BIOLOGICAL CONTROL OF INSECT AND MITE PESTS OF PROTECTED AGRICULTURE SYSTEMS IN SRI LANKA

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ABSTRACT

Protected agriculture systems (mainly poly tunnels) have been relatively new introductions to Sri Lanka but the infestations of insects and mite pests have already become a serious problem. A project was initiated to collect and identify insects and mites infesting high value crops in poly tunnels in Sri Lanka, to collect and identify prasitoids or predators that could be used as bio-control agents in poly tunnels and to study the potential of using natural enemies as bio-control agents in poly tunnels through inundative release after mass culturing.

From an initial survey of poly-tunnels the major pests of different crops were identified as two spotted spider mite (*Tetranychus urticae*), whiteflies (*Bamecia tabaci*), and leafminers (*Liriomyza stivae* and *L. huidobrensis*). The natural enemies of poly tunnel pests identified include, *Stethorus* sp., a cocinellid predator of two spotted spider mite, *Neoseiulus longifiles,* a predatory phytoseiid mite, *Diglypus isaeae*, a parasitoid of leaf miners and *Encarsia transvena,* a pupal parasitoid of white flies.

Biology and potential of using *Neoseiulus longifiles* as biocontrol agent have been studied and a simple system of mass rearing the predatory mite using pollen of *Tridax procumbens* pollen was developed. The mass rearing method can produce 70 predatory mites within a week from initial introduction of 10 predatory mites. This method is easily adaptable by farmers. Our aim is to supply nucleus population of predatory mites along with the instructions for farmers to multiply the predatory mites. Project is being continued to find out rearing methods for other potential natural enemies of poly tunnel pests, we have identified.

KEYWORDS: *Neoseiulus longifiles* Protected Agriculture, Predatory mite, *Tetranychus urticae.*

1. INTRODUCTION

Cultivation of high value crops in protected agriculture systems is a relatively new type of intensive cropping method adopted in Sri Lanka. Since the early 90s, farmers have found that insect and mite pests are one of the most serious problems that occur in these systems. Protected agriculture systems provide very good micro ecological systems to adapt biological control methods for pest control [1]. Since no specific pest control methods have been recommended for protected systems in Sri Lanka a study was initiated to find out the possibility of introducing biological control agents to control insect and mite pests in protected agriculture systems.

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The objectives of the study were to identify major insect and mite pest problems in protected agriculture systems in Sri Lanka, collect and identify native natural enemies of pests in protected systems, find out simple systems of mass rearing of selected natural enemies with potential for use as biocontrol agents, study the effectiveness of biological control within protected systems and recommend biological control methods for managing insect and mite pests in protected systems. This poster presents the results so far achieved from the project.

2. MATERIALS AND METHODS

Survey of protected systems in of Sri Lanka to find out major pest problems

An ad hoc survey was conducted by visiting poly tunnel growers in three main districts in the country namely Badulla, Kandy and Nuwara Eliya, where most of the protected agriculture systems are located, to find out commonly grown crops and major pest problems. The growers were interviewed and crops were visited to collect the samples of pests.

Field survey for natural enemies of the pests of crops grown in poly tunnels

Once the major pests of poly tunnels were identified the conventionally grown crop fields were surveyed to identify the local natural enemies of these pests. The collected natural enemies were identified and potential biocontrol agents were identified based on literature. Since the most common and difficult to control pest in poly tunnels was found to be two spotted spider mite we first concentrated on developing a biocontrol method for this pest.

Culturing of prey Red spider mites

Although the red spider mite can attack many crop plants, culturing them on crop plants is expensive. Therefore trials were conducted to find suitable, freely available host plants and it was found that marigold can be successfully utilized as a host plant for mass culturing of *Tetranychus urticae*. Our results indicate that 8 weeks old marigold plants give the best results. One 3-week-old plant infested with 100 gravid females will yield an average of 2500 mites within three weeks (60 mites per leaf).

Biology of selected biocontrol agents

The biology of two predators of two spotted spider mite, the coccinellid beetle *Stethorus* sp. and the phytoseiid mite *Neoseiulus longifiles* were studied in the laboratory. For this purpose a two spotted spider mite culture was established in the green house and field collected predators were used. Both *Stethous* sp. and *Neoseiulus longifiles* were found on manic plants growing near the research station. To study biology of *Stethorus* sp., field collected predators were placed in petri dishes (9 cm diameter) containing a moist filter and a known number of two spotted mites were added to petri dishes daily. Development rates of each growth stage were daily observed. To study the biology of *Neoseiulus longifiles* a small petri dish arena was prepared by placing a 5 cm x 5 cm piece of foam covered with similar size black paper inside a partially water filled petri dish. The periphery of the foam and paper stage was protected by water soaked tissue papers [2]. *Neoseiulus longifiles* were also fed with two spotted mites and development rate was observed as above. For each species a newly hatched male and female was observed in each petri dish. Study was replicated 5 times.

Mass rearing of *Neoseiulus longifiles*

Since the rearing of *Neoseiulus longifiles* using pollen was much easier, mass rearing of this species was attempted first.

A simple mass culture method for the predatory mite

For mass culturing of *Neoseiulus longifiles*, 30 cm x 15 cm large arenas were made according to McMurtry and Scriven [4], using shallow plastic containers consisting of water soaked foam covered with a black paper square surrounded by water soaked tissue paper barrier. Ten predatory mites were introduced to the mass culture arenas with *Tridax procumbens* pollen. Pollen needs to be added to arenas daily. Within one week 70 active predatory mites can be collected from each arena. If the predators are allowed to multiply beyond a week, cleaning of the arenas is necessary.

The experiments conducted to find out the potential of using *Neoseiulus longifiles* to control *Tetranychus urticae* were very successful. It was found that a single female predator could kill 9 eggs or 8 nymps or 6 adult two spotted mites a day. The female predatory mites live about a month and produce 1 egg per day.

3. RESULTS AND DISCUSSION

Major pests of commonly grown poly tunnel crops

The survey of poly tunnels revealed that the number of pest species in poly tunnel crops were much less than that found in conventional agriculture Despite of the high level of protection provided by poly tunnels, in many instances the following pests were found out to be serious problems for poly tunnel crops in Sri Lanka.

1. White fly (*Bamesia tabaci*), pest of tomato and salad cucumber
2. Two spotted spidermite (*Tetranychus urticae*), major pest of all crops
3. Leaf miner (*Liriomyza sativae, Liriomyza huidobrensis*), pest of cucumber and tomato.

Other occasional pests observed in poly tunnels during the survey included, thrips, aphids, *Spodoptera litura* and slugs.

Natural enemies found from the field

The survey of natural enemies were limited to those active against the major pests mentioned above. Based on literature we identified following natural enemies as potential biocontrol agents.

1. *Stethorus* sp. a coccinllid predator of mites
2. *Neoseiulus longifiles* a phytoseiid predatory mite of spider mites
3. *Diglypus iseae* an larval parasitoid of leaf miner
4. *Hemiptarsinus vericornis* a native parasitoid of leaf miner
5. *Encarsia transvena* a parasitoid of white flies.

Since the two spotted spider mite was identified as the most serious pest in protected systems we focused on the mass rearing of spider mite predators.

Biology of *Neoseiulus longifiles* and *Stethorus* sp.

Neoseiulus females lay eggs even without the presence of males. Each female laid on average one egg per day and female longevity was 25-30 days. Eggs hatch within 1-2 days and the six-legged larval period was very short (a day). Protonymph and Dutonymph took 1-2 days to become adults. Each adult consumes 9 eggs, 8 nymps or 6 adult two spotted mites a day on average. This development rate is comparable to other *Neoseiulus* species used in biological control [3].

Biology of *Stethorus* sp.

Eggs were laid singly and they are about 0.37mm, oval and yellowish in color. They hatch in 3-4 days into campodieform larvae. There are four larval instars lasting 6 to 10 days. During the larval period a single larvae consume an average of 8 mites a day. At the end of the fourth instar, larvae attach themselves to a surface with their caudal ends and pupate. Development times of different stages are given in the **Table 1**.

Table 1. Life cycle of *Stethorus* sp.

Life stage	Duration (days)
Eggs	3-4
1st Instar larvae	1-2
2nd Instar larvae	1-2
3rd Instar larvae	2-3
4th Instar larvae	2-3
Pupae	4-5
Total lifecycle	13-19

4. CONCLUSION

Six natural enemies of poly tunnel pests in Sri Lanka were identified. One potential biocontrol agent for the poly tunnel pest two spotted spider mite is *Neoseiulus longifiles*. The system of mass culturing *Neoseiulus longifiles* described in this paper is very simple and cheap. Using this methods it is possible for farmers themselves to multiply their own predatory mites with very little expenditure. Simple mass rearing methods for the natural enemies of other pests are also being developed.

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