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RESEARCH PAPER

Effect of Phytopesticides on Sweetpotato Whitefly, *Bemisia tabaci* Gennadius

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ABSTRACT

Research was carried out to investigate the performance of extraction from botanicals on sweetpotato whitefly, *Bemisia tabaci* at the field of Patuakhali Science and Technology University (PSTU) during the period from May 2016 to April 2017. The experiments were laid out in RCBD with three replications for each treatment. Six treatments ie.T_0 (control; 100% water), T_1 (10% leaves extract of *Polygonum hydropiper* L.), T_2 (10% flowers extract of *Azadirachta indica*), T_3 (10% flowers extract of *Swietenia macrophylla* L.), T_4 (10% leaves and flowers extract of *Heliotropium indicum*) and T_5 (10% bulb extract of *Allium sativum* L.) were used on whitefly to determine the performance of botanicals. Water was used as the solvent for extracting from the plant parts using a centrifuge. The highest mortality rate of whiteflies were observed in T_1 (77.66%), followed by T_2 (66.66%) and lowest mortality rate were observed in T_0 (2.33%) on tomato. In the same way, same treatments were applied on brinjal to test the mortality of whitefly. The highest mortality rate of whiteflies were observed in T_1 (63.33%), followed by T_2 (54.00%) and lowest mortality rate was found in T_0 (6.00%) at 1% and 5% level of significance.

Key words: Bishkathali, garlic, hatishur, mahagoni, neem, whitefly

Introduction

The sweetpotato whitefly, *Bemisia tabaci* (Gennadius), (Hemiptera: Aleyrodidae) is of great concern to agriculture because they are significant insect pests of a number of important crop plants (tomato, brinjal, bean etc.), and they reach high population densities in a short time thereby damaging crops. *Bemisia tabaci* Gennadius (Hemiptera: Aleyrodidae) is one of the most destructive and invasive tropical and subtropical agricultural pests that attacks more than 700 plant species all over the world (Greathead, 1986).

In Bangladesh, *Bemisia tabaci* is a major insect pest for tomato and brinjal. For agricultural, horticultural, ornamental and greenhouse crops *Bemisia tabaci* is one of the most destructive insect pest, especially on tomato (Jones, 2003). Tomato is grown in both tropical and subtropical regions, under protected cultivation (Butler *et al*., 1986; Denholm *et al*., 1996). This species is considered destructive due to a number of factors: high degree of polyphagy, ingestion of phloem sap, massive honey dew secretion that reduces both the cosmetic value of the tomato and the available leaf area for photosynthetic activities, uneven ripening in tomatoes, and transmission of plant viruses (Duffus, 1987; Maynard and Cantliffe, 1989; Byrne *et al*., 1990; Rapisarda and Garzia, 2002).

Different strategies are under practice to control these insect pests. Chemical control is most commonly used as effective method, and farmers are still relying on the chemicals to control variety of insect pests (Naranjo, 2001). However, the excessive use of insecticides may lead to serious problems such as pesticidal pollution, pest resurgence, mortality of natural enemies and pollinators, high cost of production, reduction in nitrogen fixation and biodiversity (Miller, 2004).

On the other hand, botanicals can play an important role in agriculture that are naturally occurring toxins extracted from plants, and are environmentally friendly. There are several advantages to use botanicals rather than synthetic insecticides. Plant derived insecticides breakdown quickly in the environment, resulting in little risk of residues on food crops and less risk to beneficial insects. Some materials can be used shortly before

harvest. Most botanicals are rapid acting and most, but not all botanicals are of low to moderate toxicity to mammals.

The aim of this research work was to propose an alternative for whitefly control in tomato and avoid using large amounts of pesticides. Botanicals can offer a safe and effective alternative of conventional insecticides for controlling whitefly within an integrated pest management program. The proposed study highlights the practical application of botanical insecticides for controlling whitefly of tomato and brinjal.

Keeping in mind the above mentioned problem, the proposed research work has been planned to understand the performance of botanicals on sweetpotato whitefly which are friendly to environment by low cost in Bangladesh that will be helpful for the farmers to take proper management strategies. Conversely, farmers gain the economic sustainability by the quality production.

Materials and Methods

Seedling Preparation

The seeds were sown on a nursery bed of size 3m x 2.2m on 20th October 2016 at PSTU farm. Two separate seed beds were used for raising tomato and brinjal seedling separately. A soil mixture of sandy loam was used for preparing the bed. Seeds were sown in drills about 10cm apart at a depth of about 5mm. The distance between two stands was 20cm. A nutrient solution of 25g NPK in 15litres of water was used to irrigate the seedlings a week later (Bonsu, 2002).

Transplanting

28 days aged healthy seedlings with uniform height were transplanted following the single line of planting. A planting distance of 50 cm x 50 cm was employed. The seedlings were watered immediately after transplanting.

Insects Rearing in Laboratory

Samples of adult sweetpotato whitefly were collected from brinjal host plant at Patuakhali in Bangladesh and some of them were preserved in 99% ethanol (alcohol) for molecular study. Rest of collected alive samples was brought to IPM lab, PSTU (Insect Pest Management Laboratory of Patuakhali Science and Technology University) with their host plant separately in a rearing chamber for making colonies. These colonies were reared in separate insect-rearing chambers under conditions of 25 ± 2℃, 60 ± 5% relative humidity, and a 16 h light/8 h dark (16L:8D) photo- periodic cycle.

Collection and Processing of Plant Materials

Fresh leaves of bishkathali (*Polygonum hydropiper* L), flowers of neem*(Azadirachta indica)*, flowers of mahagoni (*Swietenia macrophylla* L.), leaves and flowers of hatishur (*Heliotropium indicum*) and bulb of garlic (*Allium sativum* L.) were collected from the surrounding of Patuakhali Science and Technology University. After collection all plant materials were washed in running tap water. Then the clean plant materials were kept in shade for air-drying and then they were preserved in refrigerator for 7 days at 4℃ temperature.

Preparation of Plant Extracts

The collected fresh leaf, flower and bulb were used for preparation of plant paste. 250 g of each category was cut into small pieces and separately blended in a blender with little distilled water to prepare paste. Then the paste was taken into container for mixed thoroughly with water by vortex mixture with equal ratio to water. Then the mixer was centrifuged at 10000 rpm for 20 minutes to obtain aqueous plant extract and that operation was repeated for 3 times consequently (Figure 1)

Figure 1. Extracts of different Botanicals after centrifuge (from the left: Leaves of bishkathali, neem flower, garlic bulb, mahagoni flower, and hatishur leaves & flowers)

Experimental Design

There were six (6) treatments with three (3) replications for each. The treatments were as follows:

T_0: Control (100% water)

T_1: 10% of aqueous biskathali (*Polygonum hydropiper* L.) leaves extract

T_2: 10% of aqueous neem (*Azadirachta indica*) flowers extract

T_3: 10% of aqueous mahogoni (*Swietenia mahagoni* L.) flowers extract

T_4: 10% of aqueous hatisur (*Heliotropium indicum*) leaves and flowers extract

T_5: 10% of aqueous garlic (*Allium sativum* L.) bulb extract

The effects of the above listed treatments were studied against whitefly (*Bemisia tabaci*) in different host plants like tomato and brinjal. The field was designed following by Randomized Complete Block Design (RCBD). Six small plots were considered at a replication for individual crop. Each plot and replication were separated from each other by using insect proofed fine mesh and polythene supported by steel made rectangular structure. Certain number of insects was released from the colony to the each plot.

Cultural Practices

The normal agronomic practices (e. g. watering, weeding, mulching, fertilization, sticking and pruning) recommended for growing vegetables in an experimental farm were followed.

Spraying Method

The botanical extracts of 10% concentrations were sprayed on experimental field with 3 days interval. Both upper and lower surfaces of plant leaves were sprayed with botanicals.

Data collection

Sweetpotato whiteflies were released from their mother stock plant to the selected experimental plots one day before of spraying for their settlement. After spraying, number of dead insects were counted and recorded after 24 hours, 48 hours and 72 hours followed by the next two sprayings, and finally mortality percentages (%) of these insects were calculated.

Statistical Analysis

Data were expressed in three individual replicates, and mean values ± standard error were plotted using Sigma plot 8.0 (Systat software, Inc., Point Richmond, CA, USA). Analysis of variance (ANOVA) was carried out in order to analyze the means by using PROC General Linear Model (GLM) with the Statistical Analysis System (SAS, 2002-2003 SAS Institute Inc., Cary, NC, USA) version 9.1 program. Significant differences among mean values were determined using Duncan's Multiple Range Tests (DMRT) at 1% and 5% level of significance.

Results and Discussion

Performance of Botanicals on Whitefly of Tomato

Whiteflies were released from the mother stock plant to the tomato plant one day before of spraying for their settlement. After spraying, number of dead whiteflies were counted and recorded after 24 hours, 48 hours and 72 hours followed by the next two sprayings, and finally mortality percentages (%) of whiteflies were calculated. The mortality percentages were presented graphically in figure 19 that showed 2.33%, 77.66%, 66.66%, 53.33%, 51.66% and 43.33% as per treatment T_0, T_1, T_2, T_3, T_4 and T_5 respectively. The highest mortality rate of whiteflies was observed in T_1 (77.66%), followed by T_2 (66.66%) and lowest mortality rate was observed in T_0 (2.33%) (Figure 2).

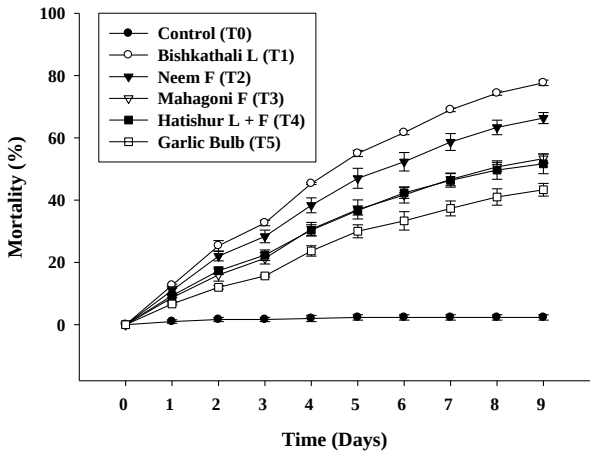

Figure 2. Performance of botanicals on whitefly of tomato.

Performance of Botanicals on Whitefly of Brinjal

Whiteflies were released from the mother stock plant to the brinjal plant one day before of spraying for their settlement. After spraying, number of dead whiteflies were counted and recorded after 24 hours, 48 hours and 72 hours followed by the next two sprayings, and finally mortality percentages (%) of whiteflies were calculated. The mortality percentages were presented graphically in figure 20 that showed 6.00%, 63.33%, 54.00%, 47.00%, 38.33% and 40.66% as per treatment T_0, T_1, T_2, T_3, T_4 and T_5 respectively. The highest mortality rate of whiteflies was observed in T_1 (63.33%), followed by T_2 (54.00%) and lowest mortality rate was observed in T_0 (6.00%) (Figure 3).

The present study was accomplished to observe the performance of different botanicals against sweetpotato whitefly were evaluated on both tomato and brinjal crops. The main compounds of plant extracts are essential oils (mono-terpenoids). These botanical compounds offer promising alternatives to chemical insecticides. These compounds may act as effective insecticides against vegetables pests (Cork *et al.* 2005; Muyinza *et al.* 2010), contact insecticides (Kim *et al*. 2004; Tapondjou *et al*. 2005). Our results revealed highest mortality percentages (77.66%) in T_1 (leaves of bishkathali) treatment which was significant both 1% and 5% level of significance followed by T_2 (flowers of neem) treatments (66.66%). T_3 (flowers of mahagoni) and T_4 (leaves and flowers of hatishur) for tomato crops. So, there was significant different among the treatments.

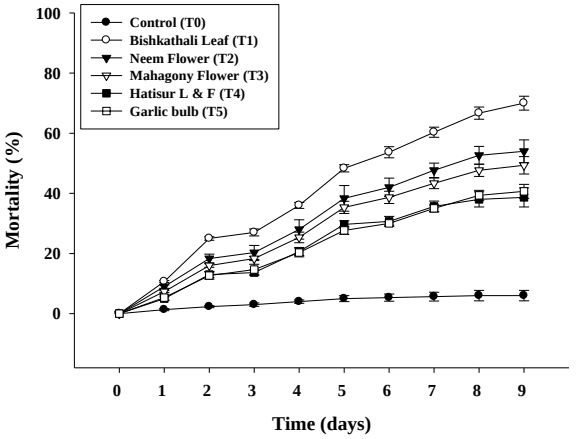

Figure 3. Performance of botanicals on whitefly of brinjal.

In case of brinjal crops, it is revealed that the trend of the mortality percentage of whitefly was observed due to application of the different treatments as $T_1>T_2>T_3>T_5>T_4>T_0$. The treatments were found significant at 1% and 5% level of significance (Figure 3). So, the treatments were significantly different. The mean comparison table showed that T_3, T_5 and T_4 treatments were almost similar with each other. Most effective result obtained by T_1 and T_2 treatments.

It is very ancient practice to use several neem products such as neem seed kernel extracts dry fruit extracts, neem oil, extracts from the leaves and barks etc for controlling insect pests. Several products of neem with different concentrations and formulations gives positive result against sweetpotato whitefly in many research work (Narayanasamy, 2002; Butler *et al*., 1991; Abou-Fakhr Hammad *et al*., 2000; Rosaih, 20001; Mote and Bhavikatti, 2003; Venkatesh *et al.*, 2004; Kumar and

Poehling, 2007; Kuldeep *et al*., 2009; Mukhtar *et al*., 2013; Barati *et al*., 2013; Chavan *et al*., 2015 and Rehman *et al*., 2015). The present research work carried out with aqueous neem flowers extract, which also showed positive result following the above cited results. Biskathalileaves extract (T_1) which showed superior performance in controlling whitefly and that was better than neem extract which are fully matched with the research of Subba *et al.*, (2017) they also observed that Polygonum extracts suppressed 56.74% whitefly population followed by neem extracts 54.92% at 5% concentration. These research works strongly support the present research findings. Moreover, Ghosh (2012 and 2014) was reported that extracts Polygonum plant at higher concentration performed very effectively, recording more than 50% whitefly suppression (54.31%) achieving more than 60 % mortality at 3 and 7 days after spraying.

Conclusion

Use of synthetic insecticides is costly and very much harmful not only for crops and beneficial insects in the field but also for both mammal and the environment where as botanicals are cheaper, locally available and hazard free as compared to the synthetic insecticides. Therefore among all treated botanicals in this experiment bishkathali leaf extract (10% of aqueous *Polygonum hydropiper* L. leaves extract) and neem flower extract (10% of aqueous *Azadirachta indica* flowers extract) can be the right choice considering all aspects of life for controlling sweetpotato whitefly in the field of tomato and brinjal, respectively.

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