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TWO PRELIMINARY METHODS FOR MASS PRODUCTION OF THE PREDATORY MITE, *PHYTOSEIULUS MACROPILIS* (BANKS) AT DIFFERENT SEASONS (ACARI : PHYTOSEIIDAE)

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Abstract

Two preliminary methods are described for mass production of the predatory mite, *Phytoseiulus macropilis* (Banks) under the conditions of two net plastic greenhouses (500 holes/inch^2 and of 40 m^2 each). The predator was reared on the two-spotted spider mite, *Tetranychus urticae* Koch, infesting bean plants grown in trays or in the greenhouse soil. The produced predators varied during different seasons. The highest predator production obtained during spring & autumn (moderate temperatures) as the average yields of *P. macropilis* were 1,881,600 and 1,528,800 predator individualss in bean plots, while they were 1,080,000 and 720,000 predators on bean trays in the two previous seasons, respectively. Moderate predator yields were collected during summer months, while low numbers were obtained during winter months due to the prevailing low temperatures and shortage of the food supply, *T. urticae*.

INTRODUCTION

Predaceous mites of the family Phytoseiidae are known to be effective natural enemies of several phytophagous mite species (Zaher, 1989; Croft, 1994; Strong & Croft, 1995; McMurtry & Croft, 1997). Large-scale production of one or more of these predatory species required. Techniques of mass rearing were demonstrated by many authors (Scriven & McMurtry, 1971; McMurtry & Scriven, 1975; Hoy *et al.*, 1982; Fournier *et al.*, 1985; Vacante *et al.*, 1989).

In a previous paper, Heikal and Ali (1996) carried out a successful trial for laboratory mass rearing of the predaceous mite, *Phytoseiulus macropilis* (Banks) on the two-spotted spider mite, *Tetranychus urticae* Koch. This encouraged the author to continue study on obtaining more suitable methods for mass production of this species in the greenhouse at different seasons.

MATERIALS AND METHODS

Three normal greenhouses (unair-conditioned) belonging to Plant Protection Research Institute at Dokki district (Giza Governorate) were used. Of these, one was for mass production of the two-spotted spider mite, *T. urticae*, while the other two were for mass production of the predatory mite, *P. macropilis*. The dimensions of each greenhouse were 8 m in length, 5 m width and 2 m height. Roof and sides of each greenhouse were covered with fine mesh plastic net (500 holes/inch^2) and each was provided with a 1.5 x 2 m wooden door at one side.

A. Mass production of the two-spotted spider mite : The two-spotted spider mite is considered the most preferable prey for mass rearing many species of predatory mites and insects (Scriven & McMurtry, 1971; Theaker & Tonks, 1977). Strong culture of this mite should be available during the rearing period. The area of the first greenhouse was divided into four equal plots. Kidney bean, *Phaseolus vulgaris* (L.) variety Nebraska treated with 0.1 % Vitavax WP (as fungicide) were firstly sown at 1-2 cm deep in the first plot, then in subsequent periods of two weeks in each of the other three plots and watered when required. Leaves from a laboratory culture infested with *T. urticae* were distributed over the new foliage of the first plot, then at a suitable time in the other plots. Infested bean leaves were cut and transferred to the predator greenhouse when prey population became abundant. When plants of the first plot were completely used, the soil of this plot was prepared for replanting. Finally, this procedure provided continuous *T. urticae* production during different year months.

B. Mass production of the predatory mite, *P. macropilis*

1. Rearing the predator in bean plots : The soil of the second greenhouse was prepared and also divided into four plots (each of about 8 m^2). Bean plants were grown and infested with the two-spotted spider mite *T. urticae* as previously described. When population of *T. urticae* in each plot reached a suitable level, the infested bean plants were inoculated with bean leaves containing the predator mite individuals. Approximately 2000 moving stages of *P. macropilis* were distributed/plot. Therefore, four bean plots varied in their degree of growth and level of prey and predator populations, were present. Plants were monitored three times per week for the following purposes :

a. Determination of irrigation needs.
b. Detection of contaminating insects and predators.
c. Estimation of the predator-prey ratios to provide bean plants with additional prey if necessary.

d. To spray bean plants with the leaf fertilizer, Greenzit NPK 5144 at a rate of 0.1 % every 10 days.

In the request of the predator individuals for release, leaves from the first plot containing mainly predator with few prey individuals were collected after the nearly estimation of the predator yield. When supply from this plot were exhausted, predators were collected from the second plot. The remained plants in the consumed first plot were removed and the soil was prepared for replanting and so on in the rest plots.

2. Rearing the predator on bean trays : The third greenhouse, bean seeds were sown in 1 : 1 peat-moss and vermiculite mixture in 30 x 40 x 15 cm plastic trays (after adjusting the mixture pH and adding the commercially recommended rates of fertilizers). When bean plants reached 1-2 weeks old, the new foliage were inoculated with the two-spotted spider mites as previously described. As the two-spotted spider mite reached a reasonable population, bean leaves containing the predators were distributed over bean trays where they moved off the infested leaves to the recipient plants, then these dried leaves were removed after 2-3 days. Approximately, 2000 predators were distributed over the forty bean trays. Bean plants were also monitored three times a week to attain the previously mentioned purposes. Forty bean trays sown, infested and inoculated every two weeks provided a continuous predator production.

Samples of 50 leaflets from each of the oldest plot (in the first greenhouse) and the oldest forty trays (in the second greenhouse) were randomly collected at the end of each rearing period (3-4 weeks from the predator inoculation), where numbers of the predator moving stages were counted. Numbers of the present leaflets in the oldest plot and the forty bean trays were also nearly estimated. Finally, the predator yield in every season could be almost evaluated in each greenhouse.

RESULTS AND DISCUSSION

The obtained yield of the predator *P. macropilis* from each rearing method was nearly estimated and the following observations were recorded :

1. The produced predator individuals varied during year months. In moderate temperatures during spring (daily average 23.8°C and 56.0 % R.H.) and autumn (19.4°C and 61.0 % R.H.) months, the estimated yields of *P. macropilis* were about 1,881,600 and 1,528,800 individuals in bean plots, and 1,080,000 and 720,000 on bean trays in the two seasons, respectively. Moderate predator yields were recorded in summer months (daily average of 27.8°C and 57.7 % R.H.) reaching only 806,400 and

630,000 in bean plots and on trays, respectively, Table 1. The prevailing high temperature which sometimes reached more than 40°C as hot spells might negatively affected the predator population in the two greenhouses, in addition of occasionally occurrence of bacterial or fungal infections on bean trays. On the other hand, the predator production was few during winter months (daily average of 13.4°C and 59.3 % R.H.) as a result of low temperature and shortage in the two-spotted spider mite population. The predator yield was about 504,000 and 384,000 individuals in bean plots and on bean trays, respectively. Smith *et al.* (1979) found that the shortest developmental period of *P. macropilis* was at 27°C. Using different temperatures, Ali (1998) also found that 28°C was the best for rearing this predator concerning acceleration of development and increasing reproduction (r_m = 0.47).

2. The two production methods were carried out with less labour requirements compared with those applied by Heikal and Ali (1996) when the same predatory mite species was reared on the two-spotted spider mites infesting bean plants in pots or trays in the laboratory.

3. Growth of bean plants in the greenhouse soil could be continued all-over the year months without severe plant diseases, while those grown in pots or trays under laboratory conditions were occasionally attacked with damping-off and root rot or fusarium wilt, specially during warm months.

Table 1. *P. macropilis* populations in the two production methods during different year seasons.

Season	Average yield of *P. macropilis* * per		Temp. °C	R.H. %
	Bean plots**	Bean trays***		
Spring	1,881,600	1,080,000	23.8	56.0
Summer	806,400	630,000	27.8	57.7
Autumn	1,528,800	720,000	19.4	61.0
Winter	504,000	384,000	13.4	59.3

* Moving stages.

** 40 m^2

*** 250-300 trays

Moreover, it is advisable to put in consideration the following procedures to achieve the ultimate prey and predator productions :

1. Good preparation of the greenhouse soil before sowing bean seeds by well plowing of soil to increase its ventilation which may effectively reduce fungal and bacterial diseases and also by adding the suitable amount of organic matters to increase the soil fertility.
2. Avoidance of host plant infestation with other pests and predators.
3. Frequence estimation of predator-prey ratios to keep them in the suitable status and to supply additional prey individuals when required.

From obtained results, it was found that mass production of the predatory mite, *P. macropilis* under greenhouse conditions was easy and suitable allover the seasons with comparatively high increase during autumn and spring months, where the predator can be easily used for biological control of the two-spotted spider mite. Previous ecological studies in Egypt indicated the occurrence of high spider mite populations during late winter and early spring together with the rarity of native predators (Heikal, 1977).

For obtaining continuous and high predator production all-over the year months, two additional controlled greenhouses are required for rearing both prey and predator during the periods of low or high temperatures. The greenhouse area can be expanded to increase predator production for mass release.

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طريقتين مبدئيتين للإنتاج الكمى للمفترس الأكاروسى *Phytoseiulus macropilis* خلال مواسم السنة المختلفة

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تم وصف طريقتين للإنتاج الكمى للمفترس الأكاروسى *Phytoseiulus macropilis* (Banks) تحت الظروف البيئية لصوبتين مغطيتان بالبلاستيك المثقب (٥٠٠ ثقب/بوصة مربعة ومساحة كل منهما ٤٠ م٢). تم تربية المفترس على أكاروس العنكبوت الأحمر *Tetranychus urticae* Koch على نباتات فاصوليا منزرعة فى صوانى أو تربة إحدى الصوب. وقد إختلف إنتاج المفترس تبعا لفصول السنة المختلفة. وقد تم الحصول على أكبر إنتاج للمفترس خلال أشهر الحرارة المعتدلة فى كل من الربيع والخريف حيث كان متوسط محصول المفترس هو ١,٨٨١,٧٠٠ و١,٥٢٨,٨٠٠ مفترس فى أحواض الفاصوليا وكان ١,٠٨٠,٠٠٠ و٧٢٠,٠٠٠ مفترس على صوانى الفاصوليا خلال فصلى الربيع والخريف، على التوالى. وقد تم الحصول على محصول متوسط من المفترس خلال اشهر الصيف، بينما تم الحصول على أقل محصول للمفترس خلال اشهر الشتاء وربما يرجع ذلك لإنخفاض درجات الحرارة وقلة الأعداد المتحصل عليها من العنكبوت الأحمر.