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IS *Matricaria chamomilla* A BENEFICIAL INSECTARY PLANT?

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ABSTRACT

Field studies were conducted at the Experimental Research Station, Faculty of Agriculture, Mansoura University, to determine if *Matricaria chamomilla* is a beneficial insectary plant. The relative attractiveness of insect predators (aphidophagous) and their preys (aphids) to *M. chamomilla* were evaluated throughout two successive seasons (2005/206 and 2006/2007). The obtained results indicated that *M. chamomilla* was visited by several insect predators. A total of ten species of aphidophagous were collected. Although species varied somewhat among the two seasons, the most common aphidophagous species in sweep net were belonging to four families namely *Coccinellidae*, *Syrphidae*, *Staphelinidae* and *Chrysopidae*. Attractiveness of insect predators to *M. chamomilla* differed by dates and seasons. Chamomile flowers appear to be strongly attractive to aphidophagous species of hoverflies and the coccinellid, *Coccinella undecimpunctata* L.

To test the hypothesis that regulation of aphid population would be improved by providing floral resources (*M. chamomilla*) for adult natural enemies, an experimental field plots each containing a central bed of pea plants *Pisum satavium*. A set of plots encircled either by chamomile plants or no forbs. Aphidophagous were more abundant in pea plots encircled by chamomile plants compared to those having no floral plants. Densities of aphid were typically lower in plots containing floral resource plants than in plots without them. On the other hand, the percentage of parasitism was significantly higher on aphid population within plots surrounded with chamomile plants than those without floral resource. These results suggest that *M. chamomilla* is an insectary plant with facultative mutualist predator-parasitoid visitors.

Keywords: Conservation, biological control; *Matricaria chamomilla*; insectary plants, natural enemies,

INTRODUCTION

Beneficial insectary planting is a form of conservation biological control that involves introducing flowering plants into agricultural system to increase nectar and pollen resources required by natural enemies of insect pests. Some natural enemies depend on nectar and pollen for reproductive success and longevity (Jervis *et al*., 1993). Surveys of plant compositions in agroecosystems have associated florally abundant, noncrop habitat with significantly higher numbers of pollen- and nectar-feeding natural enemies in and around fields (Cowgill 1989 and Cowgill *et al*., 1993). Modern agricultural practices, *e.g*., tillage and herbicide use, create farmscapes with limited diversity of flowering insectary plants, which may limit the potential role of occurring natural enemies in biological control (Wratten and van Emden, 1995). The potential of establishing flowering plants in or around fields to attract natural enemies and enhance biological control of pests in adjacent fields (Kloen and Altieri 1990, Lovei *et al*. 1992, Harwood *et al*.

1994, White *et al*. 1995, Hickman and Wratten 1996). Research is still needed to identify which plants have the greatest potentiality as beneficial insectary plants. Natural enemies exhibit a high degree of selectivity in the flowers from which they feed (Lunau and Wacht 1994). Floral attractiveness may be attributed to a combination of factors, *e.g*., kairomones, flower color and morphology, pollen and nectar availability, shelter, presence of prey, that influence landing and feeding behavior by the natural enemies.

The objectives of this study were to evaluate the relative attractiveness of *M. chamomilla* plant to natural enemies and to evaluate the hypothesis that regulation of aphid populations can be with forbs (*M. chamomilla*) that provide floral resources for adult natural enemies.

MATERIALS AND METHODS

Field studies were conducted at Agric. Experi. Res. Center, Mansoura Univ. during 2005/2006 and 2006/2007 seasons, to determine if *Matricaria chamomilla* L. is a beneficial insectary plant?.

An area of 250 m^2 was prepared and divided into suitable plots (three plots) for growing *M. chamomilla* which was sown on 9th October during 2005 and 2006 years. The area received normal agricultural practices and was not subjected to any chemical control applications.

To estimate the relative abundance and attractiveness of chamomile plants to aphids and aphidophagous species. Two sampling techniques were used, *i.e.*, plant sample and sweep net. A sweep net was used weekly to collect insect predators associated with *M. chamomilla*. Each sample consisted of 20 double stroke/plot. The collected samples were counted and identified. In addition, plant samples were collected weekly, each sample consisted of 80 branches from 20 plants (4 branches / plant). Branches were covered with polyethylene bag on the plant and then it was pulled up and taken to the laboratory for examination. The collected samples were investigated by using a binocular microscope. Aphid individuals were recorded as living and parasitized with parasitoids or emerged holes. The presence of predators on the collected chamomile branches was also recorded.

To determine floral bloom phenology, flower abundance was assessed. Flower density in each plot was estimated weekly over the entire blooming period by counting the number of bloom within an area of one meter square. For each sample date, mean floral abundance / m^2 was calculated.

To evaluate the hypothesis that aphid population can be suppressed by planting resource plants (*i.e., M. chamomilla*) adjust to host plants (*Pisum sativum*) of pests, densities of aphid population were estimated in pea plots encircled by forbs (*M. chamomilla*) or no forbs. Each plot (42 m^2) containing a central bed pea plants was sown on 9th of October 2006. A set of plots was surrounded by forbs (*M. chamomilla*) as well as a set with no forbs (control). Each set consists of three plots.

Sampling program : To estimate the density of aphid populations on pea plants surrounded and not surrounded by chamomile plants, pea leaves were collected biweekly from December 2006 to February 2007. Each sample consisted of 45 pea leaves / treatment. The collected leaves were taken to the laboratory in polyethylene bags for investigation as previously mentioned. Aphids were recorded as living, dead and parasitized with living parasitoids or emerged holes.

To determine the parasitoid species, each sample was maintained in Petri dishes (10 cm in diameter), containing a piece of moistened cotton wool. The emerged parasitoids were collected and identified. The percentage of parasitism (par.%) was calculated.

A sweep net was used to collect insect predators in plots surrounded and not surrounded by chamomile plants. The collected predators were counted and identified.

RESULTS

1. Seasonal abundance and attractiveness of chamomile plants to aphid and their aphidophagous species

Seasonal abundance and attractiveness of *M. chamomilla* to aphids and their aphidophagous species were evaluated throughout two successive seasons (2005/2006 and 2006/2007).

Insect predaceous species

The obtained results indicated that chamomile plants were strongly attractive to insect predators associated with aphid population during both years of study. More than ten insect predaceous species were recorded on *M. chamomilla*. They are *Coccinella undecimpunctata* L., *Syrphus* spp., *Crysoperla carnea* Steph, *Rodalia cardinalis* Muls., *Paederus alferii* Koch, *Cydonia vicina nilotica* Muls., *Scymnus* sp., *Orius* spp., *Polistes gallica* L. and *Mantis religiosa*. The most numerous and common predators were belong to five families, *i.e.,* Coccinellidae, Syrphidae, Chrysopidae, Staphilindae and Anthrocoridae. As shown in Figs. (1a and b) attractiveness of chamomile plant to insect predators differed from season to season.

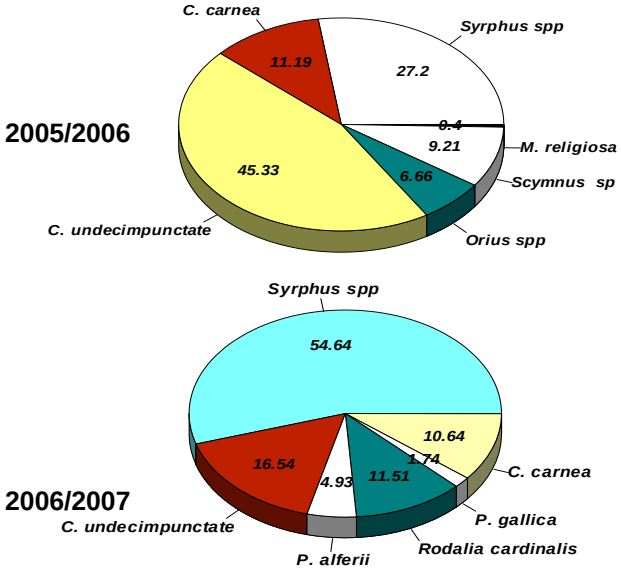

Fig. 1. Occurrence percentages of insect predaceous species associated with chamomile plants during 2005/2006 (a) and 2006/2007 (b).

In the first season (2005/2006) the coccinellid, *C. undecimpunctata* exhibited the highest percentage (45.52 %) of occurrence followed by the syrphid species (27.31%), *C. carnea* (11.19, *Scymnus* sp (9.21%) and *Orius* spp (6.66). *M. religiosa* was recorded in very few numbers.

In the second season (2006/2007) *Syrphus* species showed the highest percentage of occurrence (54.64%) followed by *C. undecimpunctata* (16.54 %), *R. cardinalis* (11.51), *C. carnea* (10.64). The staphilinid, *P. alferii* recorded the least percentage of occurrence (4.63). The other predators (*i.e, P. gallica* and *M. religiosa* were recorded with very few numbers). The results in Fig. 1 showed that *C. undecimpunctate* followed by *Syrphus* spp. were strongly dominant on chamomile during 2005/2006 season. However, the same predators were also dominant in 2006/2007 season.

Influence of flower density on the abundance of natural enemies

Fig. (2) shows changes of insect predator population coincided with flower density of *M. chamomilla.* On the other hand, statistical analysis indicated that there was a positive significant correlation between flower density and natural enemies population in both years of study. However, r- values were 0.641 (p= 0.002) and 0.552 (p=0.008) in the first and second season.

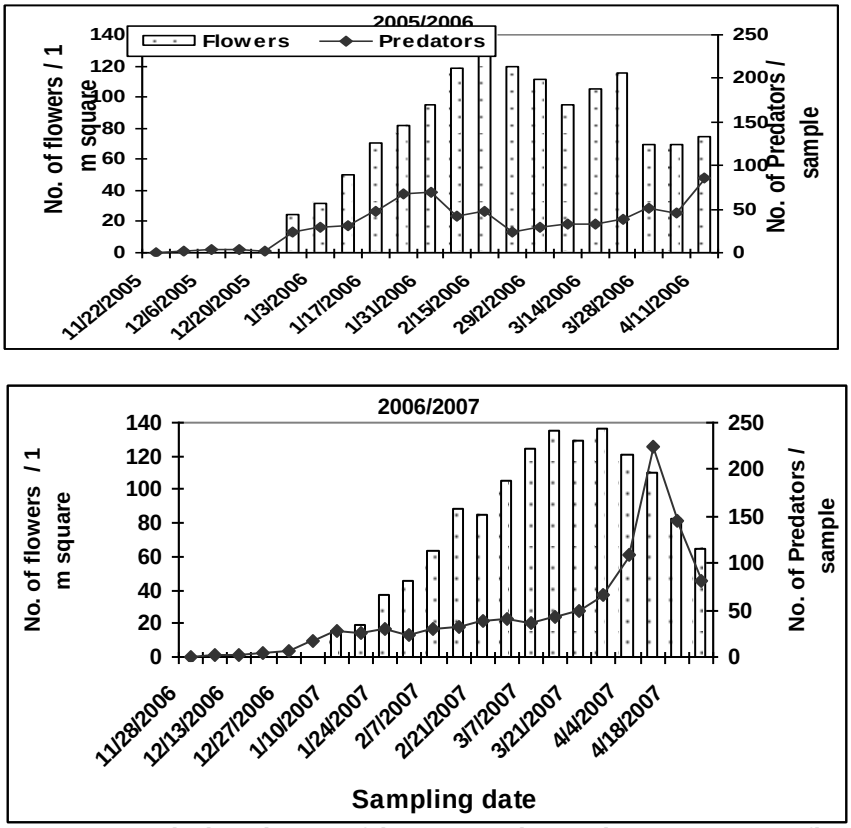

Fig. 2: Seasonal abundance of insect predators in response to flower density of chamomile plants during 2005/2006 and 2006/2007 seasons

Prey (aphid) populations

The period of occurrence of aphids on *M. chamomilla* started from 29th of November, 2005 till the 22nd of February 2006 are shown in (Fig. 3a), while, in the second season2006/2007 aphid population started later on chamomile plants from the 29th of November 2006 till the first week of March 2007 (Fig. 3b). As shown in Fig. 3, the highest abundance of aphid population was on 17th of January (22.0 and 64.4 individuals) in the first and second season. Also, it could be notice that the highest occurrence of aphid population not coincide with the phenology of flower density. With respect to the relation between aphid and predators populations, there was significantly and non significantly positive correlation between aphid and predator populations in the first (r=+0.729 and p=0.001) and second (r=+0.293 and p=0.254) seasons.

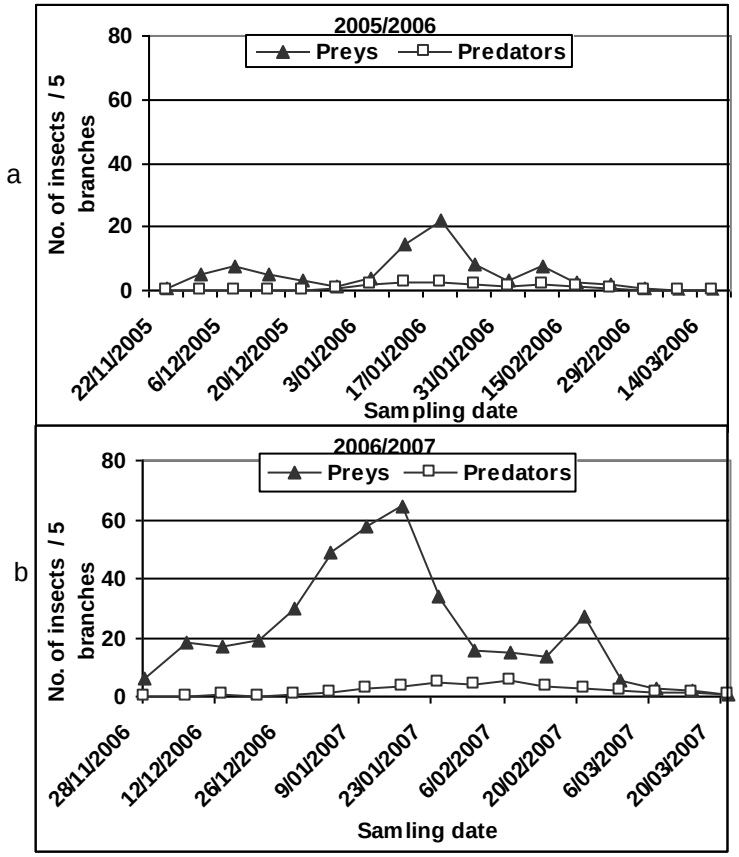

Fig. 3. Synchronization between aphid populations and their insect predators on chamomile plants during two successive seasons (2005/2006 and 2006/2007).

2. Influence of floral resource plants on aphid population:

With respect to the number of aphidophagus species (*C. undecimpunctata*, *Syrphus* spp., *C. carena* and *P. alferii*) in plots and check plots was summarized and illustrated in Fig. 4.

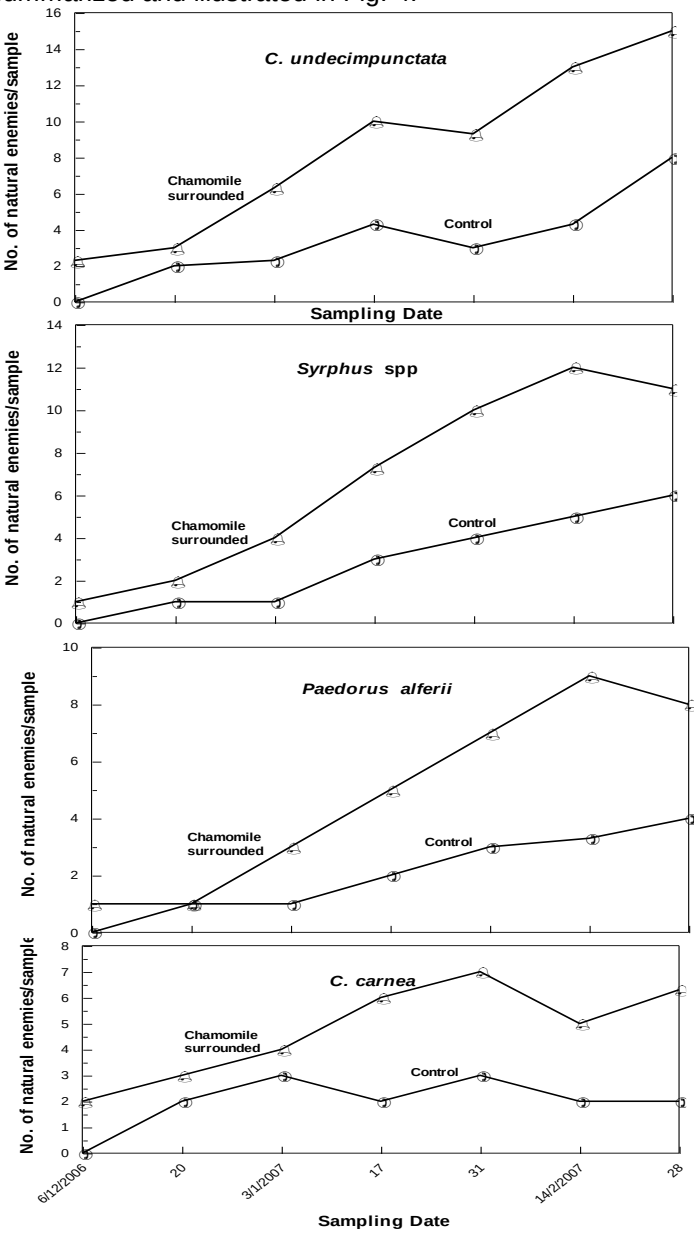

Fig. 4. Seasonal abundance of the main insect predators associated with aphid populations on pea plants surrounded either with chamomile plants (Treated) or no forbs (Control).

In treated plots (Fig. 4) the number of each insect predaceous species was significantly higher than those in chek plots. It is clearly obvious that floral resource plants increased the abundance of insect predators in *P. sativum* plots. On the other hand, the changes in the percentage of parasitism on aphid population were estimated every two weeks. The obtained results are illustrated in Fig. 5. The average percentage of parasitism by the aphelinid parasitoids on check plots was considerably low in comparison with those in treated plots. In treated plots, the average percentage of parasitism by aphilinid parasitoids was 22.45 ± 16.11 twice as in check plots (10.03 ± 8.7).

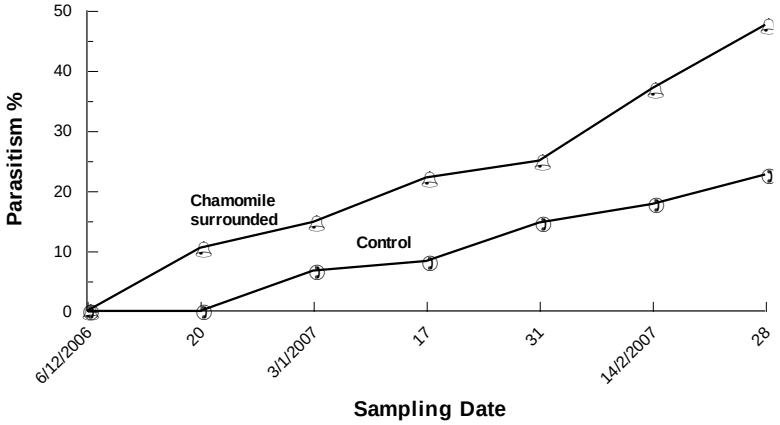

Fig. 5. Parasitism % of aphids by natural enemies on pea plants surrounded or non surrounded by chamomile plants.

As shown in Fig. 6, the number of aphids in plots surrounded by chamomile plants was initially high and then fell continuously from 17th of January till the end of February 2007 corresponding with the flowering period. In the check plots, the number of aphid was increased gradually during the same period.

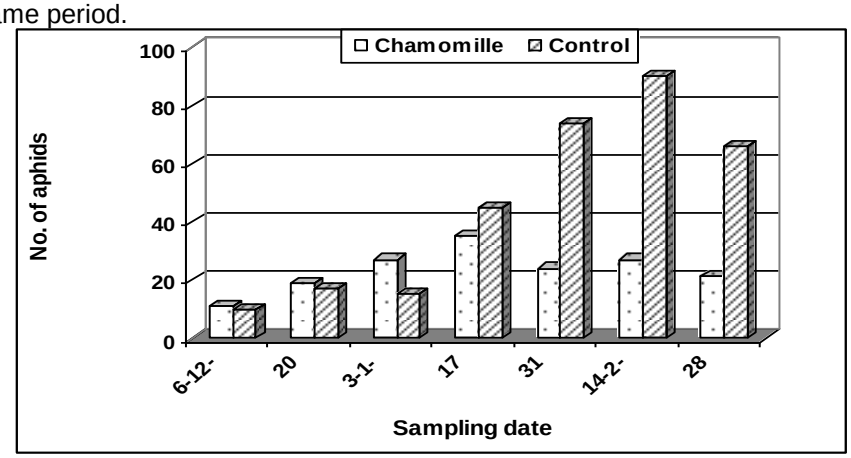

Fig. 6. Number of aphids/45 leaves of pea plants (*P. sativum*) surrounded by either chamomile plants or no forbs (check).

Regression analysis: the regression of log abundance of aphids populations/time (days) in both treated and check plots indicated that floral resource plant caused considerable reduction of aphid population. The slope of regression line (p=0.003) was significantly low. On the contrary, aphid population in check plots exhibited a tendency to increase. The slope of regression line was (p= + 0.012).

DISCUSSION

Chamomile plants, *Matricaria chamomilla* L. have white flower with short corolla. According to Lunau and Wacht (1994) white and yellow flowers were included as insectary plants because their colors have been shown to elicit feeding in hoverflies. In addition to short corolla facilitating nectar availability (Gilbert, 1981) making them a potentially good insectary plants. In the present study, the abundance of insect predator population was considerably increased especially during flowering period. However, the obtained results obviously illustrated that there are a significantly positive correlation between total number of insect predators and densities of plant flowers. Also, Chaney (1998) reported that the presence of flower in an agroecosystem can increase the abundance of natural enemies (including predators and parasitoids). However, floral resources provide additional food for predators and parasitoids. Many natural enemies require nutrients in the form of nectar, pollen or both (Jervis *et al*., 1992, 1996).

Insectary plants can also serve as resources for pests as well as natural enemies (Baggen and Gurr, 1999). The flowers of *M. chamomilla* served as a food resource for insect predaceous species (especially syrphid and coccinellid species) as well as aphid parasitoid species. However, its nectar is unavailable for its prey.

The obtained results indicated that *M. chamomilla* clearly influenced aphid populations on *Pisum sativum* (host plant). However, aphid population was decreased in study plots that contained floral resource plants (*i.e*., *M. chamomilla*), and were significantly higher in plots without chamomile plants.

The presence of flowers in *P. sativum* plots increased the abundance of insect predators and parasitism rate. Chambers and Adams (1986) reported that the larvae of many hoverfly species are voracious aphid feeders and have the potential to halt aphid population growth. According to Irvin *et al*. (2000) and Gurr and Nical (2002) flowers increase parasitoid efficiency by improving their fitness (Jervis *et al*., 1996). These results support the hypothesis that aphid population can be suppressed by planting floral resources plants adjacent to host plants of the pest. Also, the cabbage aphid *Brevicornae brassicae* population in cabbage plots with a border of phacelia (*Phacelia tanacelifolia* Bentham) was very low in comparison with those without (White *et al*., 1995).

According to Gurr *et al*. (2003) achieving success in the provision of floral resources in the field can be seen as hierarchy of research outcomes that are progressively more different to obtain (1) parasitoid aggregate at or near the flowers, (2) parasitoid fitness is improved, (3) parasitism rate is increased, (4) host population is reduced. Therefore, our results suggest that *M. chamomilla* is a beneficial insectary plant.

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هل نبات البابونج جاذب للحشرات النافعة ؟

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تعتبر زراعة النباتات المزهرة فى الحقول وحولها للإمداد بحبوب اللقاح والرحيق للأعداء الطبيعية بمثابة استراتيجية واعدة لتعزيز المكافحة البيولوجية للآفات ، ونظراً للطبيعة الاختيارية للأعداء الحيوية فى تغذيتها على الأزهار وتفضيلها لأنواع نباتية معينة ، فقد استهدف البحث دراسة إمكانية إدراج نبات البابونج ضمن النباتات الجاذبة للحشرات النافعة ، وقد أجريت التجارب خلال موسمى ٢٠٠٥/٢٠٠٦ ، ٢٠٠٦ / ٢٠٠٧ بمركز التجارب والبحوث الزراعية بكلية الزراعة جامعة المنصورة . تم تسجيل أكثر من عشرة أنواع من المفترسات الحشرية على نباتات البابونج (تتبع أربعة عائلات مختلفة وهى *Coccinellidae* و *Syrphidae* و *Staphelinidae* و *Chrysopidae*) ، كما لوحظ أن جاذبية المفترسات لنبات البابونج تختلف باختلاف تاريخ العينة والموسم . كما أبدى كل من ذباب السرفس وأبو العيد ذو الإحدى عشرة نقطة انجذاب قوى لزهور البابونج بالمقارنة بباقى المفترسات . وقد أثبتت الدراسة أن إدخال نباتات البابونج ضمن النظام الزراعى البيئى لمحصول البسلة قد أدى إلى حدوث وفرة عددية للمفترسات الحشرية وزيادة نشاط الطفيليات على المن (نسبة التطفل) مما أدى إلى انخفاض تعداد المن فى حقول البسلة المحاطة بنبات البابونج مقارنة بالكنترول . وتبين هذه النتائج أن وجود نبات البابونج ضمن الكساء الخضرى يحسن من وفرة الأعداء الطبيعية .