

Lessons of the Changes in the Arthropod Population Composition in the Hungarian Apple Orchard in the Last Six Decades

G. JENSER¹, KLÁRA BALÁZS¹, V. MARKÓ² and A. HALTRICH²

¹Plant Protection Institute, Hungarian Academy of Sciences, H-1525 Budapest, P.O. Box 102, Hungary

²Department of Entomology, Faculty of Horticulture Sciences, Corvinus University of Budapest, H-1052 Budapest, P.O. Box 53, Hungary

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About 2500 arthropod species immigrate, or carried by wind, or introduced by man in the orchards, under Hungarian climatic conditions. However, the number of the apple pest species is approximately 30. Owing to the effect of the relationships among the plant–phytophagous–zoophagous species those could colonize the orchard for which the apple provides suitable food sources and whose populations are not regulated or are regulated by a weak efficiency by parasitoids and predators. These populations create the *primary pest communities*. When the individual number of the parasitoid and predator species is reduced by the broad-spectrum insecticides, the population density of those phytophagous species could increase whose populations was restricted up to that time. In this case the *secondary pest communities* could develop. The integrated pest management provides the possibilities to solve the problems caused by the regular use of broad-spectrum insecticides. The real requirement is to find and to harmonize those methods which regulate the population dynamics of the species of the *primary pest communities*.

Keywords: IPM in apple orchards, primary pest communities, secondary pest communities, agro-ecosystem.

The application of the conventional, the broad-spectrum and the so-called selective insecticides was changed successively in the last six decades in the Hungarian apple orchards, too. The arthropod populations existing in the affected agrobiotopes reacted sensitively to the effect of all these factors, so their population composition continuously changed.

The significance and remarkable evidence of these processes were summarized and considered on the basis of the contemporary publications and notes, of the data of an eco-faunistic survey and on the results of a controlled experiment.

The faunal research of the arthropods in apple orchards in Hungary started with the investigations of Zilahi-Sebess (1955).

The occurrence of the arthropod species was studied by systematic eco-faunistic investigation, for 10 years, in different types of Hungarian orchards. It was carried out in scattered orchards receiving no treatment of any kind of insecticides, in back yard-orchard, in traditional farming-scale orchard and intensive farming-scale orchard, regularly treated with broad-spectrum insecticides and in an experimental orchard half of which

was kept as an insecticide-free control area and other half of it was treated with insecticides 4–6 times per year (Mészáros et al., 1984). Further significant data were recorded about the occurrence of arthropod species in the apple orchards by Markó et al. (1995), Bogya et al. (1999), Balog et al. (2003), Kutasi et al. (2004), Balog and Markó (2006), Bogya et al. (1999a, b), Kutasi et al. (2004), Markó and Kádár (2005).

The effects of broad-spectrum and selective (mainly IGR) insecticides on the significant changes in the structure of phytophagous and zoophagous population communities have been investigated in a controlled experiment carried out in an apple orchard, for three years (Jenser et al., 1999). The investigations of the effects of broad-spectrum and selective insecticides were continued at the Research and Extension Centre of Fruit-growing, Újfehértó.

The investigations were performed by the research workers of the Zoological Department of the Plant Protection Institute, Hungarian Academy of Sciences, the Department of Entomology of University of Horticultural and Food Industry, the Research Institute for Fruit-growing and Ornamentals, the Zoological Department of the Hungarian Natural History Museum, the Station of Plant Protection and Agrochemistry, Nyíregyháza.

Changes in the pest population compositions

THE EFFECT OF THE REGULAR USE OF THE CONVENTIONAL INSECTICIDES

From 1920s to the 1950s the pests were controlled by nicotine, lime sulphur, calcium arsenate, winter oil, and dinitro-phenyl pesticides.

At that time the following species regularly occurred in considerable population density: *Eriosoma lanigerum* (Hausmann) (woolly aphid), *Aphis pomi* De Geer (green apple aphid), *Dysaphis devector* (Walker) (rosy leaf-curling aphid), *D. plantaginea* (Passerini) (rosy apple aphid), *Diaspidiotus perniciosus* (Comstock) (San Jose scale), *Melolontha melolontha* Linnaeus (cockchafer), *Anthonomus pomorum* (Linnaeus) (apple blossom weevil), *Scolytus mali* (Beckstein) (large fruit bark beetle), *Recurvaria nanella* Hübner (lesser bud moth), *R. leucatella* Clerck (white-barred grounding), *Archips rosana* Linnaeus (rose leaf-forer), *Hedya nubiferana* Haworth (fruit-tree tortrix moth), *Spilonota ocellana* Fabricius (apple bud moth), *Pandemis heparana* Denis et Schiffermüller (dark oblique-barred twist), *P. ribeana* Hübner (common currant tortrix), *Adoxophyes orana* (Fischer von Rösslerstamm) (summer fruit tortrix moth), *Cydia pomonella* (Linnaeus) (codling moth), *Malacosoma neustria* (Linnaeus) (lackey moth), *Operophtera brumata* (Linnaeus) (winter moth), *Orgyia antiqua* (Linnaeus) (vapourer moth), (*Hoplocampa testudinea* (Klug) (apple sawfly). Their presence determined the necessity of the protection the apple orchards (Jablonowski, 1912; Reichart, 1953, 1957; Reichart et al., 1974; Balás, 1966).

THE EFFECT OF THE REGULAR USE OF THE BROAD-SPECTRUM INSECTICIDES

From 1950s the pests were controlled by organochlorine (DDT, HCH) and organophosphorus insecticides and acaricides (Szelényi, 1953; Ubrizsy and Reichart, 1958; Balás, 1966).

The insecticides containing *organochlorine* proved to be more efficient than those used up to that time. They reduced the population to a minimum level of *A. pomorum*, *D. perniciosus*, *C. pomonella*, *A. orana*, and it became possible to prevent the damage of the *H. testudinea*, in the Hungarian orchards, too.

On the other hand, the regular use of the organochlorine insecticides led to significant difficulties.

The population density of *E. lanigerum* unexpectedly increased to a high level, which endangered again the condition of the apple trees (Szalay-Marzsó and Jenser, 1959).

Although tetranychid species as *Bryobia rubrioculus* Scheuten (apple and pear bryobia mite), *Tetranychus urticae* Koch (two-spotted spider mite), *T. viennensis* Zacher (hawthorn red spider mite) occurred only in low population density in the untreated or abandoned apple orchards, they were not reported as pests in the Hungarian apple orchards, nevertheless, they appeared in high population density causing severe crop losses in the orchards treated with organochlorine (DDT) insecticides. In addition the presence of *Panonychus ulmi* (Koch) (fruit tree red spider mite) has been also observed (Bognár and Csehi, 1959; Bognár, 1960).

The withdrawal of the organochlorine insecticides and the regular use of the organophosphorus insecticides were followed by additional changes in the arthropod population composition. The populations of *B. rubrioculus*, *T. urticae*, *T. viennensis* disappeared from the orchards, and the *P. ulmi* became the dominant tetranychid species (Jenser, 1967, 1968; Bognár, 1969, 1972).

The population density of *E. lanigerum* decreased and although its populations were still present in the orchards, they did not endanger the condition of the trees.

Among the 9 leaf roller species recorded formerly from the apple orchards (Reichart et al., 1972, 1974, 1976) only *Archips rosana*, *Pandemis ribeana* and *Adoxophyes reticulana* occurred in high population density, while the single-brooded leaf roller species disappeared (Balázs, 1989/b, 1991).

The colonization of apple orchards by some miner moth species was the additional negative side-effect of the regular use of the broad-spectrum insecticides. However the specimens of *Leucoptera malifoliella* Costa, *Phyllonoricter corylifoliella* Haworth, *Ph. blancardella* Fabricius occurred only sporadically (Jablonowski, 1912; Reichart, 1957), in the 1970s their individual number increased to a high population level in the apple orchards (Vojnits and Bodor, 1972; Molnárné, 1975; Balázs, 1981). From the beginning of the years of 1980s the population density of *Ph. blancardella* lessened, and at the same time the population density of *Leucoptera malifoliella* Costa rapidly increased (Seprős, 1983; Balázs, 1989a, b) and since that time it is continuously present frequently in high population density, caused severe crop loss by damaging the leaves (Balázs et al., 1996b).

To prevent the damages of the miner moth, leaf roller moth species and fruit tree red spider mite a more intensive application of the insecticides and acaricides required.

The *Synanthedon myopaeformis* (Borkhausen) (apple clearwing moth), known as the pest of old and neglected apple trees (Ubrizsy and Reichart, 1958; Balás, 1966), appeared unexpectedly in high individual number in the farming-scale orchards, causing partial dying off of the branches (Mikulás, 1973; Balázs et al., 1995, 1996a).

THE EFFECT OF THE USE OF THE INSECTICIDES RECOMMENDED FOR INTEGRATED PEST MANAGEMENT

Since the IGR insecticides have sufficient effect against the miner moth species and do not endanger their parasitoids, following their regular application the population of *L. malifoliella*, *Ph. blancardella* and *Ph. corilifoliella* diminished to a minimum level (Balázs et al. 1996b). These insecticides have no acaricide effect, and they are harmless to the predatory mites, following their consistent application, the population of *P. ulmi* collapsed in two-three years (Jenser et al, 1999).

By the regular use of the IGR insecticides it is possible to keep the population density of *C. pomonella*, *A. orana*, *H. nubiferana*, *P. heparana*, *P. ribeana* and other leaf roller species (Balázs et al., 1996b) at a low level, to diminish the individual number of *S. myopaeformis* (Balázs et al., 1995, 1996b).

At the same time, *A. pomorum*, *D. depecta*, *A. pomi*, *D. plantaginea*, *D. perniciosus*, *H. testudinea* appear again in the plantations and their population density could increase to a dangerous individual number. The number of other minor pests like *Stephanitis pyri* (Fabricius) (pear lace bug), *Anomala vitis* (Fabricius) (anomala scarab) and *Peritelus familiaris* (Boheman) also increased. The presence of the larvae of *M. melolontha* rises unchanged significant difficulties (Jenser et al., 1999).

By the use of lime sulphur and summer oil it is possible to reduce the population density of *D. perniciosus*, *A. pomi*, *D. depecta* and *D. plantaginea*.

To prevent the damage of *H. testudinea* after the blossom and that, of *C. pomonella* and *A. orana* one or two weeks before the picking of the fruit and the colonisation of *M. melolontha* the use of organophosphorus insecticides such as phosalone is unavoidable. At the same time the application of the organophosphorus insecticides from time to time endangers the survival of the parasitoid and predatory species: the natural enemies of the pests.

INTERRELATIONSHIPS BETWEEN PHYTOPHAGOUS AND ZOOPHAGOUS ARTHROPOD POPULATIONS

In order to recognize the reasons of the changes in the population of the pest species, to reduce the intensive application of insecticides and to develop a reasonable, environmental-friendly plant protection method, we have to reveal the occurrence and the interrelationships between phytophagous and zoophagous arthropod populations in the different types of Hungarian apple orchards.

The changes in the composition of arthropod populations were induced primarily by the effect of the used insecticides. This effect was fortified in each case by the applied agricultural engineering, mainly by fertilization and pruning.

Having studied the possible relationships between the phytophagous and zoophagous arthropod populations prevailing in the Hungarian apple orchard the following have been established.

Following the introduction of *Aphelinus mali* Haldeman (woolly aphid parasite) into Hungary it was able to regulate the population dynamics of *Eriosoma lanigerum* (Jeszenszky, 1931). Since by the regular application of organochlorine (DDT) insecticides the population density of *A. mali* was drastically reduced and the *E. lanigerum* became again a dangerous pest in the apple orchards. It has been found that 93% of the specimens of *E.*

lanigerum was parasitised by *A. mali* where calcium arsenate and lime sulphur were applied, and only in 3–5% was parasitized where DDT insecticide was used (Szalay-Marzsó and Jenser, 1959). After the regular use of organophosphorus insecticides, the population density of *E. lanigerum* decreased to a minimum level on the trunk and in the crown. At the same time on the rootcollar and root of the EM IV rootstock variety, the colonies of *E. lanigerum* with the populations of *A. mali* survived. Following the introduction of the IGR insecticides (diflubenzuron, insegar) in the IPM orchards because the specimens of both arthropod species appeared on the trunk and in the canopy, the survived populations of the parasitoid were able to keep the colonies of the pest at a low level (Jenser, 1989).

However the immigration and the presence of 76 aphidophagous hoverfly (*Syrphidae*) species (Visnyovszky, 1987; Rasztik et al., 1998, 1999) of 6 *Coccinellidae* species (Zilahi-Sebess, 1955) were recorded. The most frequent species of *Syrphidae* were: *Episyrphus balteatus* (DeGeer), *Metasyrphus corollae* (Fabricius) and *Sphaerophoria scripta* (Linnaeus) (Rasztik and Mészáros, 1997). These predators were not able to prevent the frequent colonization of *Aphis pomi*, and the increase of population density of *Dysaphis devector*, *D. plantaginea* in the orchards treated with broad-spectrum or with IGR insecticides (Haltrich and Markó, 1995). There were the aphid species which damaged the apple fruit or trees before the regular application the broad-spectrum insecticides (Szalay-Marzsó, 1989; Haltrich and Markó, 1995).

Aphelinus fuscipennis Howard, a *Prospaltella perniciosi* Tower, *Aphytis testaceus* Tschumakova were reared from *Diaspidiotus perniciosus* by Szelényi (1934) and Zilahi-Sebes (1934). They cannot regulate the population dynamics of *D. perniciosus*, therefore its population density increases in the orchards treated mainly with IGR insecticides.

Pimpla pomorum (Linnaeus) *Bracon variator* Ness (*Ichneumonoidea*), *Habrocytus fasciatus* Thomson, *H. grandis* Walker, *Tetrastichus pospjelovi* Kurdjumov (*Chalcidoidea*) were recorded as parasite of *Anthonomus pomorum* (Reichart, 1990). Among them *P. pomorum* could parasitize in 4.5–27.5% of the larvae of *A. pomorum* (Ubrizsi and Reichart, 1958). In the second year of the regular use of IGR insecticides *A. pomorum* infestation of the flower reached as high level as 22–30%. According to the available data to prevent its damage the use of insecticides from time to time is unavoidable (Jenser et al., 1999).

In surveying the parasitoids of miner moth 54 parasitoid have been reared from the larvae of *L. malifoliella*, *Ph. blancardella*, *Ph. corylifoliella*. Their populations are associated with insect communities in the surrounding of the orchards. The most important species of them are: *Sympiesis sericeicornis* (Nees), *S. gordius* (Walker), *Pnigalio pectinicornis* (Linnaeus), *P. soemius* (Walker), *Pediobius pyrgo* (Walker), *Holcothorax testaceipes* Ratzeburg, *Chrysocharis pentheus* (Walker), *Minotetrastichus frontalis* (Nees), *Achrysochariodes atys* (Walker), *Neochrysocharis chlorogaster* (Erdős) and *Pholetesor bicolor* (Ness) (Balázs, 1989a). Approximately 8–10 species above all *H. testaceipes* further *S. sericeicornis* and *Ph. bicolor*, are able to colonize the orchards treated with broad-spectrum insecticides, depending on the mode of application of insecticides (Balázs, 1984), however, they have no significant population regulating effect under these conditions. Owing to the cessation of the use of broad-spectrum insecticides, the regular application of selective insecticides, among the parasitoid species, *H. testaceipes*, *S. gordius*, *S.*

sericeicornis, *P. pectinicornis*, *M. frontalis* and *C. pentheus* could colonize the orchards in the beginning. In the following year their population density diminishes and will be changed by the other parasitoid species. The population density of parasitoid species increases within 2–4 years, and they could parasitize of 30–40%, occasionally 80% of the larvae of leaf miner moths. The larvae of numerous parasitoid species could alternate their host species, therefore, they are able to survive in the orchard the change taking place in the leaf miner communities (Balázs 1991, 1997). Owing to the consistent application of IGR insecticides and the regulating effect of parasitoids the populations of *Ph. blancardella*, *Ph. corilifoliella* and *L. malifoliella* decreased to a minimum level in 2–3 years, not causing any damage. So it is unnecessary to use insecticides against them (Balázs, 1984, 1989a, 1989b; 1991, 1994, 1997; Balázs et al., 1996b; Balázs and Jenser, 1999).

Among the leaf roller species *A. orana*, *A. rosana*, and *P. heparana* are present in variable density in the Hungarian orchards treated with broad-spectrum insecticides. Twenty-five parasitoid species have been reared from their larvae. The frequent species are: *Apanteles ater* (Ratzeburg), *Dolichogenidea longicauda* (Wesmael), *D. cheles* (Nixon), *Macrocentrus linearis* (Nees), *M. pallipes* (Nees). Since they could alternate their hosts, they are able to survive the change taking place in the leaf roller communities (Balázs, 1991, 1997). However they are present in the orchards treated with broad-spectrum insecticides, but usually parasitize only 10–20%, seldom 30% of the larvae, where IGR insecticides are used regularly. They are able to regulate the populations of leaf roller species but cannot keep their population density at a minimum level. Therefore in order to prevent the damage of leaf roller species, the use of the insecticides against them is unavoidable (Balázs 1989b, 1991, 1997; Balázs et al., 1996b).

Three Ichneumonoidae, 2 Braconidae, 1 Chalcidoidae, 1 Eurytominae, 1 Pteromalinae, 1 Diptera species were found to parasitize *Cydia pomonella*. According to the unanimous opinion of the other authors at most only 2% of the parasitized larvae were observed. In addition the specimens of 2 Dermaptera, 2 Formicidae, 2 Vespidae, 1 Chrysopidae as well as birds above all woodpeckers and nuthatch are known as predators of its (Bognár, 1962a). To prevent significant damage it is necessary to regularly use insecticides.

Concerning the effectiveness of *Trichogramma* species in the Hungarian apple orchards only a few information are available. The infestation of *C. pomonella* and leaf rollers by *Trichogramma evanescens* Westwood race *semlidis* and *T. cacoeciae* March species have been recorded (Reichart, 1953; Bognár, 1962a; Nagy, 1973).

Operophtera brumata larvae are parasitized by 7 Ichneumonoidae and 7 Braconidae species (Escherich, 1931. cit. Reichart, 1993). In addition Trombidium, Chrysopa, Coccinella Carabidae and Formicidae species could prey on its eggs and larvae. They were not able to prevent its high population density occurring in every 8–10 years (Jablonowski, 1912; Reichart, 1993).

At that time appeared the tetranychid species – *Bryobia rubrioculus*, *Tetranychus urticae*, *T. viennensis*, *Panonychus ulmi* – in a high population density in the Hungarian orchards. Among their arthropod predator species the occurrence of *Stethorus punctillum* Weise, *Chrysopa perla* Linnaeus, *Anthocorus nemorum* Linnaeus, *Triphleps nigra* Wolff, *T. minuta* Linnaeus were observed (Bognár, 1960, 1962b). The occurrence of 30 Phytoseiidae

(Kropczynska and Jenser, 1968; Szabóné and Jenser, 1987) and a Stigmaeidae (*Zetzellia mali* Ewing) (Komlovszky and Jenser, 1992) have been collected in different biotopes. Among the phytoseiid mites *Euseius finlandicus* Oudemans, *Dubinellus echinus* Wainstein et Arutunjan, *Kampimodromus aberrans* Oudemans, *Amblyseius andersoni* Chant were frequent species. The most species on the trees in the abandoned orchards was *E. finlandicus*. In the treated orchards only a few specimens of them have been found (Jenser et al., 1992).

The population composition of the Acarina species radically changed in three years, according to the regular application of the IGR insecticides. Following the immigration of the stigmaeid predatory mite (*Z. mali*) the population density of the dominant tetranychid species, began to decrease. The individual number of the predatory insect *S. punctillum* (Weise) and *Orius niger* (Wolf) also diminished. In the second year immigrated the phytoseiid mite (*E. finlandicus*), while the population density of *P. ulmi* and *Z. mali*, *S. punctillum* continuously diminished and the specimens of *O. niger* disappeared. Such an Acarina population community developed in the third year that comprised *B. rubrioculus*, *T. urticae*, *T. viennensis*, phytoseiid and *E. finlandicus*, *Z. mali*, zoophagous species. The specimens of *P. ulmi* disappeared. Interestingly enough the same population composition occurred that had been observed in the pesticide-free, untreated or abandoned orchards. In these population communities the predatory mite species are able to keep the population density of the phytophagous mite species at a low level, where the rapid increase of some phytophagous tetranychid species is not possible (Jenser et al., 1999).

Among the predatory Heteroptera species *Orius minutus* (Linnaeus), *Deraeocoris lutescens* (Schilling) and *Himacerus apterus* (Fabricius) have been observed. Its adults and larvae occurred in the abandoned and in selective insecticides treated orchards as well as in the orchards regularly sprayed with broad-spectrum insecticides in the end of August and in September (Jenser et al., 1992).

In the canopy the dominant coleopteran predators, in decreasing order of their abundance, were *Coccinella septempunctata* Linnaeus, *Stethorus punctillum* Weise, *Propylea quatuordecimpunctata* (Linnaeus), *Adalia bipunctata* (Linnaeus), *Hippodamia variegata* (Goeza), among the cantharids the most common species was *Rhagonycha fulva* Scopoli (Marko et al., 1995). The most common spiders in the canopy were *Philodromus cespitum* (Walckenaer), *Theridion impressum* L. Koch, *T. pinastris* L. Koch, *Oxyopes heterophthalmus* Latreille and *Araniella opistographa* (Kulczynski) (Bogya et al., 1999/b).

The most abundant staphylinid species on the ground surface in the orchards were: *Omalium caesum* Gravenhorst, *Sphenoma abdominale* Mannerheim, *Drusilla canaliculata* (Fabricius), *Palporus nitidulus* (Fabricius), and *Dexiogyia corticina* (Erichson) (Balog and Markó, 2006). The most common carabids were: *Pseudoophonus rufipes* (DeGeer), *Harpalus distinguendus* (Duftschmid), *H. tardus* (Panzer), *Anisodactylus binotatus* (Fabricius), *Calathus erratus* (Sahlberg) (Kutasi et al., 2004).

Neither the species number nor the population density of predator and parasitoid species are enough to prevent the increase of the population density of *A. pomi*, *D. devec-ta*, *D. perniciosus*, *M. melolontha*, *S. myopaeformis*, *C. pomonella*, *A. orana*, *H. testudinea*. Consequently, in addition to the regular application of IGR insecticides the use of selective aphicide and broad-spectrum insecticides from time to time is unavoidable.

Conclusions

To appreciate the reasons of the changes in arthropod population communities occurring in the apple orchards, the interrelationships among the population communities and the impact of these processes provide significant contribution to the conception regarding the agro-ecosystem of Szelényi (1957) and Jermy (1977), that is

- every structural element of the biocenosis is found both in the undisturbed and in the agro-biocenoses,
- by the agricultural activity of man the land will be changed radically but the original agro-ecosystem under no circumstances does it become independent from the original countryside,
- in the agro-ecosystem the producent element, the cultivated plant, will be determined, and modified by man, and the succession of the vegetation will be continuously prevented,
- according to protection of the crops insecticides and acaricides are used, that endanger the natural regulating effect of the population dynamics in the agro-ecosystem.

According the available data approximately 2500 arthropod species immigrate, or is carried by wind, or introduced by man in the Hungarian apple orchards (Mészáros et al., 1984; Markó et al., 1995; Bogya et al., 1999a, 1999b; Balog et al., 2003; Kutasi et al., 2004). However, the number of the apple pest species is approximately 30 (Jablonowsky, 1912; Ubrizsy and Reichart, 1958; Balás, 1966; Szentkirályi and Kozár, 1999).

Summarizing the data of the observations and the experiences of the eco-faunistic surveys and controlled experiments, carried out in Hungarian apple orchards we established.

Owing to the effect of the interrelationship among the plant – phytophagous – zoophagous populations, those species could colonize the orchard and the population density of those species could increase for which the apple provides suitable food sources and whose populations are not regulated or are regulated only by a weak efficiency by parasitoids and predators. These populations form the *primary pest communities*, in which the dominant populations are the *Eriosoma lanigerum*, *Aphis pomi*, *Dysaphis devector*, *D. plantaginea*, *Diaspidiotus perniciosus*, *Melolontha melolontha*, *Anthonomus pomorum*, *Archips rosana*, *Hedya nubiferana*, *Spilonota ocellana*, *Pandemis heparana*, *P. ribeana*, *Adoxophyes orana*, *Cydia pomonella* and *H. testudinea*.

By the application of broad-spectrum insecticides against the populations of the primary pest communities, the population density of the predator and parasitoid species will be reduced to a minimum level. Consequently the population density of some phytophagous arthropod species could increase for which the apple provides suitable breeding plant, but their population density was restricted up to that time. In this case the *secondary pest communities* could develop, in which the dominant populations are the leaf miner species (*Phyllonoricter blancardella*, *Ph. corylifoliella*, *Leucoptera malifoliella*, the spider mite species, *Panonychus ulmi* and *Tetranychus urticae* in the Hungarian apple orchards.

The increase of the population density of some arthropod species could be caused by agrotechnical management too. The larvae of apple clearwing moth (*Synanthedon myopaeformis*) appeared in great number in the crown of apple trees where according to

the drastic pruning the butterfly finds suitable places for laying eggs in the numerous large cutting wounds.

Since the selective insecticides, above all the IGR compounds, are effective against the miner moth species, while they are harmless to the beneficial arthropods, following their regular application the populations of *Ph. blancardella*, *Ph. corylifoliella* and *L. malifoliella* collapse in two-three years. At the same time, the predatory mites: the stigmaeid (*Zetzellia mali*) and the phytoseiid (*Euseiulus finlandicus*) mites colonize the orchards and develop Acarina population communities in which phytophagous and zoophagous species, in great species and in low individual number occur. This is the same population community which exists on the abandoned or untreated apple trees. In this situation the increase of the population density of a phytophagous acarina species is not possible.

Consequently the application of the integrated plant protection method the difficulties caused by the use of broad-spectrum insecticides, namely, the high population density of leaf miner moth and spider mite species, will be solved. The population density of the pest species of the *secondary pest communities* decreased to a minimum level, or their specimens disappeared. However the species belonging to the *primary pest communities* continuously are present, or could colonize again the apple orchards. In order to prevent the increase of their population density, besides of the application of IGR and other selective insecticides, the use of some broad-spectrum insecticides is unavoidable.

The integrated pest management provides the possibilities to reduce mainly the population density of the species of the *secondary pest communities*, to solve the problems caused by the regular use of broad-spectrum insecticides. The real requirement is in the development of the environmental-friendly protection of the orchards, to find and harmonize methods against the species of the *primary pest communities*, without endangering the parasitoids and predators of the *second pest communities*.

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