoms and severity is more extensive in bird chilies than peppers, which may due to less intensive cultivation system in bird chilies than that of pepper cultivation which has fertilizing, weeding and chemical controlling for pest and disease continously. Research showed that the leaf fertilizer and inorganic fertilizer in endemic areas of yellow virus could not prevent the crops from the virus infection. This virus attacks could be prevented with a few specific cultivation techniques. The first thing to do is to save pepper seeds in the nursery by using the lid tightly (chiffon) so that the seedlings will be protected from viruses that are transmitted by *B.*

tabaci. In addition, fields are recommended to be planted with barrier crops in zigzag planting pattern and also setting a good planting time, so pepper would more protected both during vegetative and generative phase.

Regarding to the effort to increase farm production, farmers using synthetic insecticides to control *B. tabaci*. Meanwhile, synthetic insecticides practice which held continuously and unwisely leads to evoke some side effects like the death of natural enemies, the emergence of pest resistance, the resurgence, blasting secondary pests, residual effects and environmental pollution (Othman & Kennedy, 1976; Parella, 1982; Rauf *et al.*, 2000; Hidrayani, 2003). This study was conducted to determine the effect of planting maize around pepper crops in plots to the spread of *B. tabaci*, because *B.tabaci* act as vector yelow disease in pepper crops.

MATERIALS AND METHODS

This study was conducted to determine the effect of maize as barrier crop to prevent the spread of *Bemisia tabaci* was in pepper farming. Research conducted in field at Pakem, Sleman, during two cropping seasons from October 2014 to February 2015 as first planting period and in April to August 2015 as second planting period.

Seed Preparation

Pepper seeds (Twist variety) were soaked before sowing to select damage seeds and to stimulate germination. Seeds were planted on mix medium consisted of soil and compost in ratio 7:1 and mixed evenly. Experiments in the field covering: 1). Twist variety pepper was planted on 4th week in October 2014 with technical irrigation system, and barrier maize used corn Bisi variety. Treatments were carried in two ways, i.e. Plots with pepper and maize barrier and plots with pepper and without maize barrier; 2). Plotting and field trial design was carried by taking samples randomly from beds, in each treatment plot consisted 10 repetitions. Experiment design which done by using randomize design block; 3). Maize planting as barrier were planted in 3 rows, with ± 50 cm in spacing. The first row, the second, and the last row were planted before pepper at 5 weeks, 2 weeks and 7 days, respectively; 4). Beds in each treatment had ± 500 cm in length and ± 120 cm in width, consisted of 10 holes (double rows) with ± 50 cm in spacing. Every bed was ± 100 cm separated.

Plant Culture

Stitching or replacement of dead or sick plants with healthy ones were done about 1−3 weeks after planting, stakes were placed six weeks after pepper planting to help pepper plants stayed upright and sturdy, fertilization in pepper done manuring with use fertilizer compost as many as 1:10, while on the maize plant fertilization was carried out every other week with NPK, watering was given by inundation once a week when it was no rainy day. Inundation only 1/3 of bed height and weeding activities was done not only to rid weeds around the plants so the crops' roots could absorb nutrients optimizely, but also to prevent the available shelter for pests and diseases in the field. Weeding performed every 1−2 weeks.

Observation

Sampling was taken as many as 100 samples of pepper plants randomly in each plot. Observations were done every other day to facilitate the abundance of *B. tabaci* every day and the development *B. tabaci* any time, without reducing data the accuracy of the data.

Observation was intended to determine *B. tabaci* population on pepper vegetative phase to generative phase, both on plots with and without maize barrier. Parameters measured were observation on *B.tabaci* population on pepper plots with and without maize barrier and observation yellow disease caused by virus on pepper plant.

Statistical Analysis

Data were analyzed by paired t-test to compare observation parameters on treatment plots to control plots with confidence level on 95%.

RESULTS AND DISCUSSION

Bemisia tabaci ***Population and Disease Intensity***

First planting period (October 2014−March 2015). *B. tabaci* population was determined by counting the number of individuals on each plant sample that randomly selected. Shown in Figure 1, the escalation of *B. tabaci* population in plots with barriers occurred in the early observations i.e. 4 weeks after planting, then decreased at 14th week whilst the *B. tabaci* population in all plots were 0,064. Population decline occurred as the growth of the maize used as a barriers, due to the physical blocking from maize that hamper *B. tabaci* mobility into the pepper beddings. While in plots without maize barriers, the highest average population was in four observation (7 weeks after planting), The lowest population was determined at 9 weeks after planting, i.e. 2.33. Weekly average population is presented in the following graph.

Pepper yellow leaf curl virus (PYLCV) is one of viruses that infects most of the important crop species, one of which is pepper. Based on observations in the field, infected plants give vary in symptoms, but in general the initial symptoms are leaf yellowing, curling, vein clearing at the beginning of the shoots, and plants become stunted. According to Hidrayani (2003), the difference symptoms was occurred as follow. Yellow disease intensity was observed on two different planting periods, carried every week started at week four until week 13 weeks after planting. Yellow disease intensity determined based on scoring table for each infected plant. Data showed that in the first planting period, April to February, the highest disease intensity was up to 83,78% in plot without barriers, whilst in plots with barriers the highest disease intensity merely 10.26 %. Shown in Figure 1 explained that the higher population of *Bemisia tabaci*, so disease intensity will be the higher.

An obstruction mechanism for *B. tabaci* caused by maize possibly due to two reasons, physical and chemical actions. Physical action evokes by maize's height and leaves dense that complicated *B. tabaci* penetrated in to the pepper beddings. Chemical action probably because *B. tabaci* dislike the compounds released by maize so avoiding being at the area contained maize barrier.

Second planting period (April−August 2015). Experiments on second planting period showed the same result with the first planting period, which is

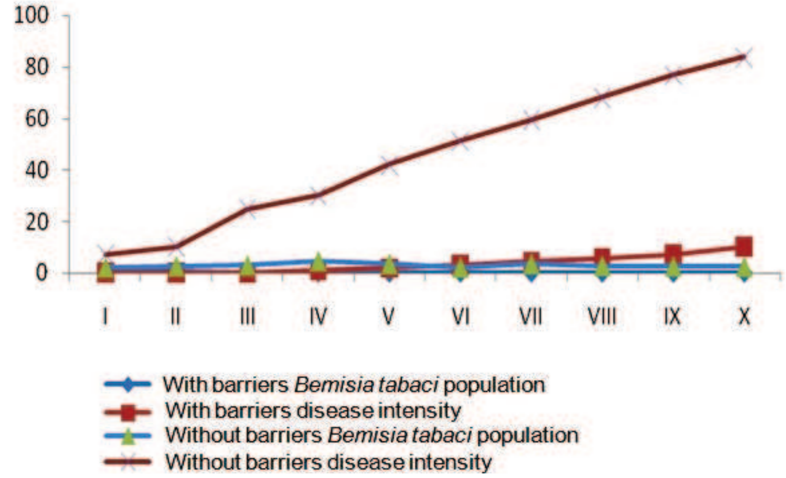

Figure 1. The average of *Bemisia tabaci* in pepper plots and yellow disease intencity with and without maize barrier in first planting period (October 2014−Februari 2015)

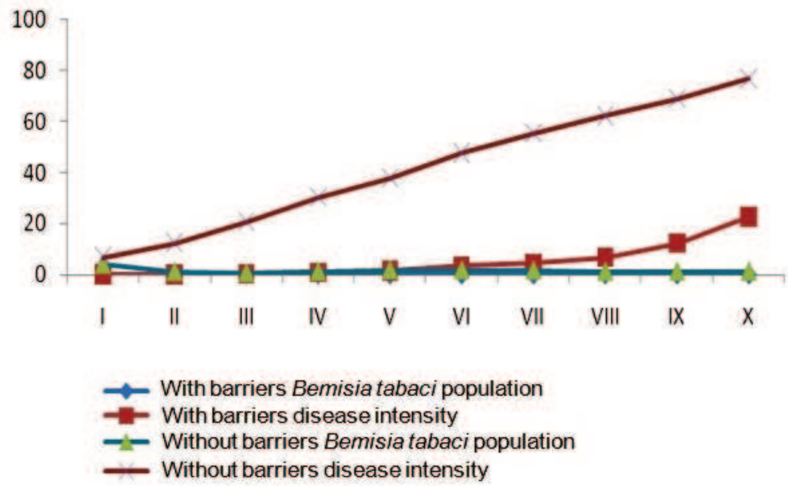

Figure 2. The average of *Bemisia tabaci* in pepper plots and yellow disease intencity with and without maize barrier in second planting period (April 2015−August 2015)

the population of *B. tabaci* was lower on plots with maize barrier than that of without maize barrier. Shown in Figure 2, the population of *B. tabaci* in plots with maize barriers are always lower than the initial observations, even though the maize was still young and short. In contrast, plots without maize barriers showed the higher population of *B. tabaci* at the same observation time. This represents an obstruction mechanism for *B. tabaci* is suspected because of the presence of a chemical compound, and not merely due to physical obstruction.

In the second planting period the highest disease intensity was 76.82% in plot without barriers, while in all plots treated with barriers the disease intensity was 22.80%. The highest average intensity of yellow disease was occurred during second planting period. This condition could happen due to *B. tabaci* population increment and also increasing rainfall in the second planting period. The data explained that the higher population of *B. tabaci*, so disease intensity will be higher.

Statistical Analysis of* Bemisia tabaci *Population and Yellow Disease Intensity in Pepper

Development of plant diseases could not be separated from the spread of pathogens in the field. This is in accordance with disease triangle which consists of the host plant, pathogen and environmental factors that favor disease development. *B. tabaci* in this case, act as vectors of disease transmission. According to Sudiono and Purnomo (2009), *B. tabaci* population and the occurrence of yellow disease indicate a positive correlation, where is *B. tabaci* population raise, the yellow disease also increase in the field. This experiment during two planting periods also obtained the same result, that the increase of yellow disease intensity was directly proportional to the population of *B. tabaci*, where it was lower plot with maize barriers than that of without barriers. Likewise for yellow disease intensity.

Factors affecting the escalation of *B. tabaci* population including planting season and alternative host. In dry season *B. tabaci* population increased compared to the rainy season. That is why the development of the pepper curly yellow disease incidence in dry season may be higher than in the rainy season. *B. tabaci* is a polifag insect so the availability of alternate hosts such as weeds will support the population and enhance the development of pepper curly yellow disease (De Barro *et al*., 2008). Therefore, sanitation should be done practice in planting area to reduce the vector presence. Sanitation especially should be managed during the rainy season. The presence of *B. tabaci* in the rainy season was less than in the dry season, however the presence of weeds flourished in the rainy season. So there was possibility that curly yellow disease also rose during the rainy season if it was not followed with management control, such as environmental sanitation and the use of plants barriers to suppress the presence of viral vectors in the field. Table 1 shows that the population, can be interpreted, there is an interaction between planting period and barriers. In the first and second planting period *B. tabaci* population was much lower in plot with barrier plants than that in plot without barrier, and the population of *B. tabaci* was more prevalent in the second planting period than in the first period. Furthermore, disease intensity variable was seemed to influenced by the interaction between planting period and barriers. Thus the result of paired t-test that there are significantly differences between the two variables were compared. Disease intensity have linear relationship with *B. tabaci* population: higher population leads to higher disease intensity.

Generally, the effectiveness of intercropping maize and chilli to control virus diseases, could be due to visual effects and physical factors of barrier against vector. The change in ground cover due to field maize plant has affected the alighting behaviour of *B. tabaci*. This is because of the camouflaging effect of the maize. Similarly, work done by various researches had shown that such cultural practice can reduce the flying insect population.

Table 1. Paired t-test of *Bemisia tabaci* population and yellow disease intensity with and without maize barriers area on both planting period

Observation variable		Treatment		Statistics	
		With barriers	Without barriers	Margins	Pr>|t|
First planting period	*Bemisia tabaci* population	0.04 b	1.63 a	1.59	<.0001
	Disease intensity	3.34 b	43.70 a	40.36	<.0001
Second planting period	*Bemisia tabaci* population	0.18 b	3.00 a	2.82	<.0001
	Disease intensity	5.28 b	40.72 a	35.44	<.0001

Information: the numbers which was followed by the same alphabet on the same row is not significantly different based on paired t-test dissimilar (alpha 5%)

With the reduction in vector population, virus disease incidence was also reduced. This confirms the results of previous work done in other countries. The adoption of such practices would definitely open the avenue to the adoption of more discriminate chemical and nonchemical practices which could be superimposed on existing ones to enhance the effectiveness of Integrated Pest Management (IPM) programmes. Another factor which might also contribute to the reduction of vector through inter-cropping is the effect of olfactory inhibition. Inter-planting two or more crops will confuse the colonization of pests by the mixed odours of different types of plants. Intercropping chilli with maize can be easily adopted by farmers.

Chilli intercropped with maize could reduce pesticide application by 50%. Moreover intercropping is a practice which is already familiar to many farmers. The adoption of such practices would definitely open the avenue to the adoption of more discriminate chemical and nonchemical practices which could be superimposed on existing ones to enhance the effectiveness of Integrated Pest Management (IPM) programmes.

CONCLUSION

The use of maize as barrier crop in pepper field could prevent *B. tabaci* introduced in to plots, this is because of the camouflaging effect of the maize plans. The prevention mechanism formed in this research was most possibly due to maize specific compound that *B. tabaci* dislike, because in every observation *B.tabaci* was more often away from maize plant. *B. tabaci* population and disease intensity in second planting period was higher than first planting period.

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