Comparison of Vertical Cloth and Whole Plant Bag Sampling Methods for Estimating Predator Populations on Cotton

M.A. Sosa, J.R. Fariña Nuñez and S. Mazza
INTA – EEA Reconquista
Instituto Nacional de Tecnologia Agropecuaria
Reconquista, Santa Fe 3560, Argentina

ABSTRACT

Two monitoring methods, whole plant bag sampling (WPBS) and vertical cloth sampling (VCS) were evaluated for estimating densities of cotton predators. WPBS was used as a standard for comparing the efficiency of the VCS. Sampling of predators was carried out at the Agriculture Experiment Station in Reconquista, Santa Fe Argentina, in 1998 (January-March). Predators were arranged in groups by species and by age (larvae, nymph and adults). Observations were taken from ten cotton fields. The average number of cotton predators counted by VCS represented 63 % of the total population. The most important predators belong to the Coccinellidae (larvae) and Araneae, followed by Hemiptera (Nabis sp., Geocoris sp. and Orius sp.) and Chrysopidae (larvae of Chrysoperla externa Hagen). Sampling methods differed in estimates of Chrysopidae and Total predators (Paired test). There was a positive correlation between methods for Chrysopidae; Coccinellidae; Hemiptera; Others, Araneae and for the total number of predators. VCS can be used to estimate densities of cotton predators.

Introduction

There are a large number of beneficial arthropods that regulate pest insect population in the cotton crops. Predators capture and eat more than one prey to complete their life cycle. Usually, their prey are smaller or weaker organisms (Nasca *et al.,* 1981; Metcalf and Flint, 1980; Price, 1975).

In order to study pest population dynamics, it is necessary to count the pests and determine which is the most appropriate sampling method to carry out this count. Sampling is one of the most important tools applied to an Integrated Pest Management (IPM) programme.

The sweep-net and visual plant observation methods were used to count pests and predators on the cotton crops. The use of the vertical cloth method (VCS) in cotton crops is increasing. This vertical cloth method was compared with the previous methods to estimate horcias bug (Sosa *et al.,* 1995) and cotton leaf worm (Sosa *et al.,* 1997) populations, showing its advantages. Domiciano and Dos Santos (1994) discovered that the ground cloth was efficient to sample cotton leaf worm, including the small larvae.

Pest insects and predators are counted simultaneously. There is no information available on VCS with cotton predators. In the northeast of Santa Fe (Argentina), predators and soybean pests were sampled using ground cloth and sweep-net (Sosa, 1993b and Vivas *et al.*, 1994), and the predominance of the Araneae – Hemiptera (*Geocoris* and *Nabis*) was registered. Gamundi (1998) evaluated sampling techniques of soybean pests and predators in no-tillage and conventional sowing system using sweep-net, ground cloth, VCS and Whole Plant Bag Sampling (WPBS), and found that the same arthropod complex is predominant. Gamundi (1998) gave some advantages in the use of the vertical cloth in soybean arthropods, analyzing the relative accuracy of this technique over others. Among the advantages, he mentioned the reduction of observation areas and the ease and speed of counting of high escape insects. He also noted the possibility of bagging insects for subsequent count in the laboratory. A disadvantage noted was sampling on a windy day.

The aim of this study was to compare two sampling methods, the VCS and the WPBS to estimate cotton predator populations.

Materials and methods

The work was conducted in cotton fields and laboratory in the Agricultural Experimental Station at National Institute of Agricultural Technology, Reconquista, Santa Fe, Argentina from January to March 1998. Ten sampling sites were chosen (different sampling dates and fields). In each sampling site, 10 sampling stations were selected at random. One sampling unit of each method, VCS and WPBS, was performed in each station.

1. Whole Plant Bag Sampling: (WPBS) was used as absolute or standard. This technique consisted of bagging all plants in plastic bags of 1.30 m x 0.90 m from one metre of row. The plants were cut at ground level. Predators that fell on the ground or flew were also counted. The bags were tied, labelled and taken to the laboratory to count the insects. Predators were classified according to their species and age (adult, larvae or nymph).

2. Vertical Cloth Method (VCS) is similar to that described by Sosa *et al.* 1995 and 1997. It has two parts: a) a half PVC pipe, 1 m long and with 6.35 cm radius; and b) one nylon cloth of 1 x 0.70 m joined to one of the half pipe borders with a wooden stick fixed to the opposite end. At the sampling station, the VCS was placed parallel to the cotton row and the plants were shaken vigorously. Predators that fell on the cloth and in the pipe were identified, counted and recorded. They were classified according to their species and age. Predators that fell on the ground or flew were also counted.

The results were analyzed by a paired comparison t-test. The variables tested were Coccinellidae, Chrysopidae, Hemiptera, Araneae, others and total predators. A correlation model was also applied.

Results

It was assumed that the number counted by WPBS represented the total predator population. A total of 1,369 predators were counted by WPBS in the sampling sites. VCS counts only reached 863 predators, representing 63 % of the probable total population (Table 1). The Predator population was composed by Coccinellidae (39.1 %), Araneae (24.2 %); Hemiptera (15.3 %); Chrysopidae (14.8 %) and others – Syrphidae, Dermaptera, Staphylinidae and Carabidae - (6.6 %), using WPBS. Coccinellidae (34.8 %), Araneae (33.5 %), Hemiptera (17.5), Chrysopidae (10.8 %) and others (3.9 %) were collected using the VCS.

The number of predators in each sampling site were compared (Table 2), using paired comparison t-test. There was a significant difference between the methods for Chrysopidae and total predators. Significant differences were found among the other groups. The means of Chrysopidae, Coccinellidae, Hemiptera by VCS and WPBS were well correlated, as shown by the correlation coefficient obtained.

Discussion

Two families represented more than 60 % of the total predator community in both sampling methods, namely Coccinellidae and Araneae.

Soybean and cotton crops were grown at the same time. Regardless of which system was used in sowing soybean (conventional or no tillage) the Araneae-Hemiptera was the predominant complex, while Coccinellidae-Araneae was predominant in cotton. This situation can be attributed to the optimum environmental conditions that lead to the outbreak of aphid populations infesting cotton plants and then providing enough food to increase their natural enemies (Sosa, 1993a; 1993b and Vivas *et al.*, 1994). The presence of Coccinellidae and Syrphidae insects was associated with cotton aphids.

Larvae represented 90 % of the Coccinellidae community. Most of the larvae and adults collected belonged to *Eriopis connexa* Germar. Low number of *Cycloneda sanguinea* L. and *Coleomegilia quadrifasciata* Mulasant adults were counted too.

Hemiptera and Chrysopidae together represented 30 % of the total population. In the case of Hemiptera, there was no significant difference between the two methods. *Nabis sp.*, and *Geocoris sp.* represented about 80 % of that group. In soybean, the same species were predominant in the same area (Vivas *et al.*, 1994). *Orius* and *Podisus* were collected in smaller number.

All larvae and adults of Chrysopidae identified belonged to the species *Chrysoperla externa* (Hagen) (Polac, personal communication). Although there is a significant difference between the two methods and more Chrysopidae were collected by the WPBS, there was a high association between both variables (r=0.8684). The number of larvae sampled using VCS represented a large percentage of the total population. In soybeans, larvae were counted better with the ground cloth than the sweep net while adults were counted better with the sweep net (Sosa, 1993a). In cotton crops, larger numbers of larvae were registered using WPBS and some adults were captured by VCS. No adults were collected by WPBS.

Syrphidae larvae and Dermaptera adults (*Doru lineare* (Eschscholtz)), Carabidae adults (*Callida sp*., *Lebia concinna* Dejean), and Staphylinidae adults comprising the group 'others.' *D. lineare* adults attempted to hide in the joint of the pipe and nylon cloth. This should be considered when using this sampling method.

VCS could be useful in estimating the relative abundance of cotton predators but in the case of Araneae more research is necessary.

Conclusions

Coccinellidae and Araneae were the main cotton predators by number.

The vertical cloth sampling method captured 63 % of the apparent total population.

Statistical differences were found between the two sampling methods applied to Chrysopidae and the total predators but no differences were found for the other groups.

A significant positive correlation was found between the two sampling methods for Chrysopidae (r=0.8684); Coccinellidae (r=0.7586); Araneae (r=0.35); Hemiptera (r=0.7769); others (r=0.9819) and total predators (r=0.8595).

The vertical cloth sampling could be used to estimate predator population.

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Table 1. Number of predators registered by sampling methods, classified in groups according to species and age (larvae, nymphs or adult).

Predators	PV	WPBS	Predators	PV	WPBS
Chrysopidae	89	203	Araneae	289	332
Lv – A.	83 – 6	203 – 0			
Coccinellidae	300	535	Hemiptera	151	209
Lv	274	495	*Geoc. Sp.* N–A	27 – 27	50 - 41
A - *E. Connexa*	23	30	*Nabis sp.* N-A *Orius*	14 – 58	31 - 40
Various	3	10	*sp*. N-A	2 – 19	9 - 36
			Various	4	2
Others	34	90	Total	863	1.369

Table 2. Paired T Test for WPBS and VCS in 10 sampling sites and correlation between both methods.

Variable WPBS-VCS	Mean	Std Error	t	DF	p	r	p
Coccinellidae	23.7	10.20	2.12	9	0.0635	0.7586**	0.0011
Araneae	4.4	6.52	0.67	9	0.5171	0.3501**	0.0004
Hemiptera	5.7	3.78	1.51	9	0.1665	0.7769*	0.0082
Chrysopidae	13.1	4.57	3.03 *	9	0.0186	0.8684**	0.0011
Other	5.6	3.79	1.48	9	0.1733	0.9819**	0.0000
Total Predators	50.7	11.50	4.41 **	9	0.0017	0.8595**	0.0014