CULTURAL AND BIOLOGICAL TOOLS OF INTEGRATED PESTS CONTROL IN THE FIELD PEPPER CROPS

MIJLOACE CULTURALE SI BIOLOGICE DE CONTROL INTEGRAT AL DAUNATORILOR LA CULTURILE DE ARDEI IN CAMP

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Abstract: *Studies concerning the effectiveness of some cultural and biological means used to control the aphid populations (Myzus persicae Sulz.) in the field pepper crops were conducted during 1990-2001, at R. I. V. F. C., in Romania. Results obtained showed that maize barriers assured a decreasing in average with 20 % of aphid density level, during the vegetation season. Associating the maize barriers and pepper intercropped with mustard rows, the aphid density was reduced with 55 % up to 75 %, as a result of natural entomophagous action, that were attracted of honey plants (mustard). Efficiency of natural aphidophagous populations (including coccinellids, chrysopids, cecidomyids, aphidiids) varied between 32 % and 75 %. In the case of Coccinella septempunctata eggs releases, efficiency increased up to 94-96 %, after 15-20 days from predators' dispersal. During the years, any chemical treatments against the main pests (green peach aphids, trips, mites and tomato fruit borer) were not necessary, in the vegetation season.*

Key words: *sweet pepper, aphids, cultural and biological control, maize barriers, mustard inter-cropped, Coccinella septempunctata releasing.*

Used as a method of intensive agriculture during more than 50 years, chemical control contributed of yield increasing and saving mankind of starvation. But long practice of this method determined the major and often irreversible changes in whole biosphere (soil, water, air, plants and animals, etc.), whose acute manifestation attained an alarming level in the last decade.

As a result, the agricultural researches were directed to the "improvement of breeding, growing and plant protection methods to assure the world necessary food in the safe environmental conditions" (5).

In this context, studies performed during 1990-2001 period, concerning the possibility of using some cultural and biological tools to aphids control in the field sweet pepper crops, had the following objectives:

- establishing of wild aphidophagous populations efficiency;
- estimation of aphidophagous populations efficiency after supplying of wild predators populations by releasing of *C. septempunctata* predators eggs;
- maize barriers and inter-cropped mustard impact on green peach aphid (*M. persicae*) and it specific entomophagous densities and dynamics.

MATERIAL AND METHOD

Experiments were conducted under conditions of natural crop infestation. The plots area varied between 1000-1400 m^2, each plot having around 350 m^2. Crops

keeping respected the general growth technologies, excepting the chemical treatments against the leaves pests (aphids, trips, mites, etc.), which were eliminated. Mole crickets (*Gryllotalpa* spp.) control was assured yearly, by a single soil treatment applied at the crops founding, with a mixed insecticide (malathion 0.3% + fenitrothion 4.7%), used in a rate of 25 kg/ha.

Maize barriers and inter-cropped mustard rows were sowed with 30 and 15 days, respectively before of pepper crops founding.

Coccinella septempunctata predator eggs, obtained by the lady beetles mass-rearing under controlled conditions, were released. The number of dispersed eggs was accorded with aphid density level. The real number of released predators was estimated by egg-hatching percentage, established on a sample of 500 eggs per each releasing.

Aphids and aphidophagous insects (coccinellids, chrysopids, cecidomyids, aphidiids) were supervised at intervals of 10 days, during whole vegetation season.

The registered data were used to establish the insect populations dynamics and estimate the entomophagous efficiency.

RESULTS AND DISCUSSIONS

a) Supervision of aphid population's dynamics, during 1990-1998 period, emphasized the different evolution of this indicator in certain years (1990,1993 and 1994), compare with other years (1995 and 1996).

Thus, in the first case (fig.1) aphid density varied at low levels, showing two increasing tops. In these conditions, efficiency of wild aphidophagous populations (fig.2) was in average of 53%, the obvious parasites action being registered at the beginning of vegetation season (May–June), while the predator's regulation effect became visible from the middle of July to the end of September.

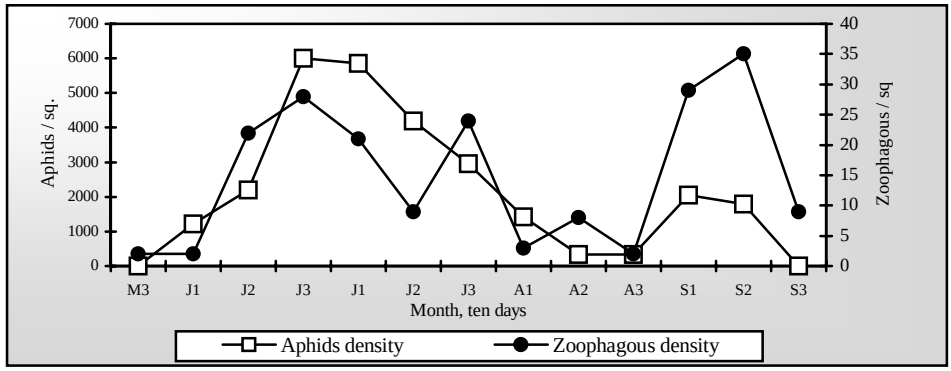

Figure 1. Dynamics of aphids and wild aphidophagous zoophages populations (average of 1990, 1993 and 1994 years)

In the second case (fig.3) the average level of aphids' density was 2.5 times higher than in the first situation, and aphid population's dynamics presented only one increasing top, in the middle of August.

The attack late manifestation followed of quick and ample pest density increasing, in the high temperatures conditions (usually registered during July–August period), negatively influenced useful entomofauna efficiency (fig.4), whose action depends of certain biotic factors.

Between these factors are mentioned aphids kayromones, whose attractant effect to adult's coccinellids is manifest at certain concentration level, dependent on aphid's density and detectable by predator's olfaction (6). This fact determined the belated migration of coccinellids predators in sweet pepper crops.

On the other side, though zoophagous migration period (from middle of July to beginning of August) was marked of its significant density increasing, the effect of its action was manifested just in the end of August. That situation occurred because the greatest weight inside of entomophagous populations was owned either of passive (eggs) or inefficiently (young larva) stages of very voracious predators (coccinellids, chrysopids), or of the active predators (cecidomyids) or parasites (aphidiids) characterized by low voracity and efficiency, respectively. Moreover, the entomophagous development rhythm, usually lower than of aphids, made that its action can be measured just in the second half of August.

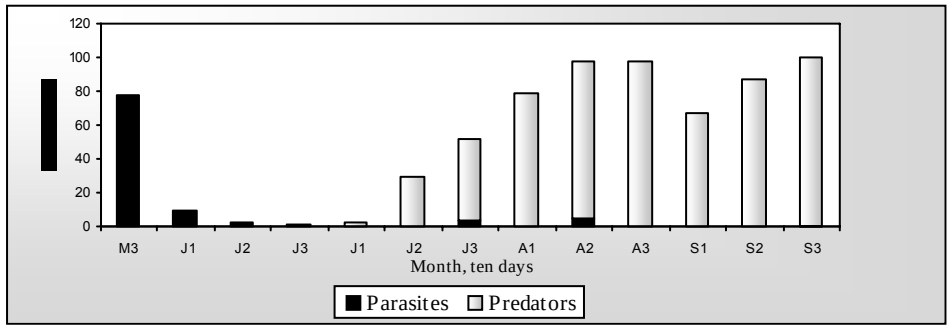

Figure 2. Wild aphidophagous zoophages populations efficiency (average of 1990,1993 and 1994 years)

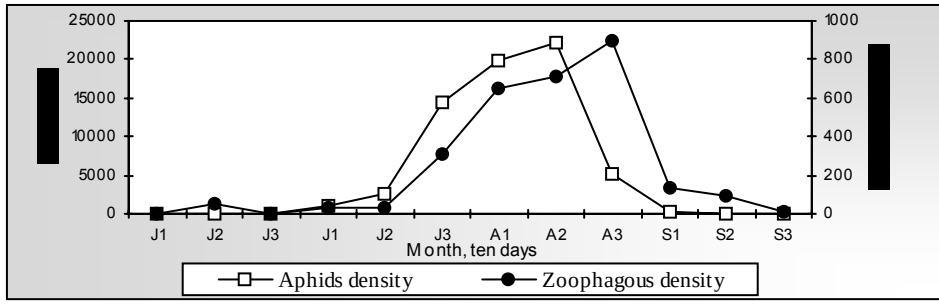

Figure 3. Dynamics of aphids and wild aphidophagous zoophages populations (average of 1995 and 1996 years)

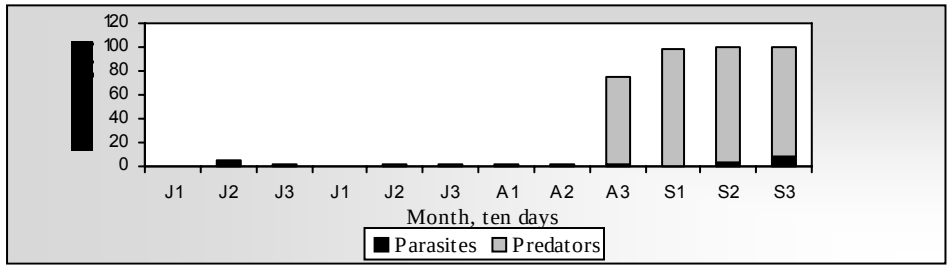

Figure 4. Wild aphidophagous zoophages efficiency
(average of 1995 and 1996 years)

b) By releasing the *C. septempunctata* predators in the rates of 70,000 up to 180,000 eggs/ha, the efficiency of zoophagous (including parasites, wild and released predators) varied from 31 to 97%, after 21 days, and from 61 to 99%, after 30 days. The best results were registered by using the rates of 100,000 and 150,000 eggs/ha (fig.5 and 6).

The field hatching eggs registered 80% and 40%, respectively determining an adequate reduction of initial releasing rates (80.000 and 60.000 eggs / ha, respectively). Low hatching eggs value registered in the second case was due of intra~ and inter-specific cannibalism, manifested by wild predators already available in the crop, which assured the population self-regulation (1, 2). However, in both situations the predators releasing contributed of aphid populations diminishing as well as of their maintaining under damaged threshold up to the end of vegetation season, without be necessary the chemical treatment application for the control of aphids, trips, mites or tomato fruit borer. On the other side, the predators releasing performed during a period of four years conducted to a significantly increasing of coccinellids wild populations' density and potential in the releasing area. The unilateral supplying of wild entomophagous populations by coccinellids predators releasing determined some changes in the zoophagous populations structure, such as: increasing of predators relative abundance to competitor parasites detriment, and significantly increasing of coccinellids and chrysopids weight to cecidomyids, aphidiids and syrphids especially detriment, without affect trombidiids abundance.

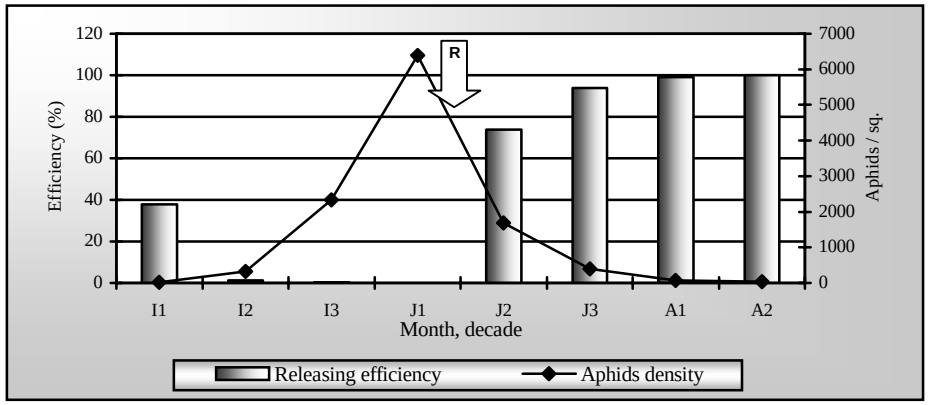

Figure 5. Action of *C.septempunctata* predator, used at a releasing (R) rate of 100.000 eggs/ha in the control of aphid's populations in sweet pepper crops (1993)

Obtained results show that self-regulation mechanism inside of the same food competitor zoophagous populations acted in the sense of reducing or even eliminating of some less voracious predators (cecidomyiids, syrphids) and parasites (aphidiids) by the very voracious predators.

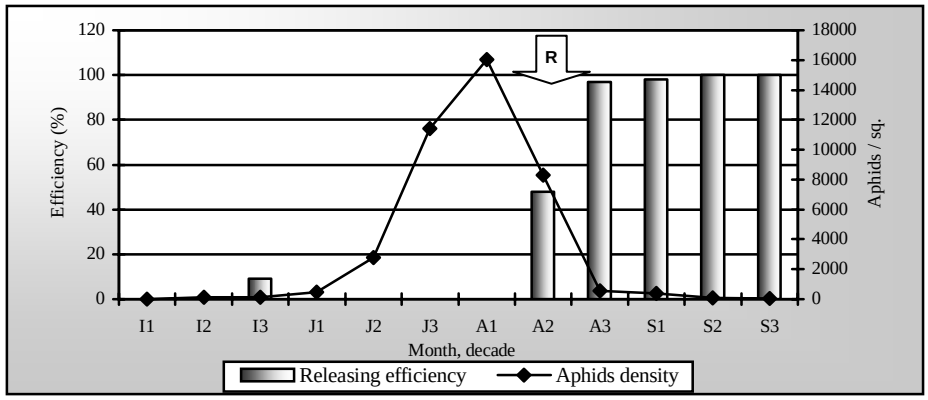

Figure 6. Action of *C.septempunctata* predator, used at a releasing (R) rate of 150.000 eggs/ha in the control of aphid's populations in sweet pepper crops (1995)

As a result, the repeated releasing of a single zoophagous species could determine it excessive increasing, leading to the competitor species substitute in the releasing area, and reducing of entomophagous species diversity, also (4). This situation required the releasing interruption and some measures approaching in order to preserve the new created biological stock and restored the useful entomofauna diversity.

c) Initially used as an aphid population-diminishing mean, the maize barriers proved to influence equally the pests and entomophagous densities (fig.7 and 8).

Thus, aphids density diminishing involve the releasing rates reducing as well as the zoophagous producing costs. At the same time, these two methods application contributes both of confining and keeping pests densities under economical damaged threshold, in the conditions of leaves insecticides treatments eliminating, and wild entomophagous populations protection, restoration and keeping.

d) In order to restore the useful entomofauna effective, pepper crops was inter-cropped with mustard rows.

This honey plant have a multiple role: attracting coccinellids predators, assurance of pollen feeding source necessary for their sexual maturation, alternating of aphids-prey and create refuges places in the case when chemical control of different other insect pest species (trips, mites, etc.) could be necessary (3).

Comparing the results regarding of aphid and aphidophagous insects densities from an experimental pepper crop (E), placed between maize barriers and mustard rows inter-cropped, and a conventional crop (C), placed in open field and chemical treated against diseases and pests attacks, was established that:

- in C plot, chemical treatments affected both aphids and its specific zoophages during a shorter or longer period, their densities evolving later on lower levels than in E crop;

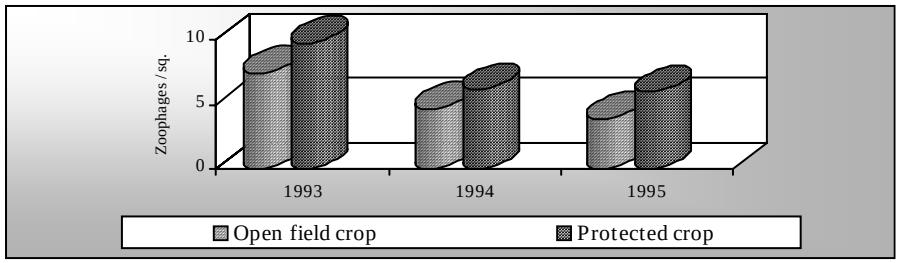

Figure 7. Maize barriers influence on aphid's density in the sweet pepper crops

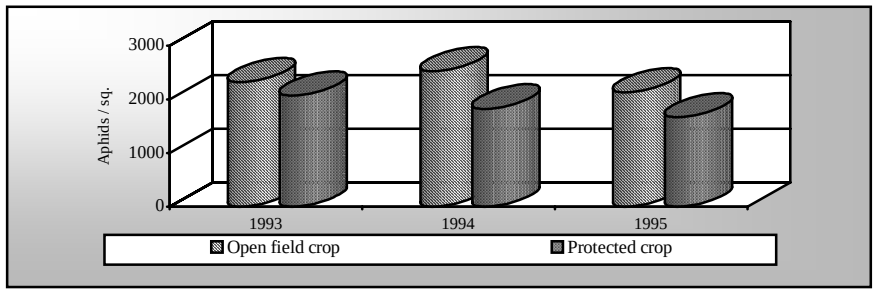

Figure 8. Maize barriers influence on zoophagous density in sweet pepper crops

- in E plot, an average increasing with 95% of aphids density was accompany of a coccinellid adults reducing with 1.6% and an increasing with 41.2%, 186.2% and 176.4% of their eggs, larva and nymphs, respectively compared to C plot. At these results was added the increasing with 18.8% of chrysopids eggs, 373.4% of cecidomyids larva and 86.2% of aphid parasitized by aphidiids.

Algebraically sum of differences, monthly registered of each biological category, showed that its maximum values was attained in July, when an increasing with 447% of aphids density corresponded of an increasing with 3.355 % (7.7x) of entomophagous density.

The average seasonal difference was with 95% and 881% (9.9x) higher in aphids and entomophagous case, respectively compare to C plot (table 1).

Table 1

Differences regarding aphids and specific zoophagous densities in the sweet pepper experimental (E) and conventional (C) crops

Month	Difference to crop C (%)								
	Aphids	Entomophagous							
		Coccinellids				Chrysopids	Cecidomyids	Aphidiids	Sum
		adults	eggs	larva	nymphs	eggs	larva		
June	+100	- 24	0	+100	- 39	- 38	0	+100	+ 99
July	+447	+ 56	+206	+759	+267	+ 18,8	+1867	+131	+3355
August	- 57	- 62	0	-100	+321	+ 33	0	+100	+ 292
September	+ 54	+ 13	0	+122	+133	- 11	0	+100	+ 357
October	- 67	+ 9	0	+ 50	+200	+ 41	0	0	+ 300
Average	**+ 95**	- 1.6	+41.2	+186.2	+176.4	+ 18.8	+373.4	+ 86.2	**+880.6**

In these conditions, the wild entomophagous populations efficiency was in average of 95% in the untreated pepper crop (E), while in the conventional crop (C), chemical treatment has as effect aphid populations diminishing with 69 % only (fig. 9).

Moreover, in E plot the entomophagous action determined a drastic aphid density reducing, from an exceeded damaged threshold level to a very low density, which maintained during the whole vegetation season. Unlike this, in C plot, where aphids density was found at damaged threshold level, applying of chemical treatment determined an aphids and aphidophagous simultaneously reducing, this fact being suggestively reflected by the substantial increasing of differences , in July.

Based on obtained results it is thought that by using of the two mentioned cultural methods it create the favorable development conditions of a large entomophagous species range, which will contribute at insect diversity and natural biocoenosis balance restoration during the time, in the cropping area.

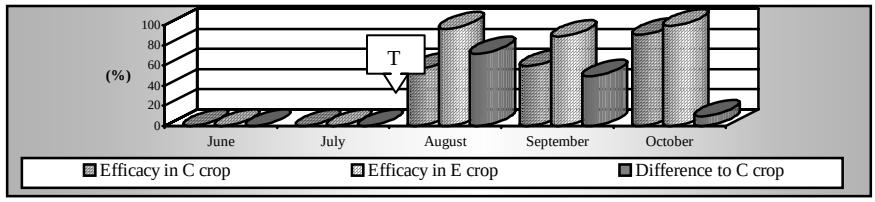

Figure 9. Comparative study regarding the efficacy of wild zoophagous action and chemical treatment (T) against aphids in E and C pepper crops

CONCLUSIONS

a) Wild zoophagous populations efficiency varied indirectly with aphid's density, showing the seasonal average values of 35% up to 53%;

b) Efficiency of wild aphidophagous populations supplied with released *C. septempunctata* predators varied directly with real releasing rates, registering seasonal average values of 91.5% and 88.3% respectively;

c) Using of maize barriers associated with inter-cropped mustard rows, determined an average increasing with 95% and 881% of aphids and aphidophagous populations' densities respectively compare to a conventional crop (control);

d) Cultural and biological tools complex used, as unpolluted strategies to aphid populations diminished can constitute an economical and ecological advantageous way in the pepper crops integrated pest management.

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