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Ecological pest management strategies in vegetable crop protection

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Abstract

The researches were carried out from 2006 to 2008 at Cluj-Napoca (Romania) in laboratory, greenhouse and field conditions, in five experiments. Our aim was to study and use some ecological pest control methods based on indirect and direct strategies: 1) the pest monitoring in vegetable crop ecosystems and useful fauna identification (by visual control, collecting manually, striking method on a tarpaulin); 2) the use of some physico-mechanical and biotechnical methods (use of barriers – panels, vases, attractant traps – alimentary, visual, reflective mulching) to control the pests. The harmful and useful fauna in studied ecosystems proved to be very different. All the methods recorded a good efficacy against the pests.

Key words: pest, vegetable crop, ecological control

Introduction

The animal pests impact in environment is essential, because they produce extensive damages in different ecosystems (Seastedt and Crossley Jr., 1984). The irrational use of chemical pest control determined a new pest management approach to study and use of some ecological control measures in agroecosystems. The use of unchemical methods is the main approach in ecological technology of modern agriculture (Debach, 1974; Glass et al, 1979; Horn, 1988). In Romania, the chemical control is widely used by integrated pest management, at a superior level. Besides the negative impact on the environment, the high price of modern pesticides settle the direction to unpollutant methods, cheaper, like the unchemical control methods of pests.

We proposed to study and use some ecological pest control methods based on the unchemical control (Land, 1997; Bunescu et al, 2003).

Materials and methods

The methods are based on indirect and direct strategies: 1) the pest monitoring in vegetable crop ecosystems and useful fauna identification (by visual control, collecting manually - direct with pincers, striking method on a tarpaulin); 2) the use of some physico-mechanical and biotechnical methods (use of barriers – panels, vases, attractant traps – alimentary, visual, reflective mulching) to control the pests from studied ecosystems. The experiment were carried out from 2006-2008, according to experimental techniques, in laboratory (Discipline of Entomology-Zoology at USAMV Cluj-Napoca), field and greenhouses (in some private gardens at Cluj-Napoca - District of Cluj - Romania). The host-plants has chosed according to their economic importance and the relationship with the specific pests, respectively widespreaded plants as vegetable crops: cabbage, tomato, pepper, potato, cucumber, bean, onion.

1) The indirect strategies by monitoring of harmful fauna and identification of useful one, carried out from May 2006 to 2008. The insect has been collected straight by hand or with the aid of fine bruses and pincers, from different vegetal organs (sprouts, stems, leaves, flowers and inflorescences) by shaking down the plant on a tarpaulin, by random collecting from plants for a better objectiveness. The collected material has been introduced in small bottles (with 70% ethanol or 4% formalin), boxes or plastic bags which has been labeled. The identification of the material has been made with the binocular microscope in the Laboratory of Zoology-Entomology. After the species identification, the collected material has been prepared and conserved. The species identification was made according to identification keys (Ghizdavu et al, 1987; Perju et al, 1988). The useful insects has been collected, studied and identified, then they has been released back to their natural environment, to continue their positive activity in studied vegetable crop ecosystems, respectively the protected and field crops.

2) The direct strategies to control the pests, meant the use of some alternative, unpollutant methods, in studied vegetable crop ecosystems: physical and biotechnic (use of barriers – panels, vases, attractant traps – alimentary, visual, reflective mulching).

a) reflective mulching with different materials which reflects the light radiation, changing the wave length and disrupting the recognition action of host-plants by winged pest species or the feeding activity of the ones sheltered on the background of leaves. It has been used more types of reflective materials (film or foil): aluminium film, white and grey plastic film (polyethylene), as tapes of 10 m length and 30 cm width, with repellent action to many pests categories (aphids, thrips, whiteflies). The experiment was carried out in June, in 3 variants with the 3 film types at cabbage, tomato and pepper crops respectively, in field conditions. The control was represented by a variant without reflective film. The film tapes has been aligned between the plant rows, direct on the cleaned soil of weeds, being fixed on the borders with soil, here and there, to be protected against the wind. The data has been recorded every week.

b) colored sticky traps - The experiment with attractant materials was carried out in June at a cabbage and pepper crops, using visual or colored traps (panels) – 7 variants (white, silver, light-green, emerald-green, light-blue, dark-blue, red) + control (yellow). The visual traps (panels) has been made by plastic and aluminium, measuring 25/25 cm and covered with a special adhesive not siccative. 7 traps „windmill type" has been made, and fixed on a 1 m length stick. The data were recorded after 1 week.

c) colored ceramic plates with water - The 3rd experiment was carried out in July at a cabbage crop using colored ceramic plates with water – 5 variants (white, orange, green, blue) + control (yellow), fixed on wood holders between the plant rows. The results has been noted every 2 days.

d) attractant traps with alimentary baits - The experiment was carried out in August at a cabbage crop, using alimentary baits, containing: water, honey and a proteic constituent respectively beer yeast; beer with sugar and a proteic constituent. The baits were boiled, and finally resulting in a viscous substance which has been set in plastic vases (plate type) 25 cm diameter. The vases were set at 1 m high from ground on wood holders between the crop rows, every 10 m. 10 vases in all has been set, 5 with the first bait type and 5 with the second one, on 1000 m^2. The data has been recorded every week.

Results and discussion

1) THE HARMFUL FAUNA

a) Results under field conditions

Results concerning the morphology on the harmful fauna from vegetable crop studied showed the following 17 pest species:

Phyll. MOLLUSCA - Cls. GASTROPODA - Ord. STYLLOMATOPHORA - Fam. AGRIOLIMACIDAE - *Deroceras agreste* Linné

Phyll. ARTHROPODA - Cls. INSECTA - Ord. ORTHOPTERA - Fam. GRYLLOTALPIDAE - *Gryllotalpa gryllotalpa* Linné

Ord. HOMOPTERA - Fam. APHIDIDAE - *Brevicoryne brassicae* Linné; *Aphis fabae* Scopoli; *Myzodes persicae* Sulzer

Ord. HETEROPTERA - Fam. PENTATOMIDAE - *Eurydema ornata* Linné

Ord. COLEOPTERA - Fam. MELOLONTHIDAE - *Melolontha melolontha* Linné

Fam. CHRYSOMELLIDAE - *Leptinotarsa decemlineata* Say

Fam. HALTICIDAE - *Phyllotreta nemorum* Linné

Fam. ELATERIDAE - *Selatosomus latus* Linné; *Agriotes lineatus* Linné

Ord. LEPIDOPTERA - Fam. PIERIDAE - *Pieris brassicae* Linné

Fam. NOCTUIDAE - *Mamestra brassicae* Linné

Ord. DIPTERA - Fam. ANTHOMYIDAE - *Delia brassicae* Bouché; *Delia antiqua* Meigen

Phyll. VERTEBRATA - Cls. AVES - Ord. PASSERIFORMES - Fam. CORVIDAE - *Corvus frugillegus* Linné

Phyll. VERTEBRATA - Cls. MAMMALIA - Ord. RODENTIA - Fam. MICROTIDAE - *Microtus arvalis* Pallas

b) Results under greenhouse conditions

Under greenhouse conditions the development cycle of pests don't follow the natural rule anymore. The infection sources, succesion of generations, abundance of populations, length of different stages, frequency and intensity of damages, being under the inluence of local microclimate, which give the pest diversity and variability. After identification of material collected in the greenhouses, the following 3 pest species has been identified:

Phyll. ARTHROPODA - Cls. ARACHNIDA - Ord. ACARI - Fam. TETRANYCHIDAE - *Tetranychus urticae* Koch

Phyll. ARTHROPODA - Cls. INSECTA - Ord. THYSANOPTERA - Fam. THRIPIDAE - *Thrips tabaci* Lindeman

Ord. HOMOPTERA - Fam. ALEURODIDAE - *Trialeurodes vaporariorum* Westwood

2) THE USEFUL FAUNA

a) Predators

After the analysis of collected material from field and greenhouses, the following 16 predator species has been identified:

Phyll.. ARTHROPODA - Cls. INSECTA - Ord. THYSANOPTERA - Fam. THRIPIDAE - *Scholothrips longicornis* Uzel

Ord. HETEROPTERA - Fam. PENTATOMIDAE - *Perillus bioculatus* Linné

Fam. NABIDAE - *Nabis rugosus* Linné

Ord. PLANIPENNIA - Fam. CHRYSOPIDAE - *Chrysopa carnea* Stephens

Ord. MECOPTERA - Fam. PANORPIDAE - *Panorpa communis* Linné

Ord. HYMENOPTERA - Fam. FORMICIDAE - *Formica rufa* Linné; *Formica sanguinea* Linné; *Formica pratensis* Linné

Ord. COLEOPTERA - Fam. CARABIDAE - *Harpallus aeneus* Linné

Fam. COCCINELLIDAE - *Coccinella 7-punctata* Linné; *Adalia 2-punctata* Linné

Ord. DIPTERA - Fam. CECYDOMYIDAE - *Aphidoletes aphidimyza* Linné

Fam. SYRPHIDAE - *Syrphus ribesii* Linné

Phyll. ARTHROPODA - Cls. ARACHNIDA - Ord. ARANEAE - Fam. LYCOSIDAE - *Pardosa agricola* Thorell

Phyll. VERTEBRATA - Cls. AVES - Ord. PASSERIFORMES - Fam. PARIDAE - *Parus major* Linné

Phyll. VERTEBRATA - Cls. MAMMALIA - Ord. INSECTIVORA - Fam. ERINACEAE - *Erinaceus europaeus* Linné

b) Parasites

After the analysis of collected material from field and greenhouses, the following 3 parasite species has been identified:

Phyll. ARTHROPODA - Cls. INSECTA - Ord. HYMENOPTERA - Fam. SCELONIDAE - *Trissolcus flavipes* Thomson

Fam. BRACONIDAE - *Apanteles glomeratus* Linné

Fam. PTEROMALIDAE - *Pteromalus puparum* Linné

2. The direct strategies to control the pests and use of some alternative, unpollutant control methods in vegetable crops studied ecosystems:

a) reflective mulching - The experience with different reflective materials used as mulch on the ground between the plant rows (cabbage, tomato and pepper), had a very good repellent action, removing different pests from the host-plants (aphids, thrips, whiteflies, flea-beetles). All the 3 variants has recorded a good efficacy comparing with the control, the most efficacy being the aluminium film.

b) colored sticky traps - At the experience with colored sticky panels installed in a cabbage and a pepper crop, it has been recorded a very good efficacy at all variants. The most captures has recorded the yellow trap (variant 8-control) with 600 captures, the white one with 550 captures (variant 1), followed by the silver trap (variant 2) with 400 captures, the light-green trap (variant 3) with 350 captures, the light-blue trap (variant 5) with 300 captures, the emerald-green trap (variant 4) with 200 captures, the dark-blue trap (variant 6) with 180 captures and the red one (variant 7) with 100 captures. It has been captured aphids, adult flies, small beetles, wasps, thrips.

c) colored ceramic plates with water - At the experiment using colored ceramic plates with water in a cabbage crop, it has been recorded a very good efficacy. The best results recorded the control – variant 5 (yellow) with 1030 captured insects (Ord. **Homoptera, Diptera, Hymenoptera, Lepidoptera, Coleoptera, Thysanoptera**), followed by variant 1 (white) with 850 captures (Ord. **Homoptera, Diptera, Hymenoptera, Coleoptera**), variant 2 (orange) with 720 captures (Ord. **Diptera, Hymenoptera, Homoptera, Lepidoptera, Coleoptera**), variant 3 (green) with 680 captures (Ord. **Diptera, Hymenoptera, Homoptera, Coleoptera, Lepidoptera**), variant 4 (blue) with 540 captures (Ord**. Diptera, Hymenoptera, Homoptera, Lepidoptera**).

d) attractant traps with alimentary baits - Regarding the experiment with attractant traps based on alimentary baits, the both variants had a good efficacy, continuous capturing butterflies (especially **Noctuidae, Pieridae**) and different flies.

Conclusions

After the developed experiments in 2006-2008, from the experimental data analysis recorded after the use of 2 strategies in controling the pests from vegetable crop ecosystems the following conclusions are evident: the use of some indirect strategies showed that in field and greenhouses, the harmful and useful fauna proved to be very different; the direct strategies by reflective mulching with different materials had a very good repellent action; the use of colored sticky traps recorded a very good efficacy at all variants; the use of some colored ceramic plates with water recorded a very good efficacy at all variants, the best results recorded variant 5 (the control – yellow) followed by variant 1 (white) with 850 captures; in the experiment with attractant traps based on alimentary baits, the both variants showed a good efficacy, continuous capturing butterflies (especially Noctuidae, Pieridae) and flies. The field experiments with reflective mulching, have advantage that benefits of a rich light radiation, which allow also the warming of vegetal material of crop. In summertime with high temperature level it is recomended the removing of reflective films from crops, to avoid the overheat of plants. The lifetime of reflective films is about 3 months.

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