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Modeling Mass Production of Phytoseiid Predator, *Neoseiulus longispinosus* Evans *In vitro* on French Bean Plants Harbouring the Prey, *Tetranychus urticae* Koch

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ABSTRACT

The studies were conducted to develop a module for mass production of phytoseiid predators using data of four batches of mass production of phytoseiid on French bean plants grown in polycarbonate house during different months. Regression analysis of the pooled data from four batches of mass production of the predator showed that the predator population reached peak around 23 days after predator release at four predators per leaflet of French bean plants ten days after infestation of spider mite, Tetranychus urticae at ten per leaflet. This model can be used to predict the day of peak predator population making use of the population counts of different stages of both prey and predator on any given day, and accordingly plan the harvesting of predators efficiently.

Key words: *Modeling, Mass production, In vitro, Neoseiulus longispinosus.*

INTRODUCTION

The phytoseiid predator, *Neoseiulus longispinosus* (Evans) has a wide distribution and better ability to adapt to warm temperature inside greenhouses under south Indian conditions[1]. It is a promising predator which can suppress the spider mite population both in laboratory and field conditions when released in suitable predator: prey ratios[1,2]. Mass multiplication of these native predators is also possible, if not easy since they are obligatory predators[3,4,5]. Population of *N. longispinosus* mass produced *in vitro* on plants harbouring the prey, will reach a peak and decline further consequent to the depletion of the prey population. The fluctuations in prey population are affected by various biotic and abiotic factors. The best time to harvest the predators would be when their population reaches the peak, however this cannot be predicted precisely. Hence, the studies were conducted on developing a module for mass production of phytoseiid predators during different months using four batches of French bean plants grown in polycarbonate house.

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MATERIAL AND METHODS

French bean seeds were sown in earthen pots. When they reached the trifoliate leaf stage, spider mites (*Tetranychus urticae*) were released @ 10 per leaflet and allowed to multiply for 10 days. After 10 days when the spider mites had established, predatory mites, *Neoseiulus longispinosus* were released on these plants @ four per leaflet and were allowed to establish for one week. After one week, 20 leaflet samples were drawn randomly from the French bean plants and number of different stages of both *T. urticae* and *N. longispinosus* in each leaflet were recorded separately. Every day 20 leaflets were sampled from the French bean plants till spider mites exhausted the batch (Fig. 1). The experiment was repeated with four different batches of French bean plants during different months in a year, and temperature and relative humidity of the respective months were recorded.

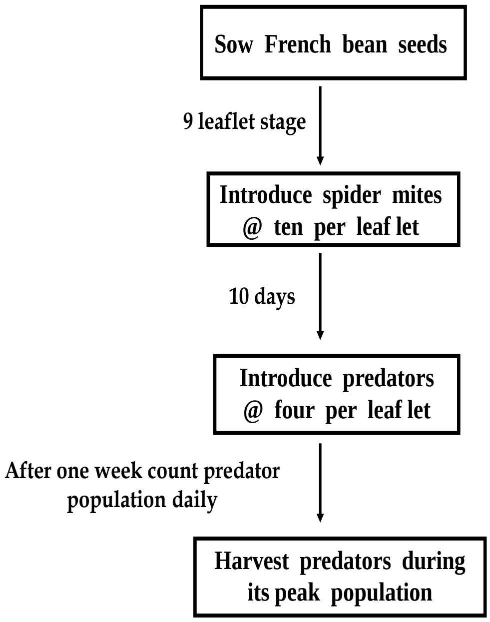

Fig. 1. Flow chart for modeling mass production of predators

The data were subjected to regression analysis to develop the model for mass production of *N. longispinosus.* The exact time for the peak harvest of predators as well as maximum harvest of predators could be predicted using regression models. Maximization of predators was computed by following equation,

$$\mathbf{Y=a + bx_1 + cx_2 + dx_2^2+ex_2^3}$$

Where, predator (Y) is a function of prey (x_1), time (x_2), time square ($x_2^{\ 2}$) and time cube ($x_2^{\ 3}$).

RESULTS AND DISCUSSION

The results are depicted in table 1and figures 2-5. In the first batch, during June-August 2008, the trend indicated that the predator population reached the peak about 24 days after its release thereby reducing tetranychid population in the process and thereafter the predator population also declined (Figure 2). In the second batch, during August-October 2008, the trend indicated that the predator population reached the peak at about 23 days after its release and declined further (Figure 3). In the third batch, during December 2008-January 2009, the trend indicated that the predator population reached the peak at about 26 days after its release thereby reducing tetranychid population in the process and predator population also declined further (Figure 4). The maximum and minimum temperatures and relative humidity was high during these months compared to earlier two batches which hindered multiplication of both predators and spider mites, hence peak population of predator was observed late.

In the fourth batch, during February - April 2009, the trend indicated that the predator population reached the peak at about 23 days after its release and declined further (Figure 5). The maximum and minimum temperatures during this period were high and relative humidity was low compared to other months. This favoured the multiplication of both predators and spider mites; hence the peak population of predator was observed early.

Regression analysis of the pooled data from these four batches showed that the predator population reached peak around 23 days (on 53 days old French bean plants) when predators were initially released at four predators per leaflet after 10 days following the infestation of *Tetranychus urticae* at 10 per leaflet at nine leaflet stage (Fig. 6.). This module could be used to predict the day when the peak would be reached by the population of the predator making use of the population count of different stages of both prey and predator on any given day, and accordingly plan the harvest of the predators precisely.

The present findings are in conformity with the findings of[5] who reported that the optimal time for harvesting *N. longispinosus* was 25 days after the release of predators (from 55 days old French bean plants). Similar results were reported by[6], who mass-produced *Metaseiulus occidentalis* using *T. urticae* on pinto bean plants and found the suitable initial predator: prey ratio of 1:20 to 1:40 and best harvesting time of *T. occidentalis* would be two weeks after inoculation. Similarly[7] developed a predictive model which helped in planning the day of harvesting predators. Predators were found to reach peak number between 13-17 days after release. But in this study the number of spider mites and predators used to infest at nine leaflet stage of the French bean plant is not available. The number of spider mites and predators used for infestation initially is high and the peak in the predator population will be reached much early.

Table 1. Number of *Neoseiullus longispinosus* harvested from a batch of 240 plants during different seasons of the year

Season	Peak in spider mite population		Peak in predators population		Days after sowing	No. of harvestable predators (in lakhs)
	Days after release	Number	Days after release	Number		
June-August 2008	15	1850.70	24	59.85	53	7.60
August-October 2008	14	1945.65	23	62.20	50	7.90
December 08-January 2009	18	1790.35	26	59.25	56	7.53
February-April 2009	14	2125.70	23	68.75	50	8.75

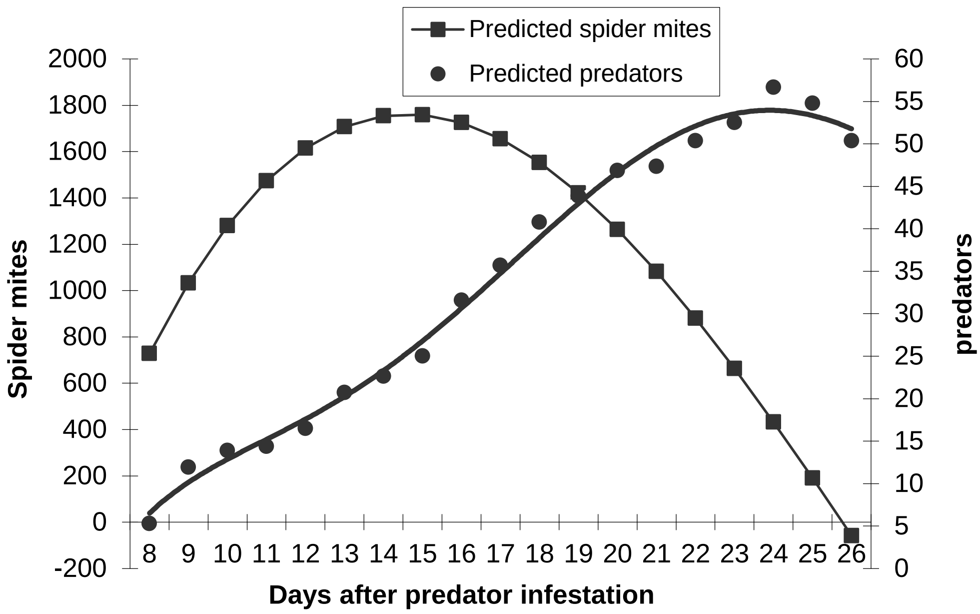

Fig. 2. Population of spider mites and predators predicted using data of June - August 2008

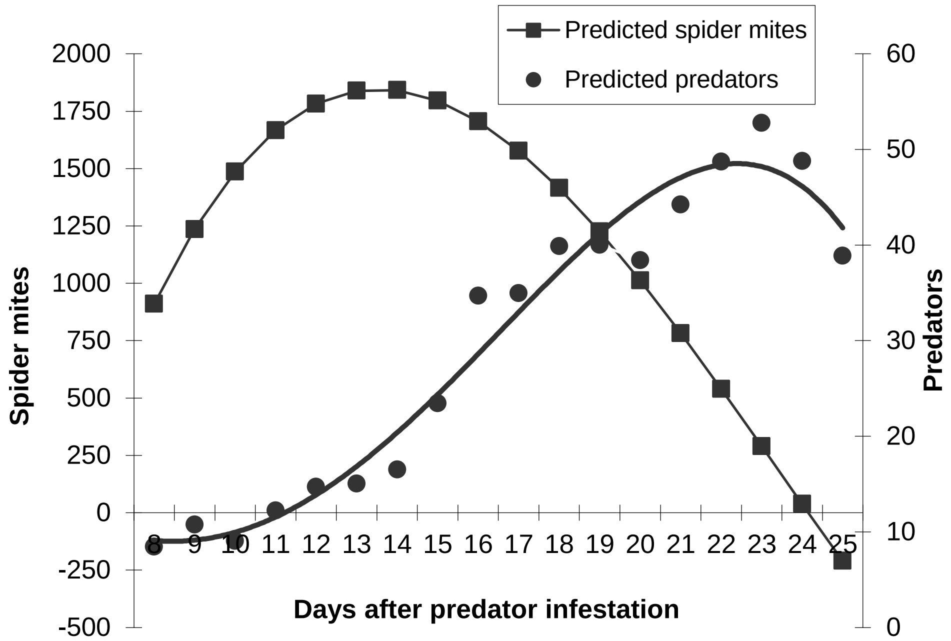

Fig. 3. Population of spider mites and predators predicted using data of August-October 2008

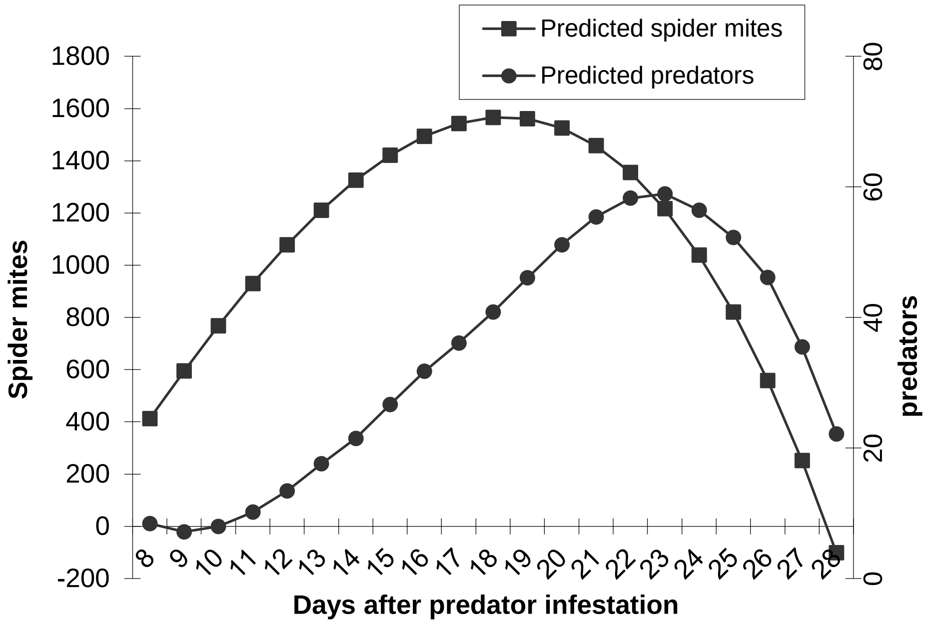

Fig. 4. Population of spider mites and predators predicted using data of December 08-January 2009.

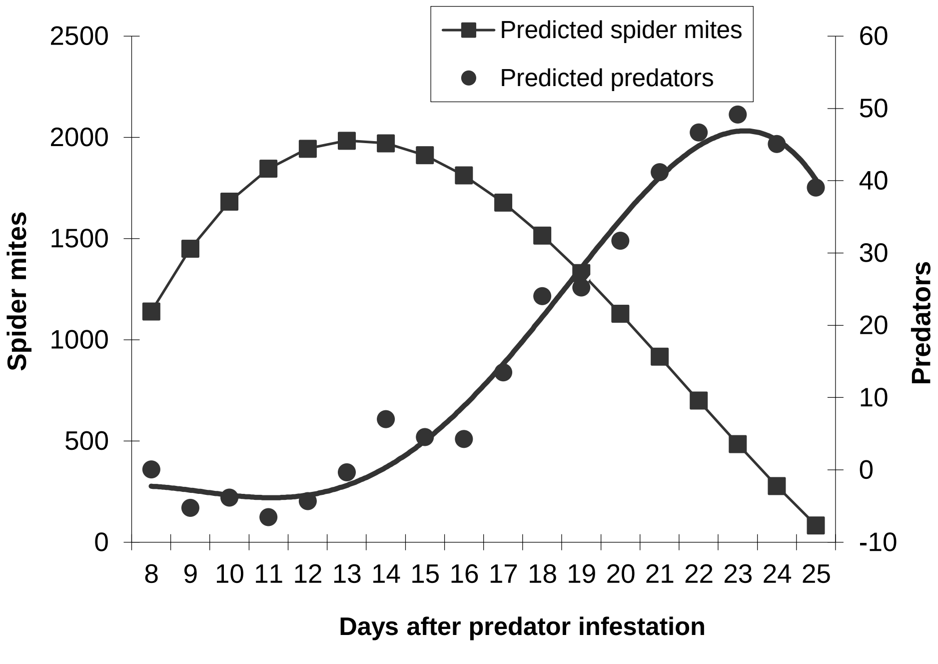

Fig. 5. Population of spider mites and predators predicted using data of February-April 2009.

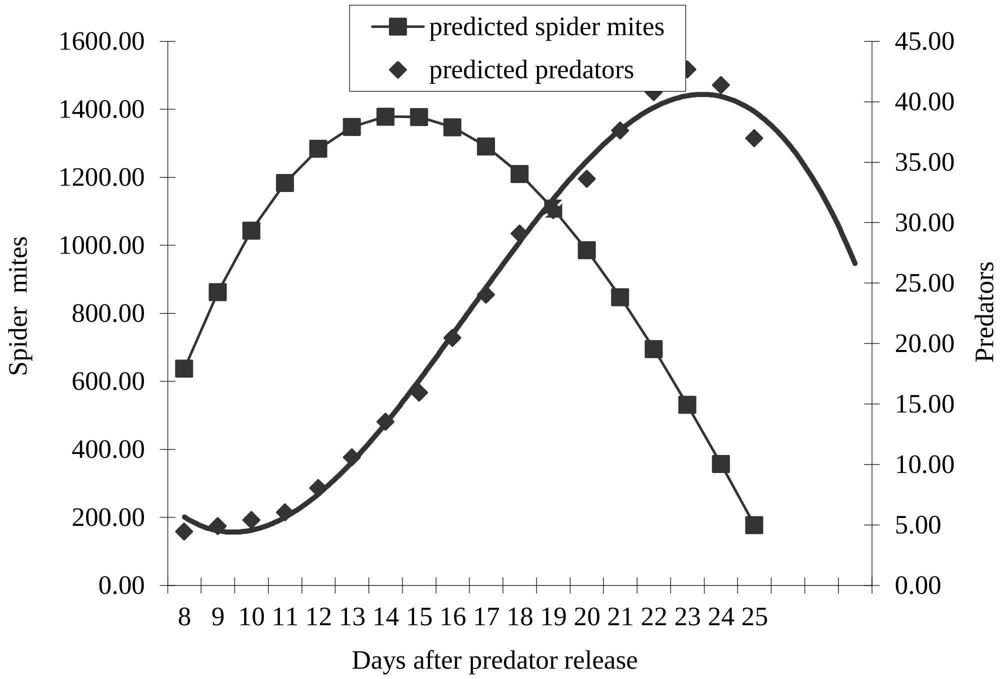

Fig. 6. Population of spider mites and predators predicted using data of four different batches

CONCLUSION

Regression analysis of the pooled data from four batches of mass production of the predator on the French bean plants shows that the predator population reached peak around 23 days after predator release @ four predators per leaflet of French bean plants ten days after infestation of *T. urticae* @ ten per leaflet. This model can be used to predict the day of peak predator population making use of the population counts of different stages of both prey and predator on any given day, and accordingly plan the harvesting of predators efficiently.

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