ACARINES, 4: 63-65, 2010

A Simple and Low Cost Method for Mass Production of the Predatory Mite *Phytoseiulus persimilis* (Acari: Phytoseiidae)

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(Received: August 29, 2010)

ABSTRACT

Usually, the predator mite *Phytoseiulus persimilis* Athias - Henriot is commercially reared on living plants. Since this method has some disadvantage and occupy wide area, a new method is developed based on rearing the predatory mite in controlled room under optimum temperature and humidity. Highly infested bean, *Phaseolus vulgaris* L., leaves were plucked and provided to the predator culture. The predator culture was maintained in a plastic boxes and isolated carefully. A computer model was designed to assess the required daily leaflets. Thereafter, predators were collected purely and simply via aspiratory apparatus from the edge of the boxes and counted according to their weight. Almost 162,000 predator individuals were harvested within 4 weeks from five boxes occupied 1m long shelf. A reasonable rate of increase of 1.26 individual per individual per day, was recorded in current study.

Key Words: *Phytoseiulus persimilis*, mass production.

INTRODUCTION

Phytoseiulus persimilis Athias-Henriot and *P. macropilis* (Banks) were used for controlling *Tetranychus urticae* Koch since many years (Rasmy and Ellathy, 1988 and Parvin and Haque, 2008). Many attempts have been done for rearing these predator mites. Since they are reared exclusively on spider mites, such as *Tetranychus spp*, the most common rearing methods were designed to be carried out on plants infested with the prey, (Heikal, 2001, Heikal and Ibrahim, 2002 and El-Halawany, 2008). Rearing predators on plants has two disadvantages; first is the escape of the predators especially in hot days. Second is the difficulty to adjust the balance among three factors, plant, prey and predator, which resulted in loss of some of the inputs. In addition to the above disadvantages, it is also difficult to collect the predators purely; besides the difficulty and outlay of controlling the environment in the greenhouse to be suitable for the predator. To overcome these disadvantages the present method was developed based on rearing the predator on plucked infested leaves in a controlled room.

MATERIALS AND METHODS

Rearing of the two spotted spider mite

Rearing of the two spotted spider mite was carried out under a plastic-net greenhouse 4 x 6 m dimensions and 22 mesh porosity. Bean plants, *Phaseolus vulgaris* L. (variety Nebraska) was planted in plastic trays (30 x 40 cm) using 1 : 1 peat-moss and vermiculite mixture. Recommended agricultural procedures were applied. Bean foliages were inoculated with *T. urticae* by distributing infested leaves on the foliages, so spider mite migrate to the bean foliages. Infested leaves were removed after 5 days as it is enough time for eggs to hatch and larvae move to bean plants. Sample of 10 leaves were photographed every 3 days. These photos were undergone an image analysis, as it was described by Bakr (2005) in order to measure the consumed area and recognize the proper harvest time which revealed maximum number of spider mite. When spider mite population reaches the maximum and just before leaves were completely consumed, leaves were harvested carefully. The most severely infested leaves were harvested first. The above procedures were carried out successively in order to get continues infested leaves.

Rearing of the predator *Phytoseiulus persimilis*

Rearing the predator was carried out in a controlled room, 25°C and 75 R.H. Predatory mites were reared in a plastic boxes, 30, 20 and 15 cm length, width and height, respectively. Each five boxes were ranked as one row on a small metal table, 100, 15 and 10 cm length, width and height, respectively. Table legs were laid in cups filled with water. Five boxes, table and 4 water cubs construct a one rearing unit. Each rearing unit was placed on a shelf (100 x 30 cm). The shelf was placed on two arms those were fixed to the wall. Thus the shelf is connected in only two points to the wall. Vaseline with citronella was used to cover these connection points in order to isolate the shelf and prevent any crawling contamination. Some of predator mites fall from the boxes and were found on the shelf. Spider mite arenas were prepared, with the aim of trapping these falling predators, as following: 15 x 10 x 2 cm

arena was filled of moist cotton. Mulberry leaf was cut as the size of the arena and placed up side down on the arena where mulberry leaf overlap the edges of the arena, then 1 or 2 infested bean leaflets were placed on the mulberry leaf. Two arenas were used per shelf. When the arena was found to be full of predators, the mulberry leaf was taken to one of the boxes and replaced by new one and so on.

To initiate rearing of the predator mites, three infested bean leaflets were placed in each box and inoculated with suitable number of predators in order to represent almost 15 : 1 prey : predator as a initial ratio. Hand lens was used to monitor the edges of the boxes daily and watch predator and prey quantities in order to determine the daily required amount of preys. Sufficient number of infested bean leaflets were added daily. Number of infested bean leaflets were increased when a large number of predators were observed on the edges, which reflects a lack of preys. Number of daily added leaflets increased from time to time following the increase of the predator population.

Harvesting

Predators are collected when it is needed or when the boxes become full of dry leaflets. It is required to starve the culture one day to drive the predators to run over the edge of the boxes. Thereafter predators could be collected easily and purely via aspirator.

Counting

Collected predators were weighted then a little sample of the predators was taken apart and weighted separately. This sample was suspended in aqua's solution with the aim of making a suitable concentration for counting. Number of predators were calculated proportionally to the number of the counted sample.

In order to monitor the rate of increase of the predators, a sample of 5 boxes were harvested and counted weekly. Actual daily rate of increase was calculated based on obtained predators.

Computer model was designed in order to estimate the required preys and leaflets per day and assess the count of predators on a certain day. This model based on the rate of increase and food consumption of the predator besides the number of preys (adults and eggs) on the leaflet. As Fasulo and Denmark (2000) reported that one female of *P. persimilis* consumes 20 eggs or 5 adults of *T. urticae* per day. Since plucked leaves contain all stages of mite, a factor is suggested to convert the number of eggs to the equivalent number of adults; i.e. four eggs are equivalent to one adult. Thus, predator rate of increase leads to estimate the number of the predators, consequently the required leaflets could be estimated on bases of the rate of consumption and number of preys on the leaflet (equivalent to adult female). The model were designed to accept feed back and correct the number of predators at any point by reassessing number of predators according to real daily consumption.

RESULTS AND DISCUSSION

Data in Table (1) represent the yield of one shelf (5 boxes; 30 x 100 cm); 250 *P. persimilis* individuals (50 per one box) were used to initiate the culture. Predators' population grown increasingly to 1313, 7614, 36206 and 161812 individuals after 1, 2, 3 and 4 weeks, respectively. Consequently, daily rate of increase values was calculated according to the above populations. Daily rate of increase values recorded 1.267403, 1.285396, 1.24951 and 1.238483 for 1st, 2nd, 3rd and 4th week, respectively, with an average of 1.260198 individual per individual per day. Concerning the consumed bean plant trays, it could be seen that the culture consumed 0.5, 2.9, 13.4 and 70.8 trays until 1st, 2nd, 3rd and 4th week, respectively. Under the shadow of obtained data we can calculate the yield of one tray (no. of predator on a certain day/consumed trays until the same day). It could be concluded that the average of the yield of one bean tray, in the present experiment, is about 2500 predators.

Table (1): Predators yield from one shelf (100 x 30 cm).

Day	No. of predators	Daily rate of increase*	Consumed bean plant trays
0	250		
7	1313	1.267403	0.5
14	7614	1.285396	2.9
21	36206	1.24951	13.4
28	161812	1.238483	70.8

* Calculated from harvested predator numbers.

Heikal and Ibrahim (2002) reared *P. macropilis* in a greenhouse on bean plants, *P. vulgaris* and recorded the number of predators weekly. According to their data, number of predators were 1.9, 5.4, 13.1, 21.2, 29.0 and 40.8 predator per leaflet after 1st, 2nd, 3rd, 4th 5th and 6th week, respectively. Daily rate of increase was calculated on base of their data, in order to compare this value with the present method. According to their data, daily rate of increase values were 1.161, 1.135, 1.0835, 1.03995 and 1.05 on 2nd, 3rd, 4th, 5th and 6th week,

respectively, with the average of 1.09389. In the present method, the obtained rate of increase values recorded 1.267403, 1.285396, 1.24951 and 1.238483 for 1st, 2nd, 3rd and 4th week, respectively, with an average of 1.260198. Thus, the present method provides a higher reproduction rate which resulted in a reduction in the required time; besides the expected duplication when all the available area is used to produce preys.

Advantages of the current method

- Harvest could be undertaken whenever the predator is needed.
- Reduce the loss of predators during rearing which may occur in the greenhouse at the lack of preys or on hot days.
- Easy to rear the predator in the optimum conditions which resulted in obtaining the best rate of increase.
- No need for a greenhouse to maintain and rear the predators so it could be used to produce preys which could finally resulted in duplicate the predator yield.
- Avoid any drop caused by the weather fluctuation.

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