(Plenari)

EFFECT OF PLANT GROWTH STAGE ON THE POPULATION OF WHITEFLY *Bemisiatabaci* UNDER GLASSHOUSE CONDITIONS

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INTRODUCTION

The infestation of the whitefly (WF), *Bemisiatabaci* (Genn.) (Homoptera: Aleyrodidade) has caused losses in greenhouse crops in tropical and subtropical regions. The pest sucks plant sap, thereby weakening plants and causing shoot and leaf distortion (Brown *et al*, 1995). More significantly whiteflies secrete large amount of honeydew onto leaves and fruit, which in turn gets colonized by sooty molds, thus deteriorating the quality of greenhouse vegetables such as chilli, eggplant, tomato and okra.The first documentation of whiteflies in Malaysia was in 1935, albeit not as an economic pest, on chilli (*C. annuum*), soybean (*Glycine max*) and okra (*A. esculentus*) in the lowlands of Malaya. It has since been seen in numerous locations in Peninsular Malaysia on angled loofah (*Luffaacutangula*), brinjal (*S. melongena*), cucumber (*Cucumissativus*), french bean (*Phaseolus vulgaris*) and longbean (*Vignasesquipedalis*) (Syed *et al*, 2000). With its recognition as a polyphagouspest there is aconsiderable rise in the research dedicated to the whitefly (Inbar&Gerling. 2008). A key factor that determines the selection of the host plant for whitefly feeding is plant age (Horowitz. 1986), a demonstration of which was the increase of *B. tabaci* populations in pumpkin, bean, zucchini and other plants as they aged (Simmons, 1999). This study aims to better understand the relation between plant growth stages and whitefly populations.

METHODS

The study was carried out in a glasshouse at MARDI (Malaysian Agricultural Research and Development Institute) Serdang, Selangor, from January, 2011 to March, 2011. Experiments were conducted in cages measuring 1.5×3.0 m and 2.0 m in height, covered by insect proof screen at the side and top, at 30-36ºC, 80% RH. The insects used in the tests were reared on tobacco plants for one month (before the start of the experiments) inside cages measuring 0.5×1.20 m and 1.20 m in height covered by insect proof screen. The plants, chilli, (*C. annuum* MC11), brinjal, (*S. melongena* MTe1), tomato (*S. lycopersicum,* MT1), and okra, (*A. esculentus*, MKBE1), were obtained from MARDI Station, Jalan Kebun Klang. Seeds were planted in pots with soil (2:1:1 for clay, sand & natural fertilizer). After sowing, the seeds were placed under net covers in separate isolated compartments of the glasshouse to reduce infestation by insects. After the plants reached 3-5 leaf stages, they were transferred to experiment cages. Each plant type was put in the cages individually (different growth stages of 45 days, 60 days and 75 days). A total of 24 plants of each variety used in this experiment were arranged following a completely randomized design (CRD) with 3 replicates, each having three rows of 10 cm within and 20 cm between rows with 300 whitefly adults released into it. After one day of infestation, the adult WF density was randomly counted daily on 3 plants per replicate on the underside surface of the leaf (abaxial) from the upper, middle and lower stratum for one month (Naranjo& Flint, 1995). Samplings of WF eggs and nymphs were done every 4 days in 1 cm² using a stamp which was placed between the central and left lateral leaf veins (three times per leaf). Sampling was made on abaxial surface of three leaves per plant from each stratum (upper, middle and lower) for one month. The number of eggs and nymphs was observed by a stereoscopic microscope at 40X magnification in the laboratory.

One way ANOVA was used to analyse the numbers of egg, nymph and adults at different plant growth stages. Where ANOVA result was significant, means were then separated by Tukey`s Protected Least Significant Difference LSD,$P< 0.05$. To evaluate the influence of plant growth stages on whitefly abundance, the correlation and linear regression analysis were performed. Data were statistically analysed using Minitab Statistical Package programme (Minitab 15).

RESULTS AND DISCUSSION

The results showed that the mean numbers of WF adults, eggs and nymphs were significantly ($P < 0.05$) different among the three different growth stages of chilli, with adults, eggs and nymphs being much higher at the older growth stage (75 days) compared to middle (60 days) and younger (45 days) growth stages (Table 1). The mean numbers of WF adults, eggs and nymphs had positive and significant correlation with different growth stages of chilli (Adults, r= 0.306, $P< 0.05$), (Eggs, r= 0.21, $P<0.01$), (Nymphs, r = 0.150, $P = 0.01$). Similarly, the mean numbers of WF adults, eggs and nymphs were significantly different ($P < 0.05$) among the three different growth stages of tomato with adults, eggs and nymphs much higher at the older growth stage (75 days) compared to middle (60 days) and younger (45 days) growth stages (Table 2).The mean numbers of WF adults, eggs and nymphs had significant positive correlation with different growth stages of tomato plant (Adults, r= 0.306, $P< 0.01$), (Eggs, r= 0.298, $P< 0.01$), (Nymphs, r= 0.287, $P< 0.05$). Similarly, the mean numbers of WF adults, eggs and nymphs on okra were significantly ($P < 0.05$) different with adults, eggs and nymphs were higher at the older growth stages (75 days) than the middle (60 days) and younger (45 days) growth stages (Table 3). In addition, the results showed there is positive correlation between the mean numbers of WF adults, eggs and nymphs with different growth stages of okra (Adults, r= 0.293, $P< 0.01$), (Eggs, r= 0.190, $P< 0.01$), (Nymphs, r= 0.189, $P< 0.01$). It seems that the preference of *B. tabaci* on older age plants may be due to desirable changes that occur in the host plant's physiology with development. In fact, morphophysiological changes due to plant age, crop phenology and nutritional factors were reported to affect whitefly populations in several crops (Hooks *et al*., 1998; Leite *et al*., 2005). Leite*et al*. (2006) found that *B. tabaci* population tended to proliferate in the final stage of the cabbageplant.The results for the brinjal plant differ, however. The mean numbers of WF adults, eggs and nymphs were significantly different among the three different growth stages of brinjal, with adults, eggs and nymphs being much higher in the middle growth stage (60 days) and younger (45 days) than the older (75 days) growth stages (Table 4). The mean number of WF adults had negative correlation with different growth stages of brinjal (r= -0.142, $P< 0.000$), while the mean numbers of WF eggs and nymphs had no correlation with different growth stages of brinjal (Eggs, r= -0.074, $P= 0.105$), (Nymphs, r= -0.070, $P= 0.121$). These results agreed with those of Frank *et al.*(1995), who recorded that the whitefly *Bemisiaargentifolii* tended to attack the younger faba bean plants more compared with older plants. This difference in the behavior of *B. tabaci* in its attack on the brinjal plant compared with that on tomato, chilli and okra may be due to undesirable changes occurring in the host plant physiology with development. The most important of these changes is the thickness of the cuticle layers, which are thicker in older plants compared to the younger ones, which could have acted as a barrier to whitefly feeding.

In summary, several morphological and physiological changes may occur in agedplants depending on the plant species, therefore certain herbivorous insects would perform better on host-plants that grow more. The morphological changes in the leaf and sap content of a plant make it more susceptible to insect herbivores and aggravate their performance. The size and morphology of leave seems to allow the female to select suitable oviposition sites for its offspring. The results presented in this study are preliminary and further research needs to be conducted to determine the physiological changes that occur in plants during plant development and their effects on the behavior of the whitefly.

Table 3. Mean (±SE) number of adults, eggs and nymphs of *B. tabaci* at three different different growth stages of okra

Stages	45 days	60 days	75 days
Adults	0.36±0.01 a	1.388±0.039 b	2.009±0.057 c
Eggs	0.315±0.024 a	0.623±0.048 a	1.191±0.093 b
Nymphs	0.395±0.031 a	0.802±0.063 b	0.907±0.071 b

Means in row with same letter are not significantly different at P>0.05 (tukey).

Table 4. Mean (±SE) number of adults, eggs and nymphs of *B. tabaci* at three different growth stages of brinjal

Stages	45 days	60 days	75 days
Adults	1.44±0.062 a	2.16±0.082 b	0.64±0.038 c
Eggs	0.926±0.162 a	1.704±0.263 b	0.488±0.096 a
Nymphs	0.827±0.098 ab	0.988±0.109 a	0.617±0.073 b

Means in row with same letter are not significantly different at P>0.05 (tukey).

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