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SHORT COMMUNICATION

MANAGEMENT OF WHITEFLIES (*Bemisia tabaci* . GENNADIUS) USING *Amblyseius swirskii* ATHIAS-HENRIOT (SWIRSKI-MITE) IN CHILLI CROP

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Abstract

Whitefly (*Bemisia tabaci*) is an important pest of chilli in Sri Lanka. Whiteflies are also vectors of viral diseases in many crops. Indiscriminate use of insecticides leads to resistant development, high residue levels, health hazards and environmental pollution. The laboratory experiment was conducted using the biological agent, *Amblyseius swirskii* Athias- Henriot, imported from Koppert Biological Systems, Netherlands, for the control of chilli whiteflies. Results indicated *A.swirskii* reduced the white fly population significantly after two weeks of introduction. The reduction of the population of *A.swirskii* was statistically significant after the 04th week. The survival of Swirskii mites and whiteflies at the end of the 6th week in the experiment was 25 % and 26.6 % respectively. *A.swirskii* effectively controlled whiteflies in chilli, though the biological agents did not multiply in the experiment even with the provision of bee's honey as an alternate food source, hence seasonal augmentation releases are necessary.

Keywords: *Bemisia tabaci*, *Amblyseius swirskii*, Chilli, Biological control

INTRODUCTION

There are 1556 white fly species recorded in the world and *B.tabaci* remains one of the most economically important pests of vegetable and ornamental crops (Perring *et al*. 2018; Alessandro *et al*. 2016), whereas Lahey *et al*. (2020) reported that there are at least 115 species of whitefly parasitoids recorded in the world belonging to 23 genera in five families: Aphelinidae, Azotidae, Encyrtidae, Signiphoridae (Chalcidoidea), and Platygastridae (Platygastroidea)). Moreover, there are approximately 150 arthropod species currently described as predators of whiteflies, and the majority of them are ladybird beetles, predaceous bugs, lacewings, phytoseiid mites, and spiders (Xu *et al*. 2013). Two genera, Encarsia and Eretmocerus in the order Hymenoptera, are the most well-known whitefly parasitoids found throughout the world, while others are specific to different continents (Shah and Zhang 2015). These two parasitoids have been reported to lower the population of *B. tabaci* significantly, via parasitism and host feeding (Xu *et al*. 2013; Kidana *et al*. 2018; Kedar *et al*. 2014). The biological control of predators was reported by Nomikou *et al*. (2003), which showed that two phytoseiid species, *Euseius scutalis* (Athias-Henriot) and *Typhlodromips swirskii* (Athias-Henriot), can significantly suppress *B. tabaci* population on a single plant. In our study, we used the predatory mite *A. swirskii* (Swirski mite) imported from Koppert Biological Systems, Netherlands and followed their proposed experimental protocol.

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B. tabaci feeds on several solanaceous and ornamental crops, including brinjal, chilli, cotton, okra, potato, tomato and tobacco (Kunjwal and Srivastava 2018; Khan and Wan 2015). The economic damage caused by *B. Tabaci* ranges from mild to catastrophic with global annual loss reaching up to billions of USD in many crops (Hasan *et al*. 2019;

Mascarin *et al*. 2013). *B. tabaci* adults are minute insects (usually 1 to 3 mm in length) that feed and oviposit in large quantities on the underside of leaves (Choudhary 2017). *B. tabaci* may decrease the rate of photosynthesis in plants through the excretion of honeydew during feeding, besides being able to transmit a large number of plant pathogenic viruses (Polston and Capobianco 2013). Chemical pesticides are the most widely used method to control *B. Tabaci* infestation. Chemical pesticides such as neonicotinoids and insect growth regulators are the conventional way to manage *B. tabaci* (Smith *et al*. 2018). The excessive use of these chemicals has led to numerous problems, such as health risks to users and consumers, the development of pest resistance and the extinction of non-target insects. In recent years, research has shown an increasing interest in using biological control agents including entomopathogenic fungi (EPF) as well as insect parasites and parasitoids as an alternative (Skinner *et al*. 2013) for pest control. Over the last five decades, biological control measures were used successfully to control whiteflies in protected environments in other countries (Smith and Krey 2019).

In Sri Lanka whiteflies are a common garden and greenhouse pest and they are very difficult to control. Whiteflies, when fed on plant sap will result in stunting, especially in young plants. Indirect damage is by the large amounts of sticky honeydew secreted during feeding. Honeydew may cover plants and support the growth of sooty moulds, which also reduces the plant's ability to use light for photosynthesis. In addition to direct and indirect damage, whiteflies may carry and transmit viral diseases and damage susceptible plants.

In Sri Lanka use of insect biological agents for pest control was not explored and identified up to date. Hence, the availability of local biological agents is unknown. In the present study biological agent *A.swirskii* imported from Koppert Biological Systems, Netherlands was evaluated for the control of *B. Tabaci* in chilli (Figure 1).

MATERIALS AND METHODS

Chilli plants are raised in pots in the greenhouse at Plant Quarantine Unit, Gannoruwa, Peradeniya, as per the recommended practices of the Department of Agriculture and one-month-old and flower-initiated plants were used in the experiment. These plants are kept inside the mass-rearing insect cages of *B. Tabaci* for 3 weeks for egg laying. Afterwards, three plants each were kept separately in three insect cages (03 replicates) and used for treatment to introduce the parasites. Another three insect cages with three plants infested with eggs of *B. Tabaci* were used as control treatment. Insect cages are kept in the laboratory and maintained at 20^0C throughout the experiment.

Figure 1: Whiteflies on chilli leaf

[Source: Koppert biological systems, Netherlands]

Figure 2: *A. swirskii* mites

[Source: Koppert biological systems, Netherlands]

The Koppert Biological System, Netherlands recommended a dose of 4 biological agents per plant (Personnel Communication) and the introduction of *A. swirskii* mites (Figure 2) was done to all treatment cages (12 per cage) except the control. As an alternate feed for the mites, cotton wool swabs dipped in a 10% solution of bee honey was hung in all insect cages and replaced every 2-3 days.

After five days of setting up the experiment, the insect counts of whiteflies (adults and larvae) and biological agents were taken from 10 leaves per plant (30 leaves/replicate) in all treatments. Because of the small size of the larva, a hand lens (× 20) was used. Data collection was repeated at seven-day intervals for five weeks. Since the experiment was conducted under controlled conditions inside the laboratory, the treatment-to-treatment variation of different parameters is minimal. Hence, data were statistically analyzed considering an RCB design with three replicates using the SAS package.

RESULTS AND DISCUSSION

Amblyseius swirskii is a generalist predatory mite feed on small soft bodied insects and is commercially used to control greenhouse pests in many Europe and North America. Results obtained in the experiment were given in table 1 and graphically in Figure 3. Data indicated that the Swirskii mite population was not increased but there was a significant control of whiteflies.

However, the population of whiteflies in the control treatment remained unchanged till the end of the experiment. A significant drop in the whitefly population count was observed after two weeks of introduction. Since then the white fly population further reduced gradually, except in the 3rd week after the introduction and finally only 26.6% of the white fly population survived after 6 weeks whereas the survival of the Swirski mite population was 25%.

Karel *et al*. (2005) surmised that *A. swirskii* is a promising control agent of whiteflies and the western flower thrips on sweet pepper. Moreover, they indicated that *A. swirskii* can be released preventively when the crop is at the flowering stage and the mites remain in the crop throughout the entire growing season, even when pest levels are very low.

Table 1: Insect count (average of 10 leaves and three replicates) after introducing the Biological agent; *A.swirskii* (swirski-mite) to whitefly infested cages

Date	No. of *A. swirskii*	*No. of B.tabasi in treatment*	No. of *B .tabasi* (Control)
At Introduction	4.00 a	10.00 a	15.33 c
1 WAI*	4.66 a**	9.66 a	10.33 d
2 WAI	3.33 a	6.33 b	19.33 b
3WAI	2.66 a	8.33 a	22.33 a
4 WAI	4.33 a	5.00 b	22.33 a
5 WAI	2.33 a	4.33 b	18.00 b
6 WAI	1.00 b	2.66 c	16.00 c
Standard Error Difference		2.028	

*WAI = Weeks after introduction

** Values denoted by same letter is not significantly different in each column

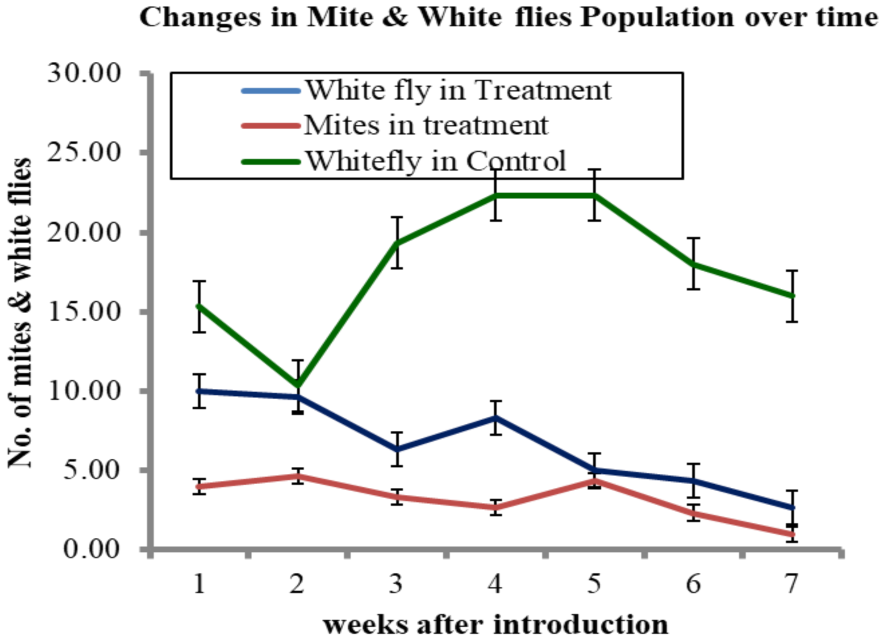

Figure 3: Population dynamics of *B.tabasi* and *A. swirskii*

Ekaterina *et al*. (2020) also indicated predatory mites *A. swirskii* and *N. cucumeris* is considered as effective bio-control agents against whitefly pest in indoor vegetable crops. Their results showed that the dynamics of the pest population are affected not only by the predator but also by the period between two introductions and their frequency. However, Arthurs *et al*. (2009) noted that prey consumption and ovi-positioning by *A. swirskii* and *N. cucumeris* do not differ between the two species, and the higher efficiency of *A. swirskii* is associated with high temperatures up to 40°C during summer, which was relatively well tolerated by *A. swirskii*. These results reported by other global scientists will confirm our results obtained in Sri Lanka, under laboratory conditions where temperatures were maintained at 20^{0}C.

CONCLUSIONS

In conclusion, the data revealed that *A. swirskii* is well effective in controlling chilli whiteflies, under laboratory conditions, but the biological agent does not multiply under local conditions even with the supply of bee honey as supplementary food, which was also reported by Perera *et al*. (2021) working on chilli thrips control. Therefore, the fresh introduction of biological agents needs to be done in every cultivation season under local conditions.

DECLARATION OF CONFLICT OF INTEREST

The authors hereby declare that there are no conflict of interests OR the existence of a financial/non-financial conflict of interest for the manuscript.

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AUTHOR CONTRIBUTION

Perera and Senanayake Contributed equally for the manuscript preparation.

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