



Mass Rearing and Use of a New Species of *Chrysoperla* (Neuroptera: Chrysopidae) in Cotton Crops in Argentina

M.G.A. Polak¹, G.B. Contreras¹, M.J. Marinich², O.M. Royo¹, M.A. Simonella¹ and J.A.F. Poisson¹

¹INTA - Sáenz Peña Chaco Argentina.

²Ministerio de la Produccion – Gobierno de la Provincia del Chaco, Argentina.

ABSTRACT

In the larval stage, Chrysoperla (Steiman) species feed on various agricultural pests. So far, only Chrysoperla externa had been recorded on cotton crops in Argentina. Towards the end of 1994, Chrysoperla chaquensis was discovered in the province of Salta, being predominant in the western region of the Argentinian cotton area, while C. externa is abundant in the eastern region. Efforts at rearing both species were successful, with higher production levels in C. chaquensis, showing the advantage of a shorter life cycle than C. externa. A daily yield of 500,000 eggs was reached for C. chaquensis that were used for inundative and inoculative releases on cotton crops aimed at the control of aphids and the eggs and first instar larvae of bollworm and leafworm. Cotton yields for areas treated parcels with this predator, supplemented with two treatments of Bacillus thuringiensis, were comparable to those reached in fields with 11 - 12 conventional insecticide treatments.

Introduction

The use of beneficial insects for the control of agricultural pests in Argentina is not widespread, although recently, the importance of predators in pest dynamics in agroecosystems has been taken into account.

The use of species of Chrysopidae seems a reasonable alternative to pesticides in an Integrated Pest Management (IPM) program in cotton. These insects feed on a variety of plant-eating insects (aphids, coccids, psyllids, acari, thrips and lepidopteran eggs and first instar larvae). Chrysopid larvae are very active, passing through three larval stages, in the third of which they display their greater voracity. One of their main characteristic is their high searching capacity, the speed of movement of first stage larvae being 13.97 metres/hour (Fleschner, 1950).

Alburquerque *et al.* (1994) mention *Chrysoperla externa* (Hagen) as an appropriate species for biological control in programs of pest management in tropical and temperate regions of Central and South America. Ridway and Jones (1969) carried out inundative releases of larvae and eggs of *Chrysoperla carnea* (Stephens) on cotton fields in bloom for the control of *Heliothis zea* (Boddie). A reduction of up to 96% of pests populations was obtained and the production of the crop tripled.

Sampling performed in the Domo Central Agrícola Chaqueño area of Argentina from 1992 to 1995 using nets and light traps, showed that *Chrysoperla externa* and *Ceraeochrysa paraguayaria* (Navás) are the most abundant Chrysopidae present in cotton crops. Tests of consumption of *Heliothis virescens* eggs, carried out under controlled conditions, showed that each *C. paraguayaria* larva consumed an average of 629 (± 45) eggs during the 13.5 (± 0.7) days that the larval stage lasted. *C. externa* larvae individually consumed an average of 520 (± 63.5) prey eggs during the 10.8 (± 1.7) days of the average larval stage (Polak *et al.*, 1996).

The objectives of this work were i) to establish, in the E.E.A INTA Sáenz Peña (Estación Experimental Agropecuaria - Instituto Nacional de Tecnología Agropecuaria) continuous and massive rearing of beneficial insects, especially Chrysopidae; ii) to develop application methods, and iii) to test the management of Chrysopidae in cotton IPM programs.

Material and Methods

Initially, *Chrysopidae* species were gathered and identified in cotton fields at Northeastern and Northwestern Argentina. Rearing *Chrysoperla chaquensis* sp. Nav. (in litt.) was carried out

exclusively using field gathered material from cotton crops which is continuously replenished to assure the quality of the insects produced. Adults of this species were stored at temperatures from 5 to 8°C for 12 months.

The lacewing larvae were raised under controlled conditions at 27°C (± 2) and 70% (± 10) relative humidity and a photoperiod of 14:10 (L:D) in 5000 cm³ plastic boxes containing corrugated paper, until their transformation to pupa. Eggs, larvae and adults of *Sitotroga cerealella* (Olivier), were used fresh and/or frozen to feed the larvae. The pupae obtained were separated manually, disinfected with a 0.5% sodium hypochlorite (ClNaO) solution, weighed and placed directly in the oviposition units. These units consisted of rectangular cages of nylon cloth of 15 cm x 45 cm x 65 cm, sustained in a wire frame of the same size, in which an average of 1,200 adults of *C. chaquensis* were placed and fed with a diet made with a mixture of honey, yeast, wheat germ and water. The transfer of adults from one unit to another was carried out daily, using low temperatures to immobilize them. The eggs stuck to the nylon cloth were separated by soaking the units in a 200 litre container with a 0.5% sodium hypochlorite solution and were shaken with air bubbles from an hydraulic compressor. The eggs obtained in this way were allowed to dry on an absorbent cloth. They were then ready for either release, storage at 10°C and/or the continuation of the rearing cycle.

The eggs of *C. chaquensis* were blended with eggs of *S. cerealella* after being weighed, in a ratio of 1:1.5, respectively. Sterilized rice husks were used as dispersant, facilitating application by separating the medium among the larvae and avoiding or diminishing the cannibalism. In all the doses 15 kg/ha of rice husk were used for land and 5 kg/ha for aerial applications. By the time of application, most of the eggs had hatched. A modified granulated insecticide application machine was used for land application larval dispersion and a spraying aeroplane with a modified granulated fertilizer application machine was adapted for aerial dispersion.

During the 1996/97 season, four applications of 25,000 larvae of *C. chaquensis* in an area of 50 hectares of cotton were carried out and a systemic insecticide was applied to the seeds before the sowing. During the crop cycle it was necessary to carry out two applications of *Bacillus thuringiensis* for the control of leafworm, *Alabama argillacea* (Hübner). During the 1997/98 season, the applications were carried out on an area of 660 hectares. In the first weeks of the crop, sexually mature (3 to 4 days old) adults of *C. chaquensis* were released late in the

afternoon in receptacles at a rate of 2,000 individuals per receptacle. This was followed by land and aerial applications of 15,000 to 40,000 larvae per hectare.

Results and Conclusions

Three species of Chrysopidae were abundant in cotton crops in northern Argentina: *Chrysoperla externa* and *Ceraeochrysa paraguaria*, in the eastern area, and *Chrysoperla chaquensis* and *Chrysoperla externa*, in the less humid western area. In 1994 *Chrysoperla chaquensis* was found in the province of Salta and later in other provinces. In the western area of Argentina, it is the most abundant chrysopid in cotton crops.

The continuous rearing of these three species was achieved. The duration of the larval stage was 13.5 days for *C. paraguaria*, 11 days for *C. externa* and 9 days for *C. chaquensis*. The oviposition averaged 890 eggs per female in *C. chaquensis*, 740 in *C. externa* and 550 in *C. paraguaria*. *C. paraguaria* consumed an average of 629 eggs of *Heliothis virescens* during their larval stage and *C. externa* reached 520 eggs. Because of its shorter biological cycle and higher oviposition rate, *Chrysoperla chaquensis* was better suited to mass rearing programmes compared to the other species, giving it a great potential for use in biological control programmes in Argentina and possibly in other South American countries.

A daily production of 40,000 eggs of *C. chaquensis* was achieved in the 1996/97 season and up to 500,000 eggs in 1997/98. Adults of this species that were stored for up to 12 months (at 8°C) produced fertile eggs, ensuring the rearing of future laboratory generations. Eggs of *C. chaquensis* that were soaked in a solution of sodium hypochlorite for from five minutes to three hours both gave 92% hatching.

The use of adults of *S. cerealella* to supplement the feeding of larvae did not affect the percentage of adult emergence (greater than 90%). Thus, there is an advantage in using the adults of *S. cerealella* that, otherwise, would be discarded.

The mixture and application of the larvae was carried out successfully by the adaptive use of tools dedicated to other agricultural activities, achieving a uniform distribution of the predators. The aerial applications carried out during the 1997/98 season was a quite and effective means of distributing the predators (50 hectares in an hour).

A two tonne per hectare average yield was obtained in the 50 hectares treated with this predator, supplemented with two applications of *Bacillus thuringiensis*, in the 1996/97 season. In the same area, similar yields were obtained

where 11-12 applications of chemical insecticides were made.

The development of a methodology for mass chrysopid rearing makes the successive release of larvae and adults of lacewings possible on cotton crops, thus allowing the continuation of research into the effectiveness of biological control as an alternative method in the integrated management of cotton pests in Argentina. The use of beneficial insects can also be supplemented with other strategies such as frequent monitoring of the pests for intervention thresholds, the use of selective insecticides (such as *Bacillus thuringiensis*), pheromones and trap crops to provide the least favourable conditions for the development of the pests.

References

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