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RESEARCH ARTICLE

The importance of biological vision in the control of plant pests*

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Abstract – Animal populations living on one or more plants, as well as the parasitic and predatory populations built around them, and those living from the carcass, waste, and other populations of all these plants constitute a life-changer held together by specific laws. It is therefore essential that the ratio between plant protection products, on the one hand, and entomological ecological research, on the other hand, should very soon change. Only agrocoenologists are capable to carry out the research task, which is very closely related to plant protection already that examines the immediate and more distant effects of the broad variety of protection methods, particularly those by chemical control. We allude to the agronomist, familiar with biology and not changing his farmland exceedingly often; who can gradually, year after year, compile the building blocks of experience; who can keep an eye on the major alterations in wildlife upon the anthropogenic activities that transform nature; who can record changes in the bulk of pests, their disappearance and reemergence; and who could observe the impacts of plant protection work with a critical eye. We must strive to find processes based on biological-ecological research, practically pest by pest, that allow the greatest use of natural limiting factors by restraining chemical treatments to the narrowest and most appropriate schedule. In our article, we describe some methods and principles of the implementation of a biological approach and ecological plant protection.

Keywords – ecology, coenology, ecological plant protection, chemical control, side effects, degradation, resistance, parasitoid conservation, environmentally friendly principles

* As a tribute to the late Barnabás Nagy (1921-2020), a pioneer researcher in the development of the principles of sustainable plant protection strategies in Hungary. This paper is academic translation by Béla Darvas and András Székács of one of Nagy's original works, that appeared in 1957 in Hungarian in the periodical *A növényvédelem időszerű kérdései* [*Current issues in plant protection*]. Citation of the original publication: Nagy, B. (1957): A biológiai látásmód fontossága a növények kártevői elleni védekezésben [The importance of biological vision in plant protection against pests]. *A növényvédelem időszerű kérdései* [Current issues in plant protection], **2**, 1-10 [in Hungarian]. Béla Darvas and András Székács also edited (including the addition of an abstract and keywords), annotated (see footnotes), and formatted the references, subchapter division, and the page layout of this publication to meet the formal requirement of *Ecocycles*.

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INTRODUCTION

In the fight against animal pests, plant protection could only be limited in the past and even today to the destruction of established gradations, and mass reproduction of insects. Yet, even this attempt failed numerous times. It is clear that we must strive in the future to avert gradations from unfolding, so we must aim to prevent gradations. Chemical means are usually the most suitable for the rapid destruction of established gradations, but preventing the gradation of harmful insects is almost entirely an ecological problem. If we accept the above reasoning, this implies that chemical processes should play a much smaller role in this area in the future. In essence, these ideas also dominate the major study by Rubtsov on the possibilities of biological control, published in 1950 (Rubtsov, 1950). Given today's technical progress and advances by the pesticide industry, the above may occur a little strange. The situation today (and we cannot expect a rapid change in it even in the near future) is that new insecticides are appearing on the world market almost on a day-to-day basis, and research for specificalities further expands the number of the pesticides available for usage.

Animal populations living on one or more plants, as well as the parasitoid[1] and predatory populations built around them, and the populations feeding on the carcasses and wastes of the former, together with other populations, form a life association or biocoenosis held together by a specific principle. Should be given biocenoses and, more particularly, mainly the abiotic and biotic factors influencing the quantitative and qualitative conditions of pest populations in them be explored by ecological and coenological studies, we believe we would be able to make propositions for the most important and decisive measures to be taken to prevent gradations. In that work, however, according to our distant ideas, chemical methods would play a much smaller role than they do today. But to get there, much more intensive, in-depth ecological research is required not only on pest populations but also on the populations of other, indifferent or even beneficial animals mentioned above, playing a major role in building biocoenoses. Thus, the relative proportions of pesticide development, on the one hand, and entomological ecological research, on the other hand, must change in the near future. Given that it would not be appropriate at all to hold pesticide research back, moreover, as will be seen below, certain requirements even need further strengthening of this area as well; therefore, insect ecology and gradation research will have to increase in quantity and deepen in quality.

DETRIMENTAL SIDE-EFFECTS OF PESTICIDE APPLICATIONS

The harmful consequences of both normal and excessive chemical control are generally known, so we only briefly draw attention to them here. The fact that chemical treatment has to be frequently repeated to maintain adequate protection, and that it is therefore rather costly due to the expensive investment demand in the machinery involved is not yet an especially severe argument, because we do not know how much more economic the biological, ecological protection methods to be planned or at least process involving more biological momentum or considerations will be.

A much more serious disadvantage is that in the case of several insecticides having been used continuously and for several years, newer, previously unknown or only insignificant pests may multiply to become a substantial damage factor. Such a situation generally emerges because the pesticide used greatly degrades the predator and parasite populations that have previously effectively restrained that particular barely significant pest animal. Lord (1949) and Pickel (1948, 1949) were among the first ones to show that a harmful growth of mite populations appeared upon regular applications of DDT used against the apple moth in North America. In this case, no matter how effective DDT proved to be against the apple moth, the apple trees in Nova Scotia only switched pests at the cost of the attempted control measure. It is not impossible that the threat of mites on our apple trees in recent years can be traced back to the same reasons. Numerous additional examples could be mentioned from similar cases in lemon groves, yet given that these are a bit far from us, we only mention that 6 scale insect species, 2 mite species and 1 leaf roll moth species, in addition to aphids, have been added to the list of new pests in California and Florida emerging due to the use of DDT. In addition, Newcomer *et al*. (1946) also blame DDT for the proliferation of the woolly aphid. In recent years, such suspicion has also emerged in Hungary due to the strong proliferation of the woolly aphid, but no one has been able so far to accurately investigate this phenomenon. It is probable that the more humid climate characteristics during recent years, in addition to the decline in the actual number of individuals of the woolly aphid parasite *Aphelinus mali* due to the use of contact poisons, have also contributed to the proliferation of this aphid.

The above examples are mostly remote, American cases, although pests native to us as well are mentioned in several of them. It is no coincidence that these cases became first known in the United States of America because facilitating conditions for the emergence of such examples are fostered mostly by modern large-scale monoculture farming combined with extensive advertising campaigns of insecticides by competing large chemical manufacturers. This, however, does not mean that we should not face similar problems in the future in agricultural areas cultivated under planned economy management, despite the more cautious use of contact poisons.

An additional source of hazard not to be underestimated is represented by pesticides toxic to humans and domestic animals. The onset of contact poisons partially alleviated the situation (e.g., for DDT and HCH [lindane]) and partly exacerbated the situation (e.g., parathion). One can say along with Paracelsus, that "all things are poison, and … solely the dose determines that a thing is not a poison". In this regard, the package labels of contact poisons, mostly claiming harmlessness to warm-blooded organisms, should be taken more seriously. Perhaps too little time has passed before we could learn about the more distant indirect effects of contact toxicants, especially those that left factory laboratories or certification authorities in the past or just recently. We know at most some of the direct effects of

[1] In the original version, Nagy used the term "parasite" according to the terminology of that time. To comply with the current biological definition, this term has been changed to parasitoid throughout the text.

these agents, but hardly the indirect ones. For the time being, the latter only come to our attention by accident. Thus, for example, the treatment of a forest with contact poisons did not cause any direct damage to fish in the countryside: the very large decline in fish stocks in the following months and years could, however, be attributed to the severe mortality among aquatic insects caused by contact poisons leaching from the forest into the waters in the area (Bruns, 1955).

We particularly mention the problem of bees in connection with contact poisons. Detailed data are not available to us on the extent to which the general use of contact poisons has led to a reduction in beekeeping, and we are even less able to assess the flower pollination deficits related to the reduction in the number of bees and apiaries. Regarding the latter, certain unpleasant experiences have appeared already in the North American United States. As for Hungary, increases in direct damages due to careless or previously unannounced pesticide applications have been reported so far. According to a letter correspondence by Ferenc Bakk,[2] only in 23 cases the death of bees in Hungary were suspected to be caused by poisoning in 1954, and in 1955 the number of such reports increased to 154.

The last mentioned, but perhaps the biggest problem with pest control chemicals here is that insects become resistant to them. The development of resistance is based on the positive selection of individuals being more resistant to the agent. The development of resistance to DDT has been first observed in houseflies, but by now, it is known for a whole range of insect pests and is possible, in principle, for all insects. A particular difficulty in this regard is indicated by the finding that the cockroach[3], raised in the laboratory to become resistant to chlordane,[4] have been shown to be resistant to other organic contact agents, although to varying degrees (Butts and Davidson, 1955). The problem of resistance itself is an important area to be researched in both ecology and physiology because without such research results, we cannot express a scientifically sound opinion on important defense issues.

In addition to the major shortcomings of the chemical control methods listed above, it is an undoubted fact that rapid and dazzling results have sometimes been achieved against numerous hazardous insect pests, examples of which being unnecessary to be given here. As useful this rapid, visible result, on the one hand, as less fortunate effects it may exert on less educated people in biology and entomology, for whom the problem of pest control is merely a technical and agrochemical question. To illustrate to what extent this position is incorrect, we cite, based on the reference to him by Solomon (1955), the excellent insect ecologist, Uvarov,[5] who explains the increasing American incidence of locust invasions by the rapid, unplanned, and unscientific land utilization; perceives locust research in the North American United States and Canada as being ruled – in his opinion – by need: research institutes have to promise immediate practical results to secure their budgets year after year, while the funds available to solve the scientific – and therefore fundamental – issue of the locust problem are unfortunately insufficient. It is sad to see, Uvarov adds finally, that almost the entire research team is involved on a weekly basis in testing new insecticides in field experiments… We should be careful not to fall into a similar mistake!

DESIRABLE DIRECTIONS OF RESEARCH IN PESTICIDE CHEMISTRY

As much as we allude here, with our own words and with those quoted from others to the inadequacy of insect ecology research, we must also point out desirable directions in pesticide chemistry in a few words. We have solutions in mind primarily that make only the extermination of the pests possible. These specifics may be more or less selective e.g., toxaphene [camphechlor[6]], which does not damage bees, but physical solutions can also provide successful and viable routes e.g., those which encapsulate the particles of the toxicant in a harmless material and thus it can only harm the pests or e.g., the bait solution, which also spares parasite and predator insects from the direct effects of the toxicant.

Also born in recent years are the systemic insecticides (schradan, Pestox, Systox),[7] in the field of which we are still

[2] An esteemed apiarist expert in Hungary, who commenced mapping local bee species in Hungary and established formal apiary education in 1959/60 at the University of Veterinary Science at Budapest.
[not specified in the original manuscript as an exact citation]

[3] The German cockroach (*Blatella germanica*) in the family Blattidae.

[4] Among chlorinated hydrocarbon insecticides, chlordane has not been distributed in Hungary – see Kardos, C., Darvas, B. (2014): Pesticide active ingredients in Hungary.´ I. Insecticides and acaricides. Biokontroll, 5 (2), 49-62. http://www.ecotox.hu/biokontroll/journal/nr/114_2/bK0502.pdf (Accessed 12 May 2022)

[5] Uvarov, B. (1947): The grasshopper problem in North America. *Nature*, **160**: 857-859.
DOI: 10.1038/160857a0
[not specified in the original manuscript as an exact citation]

[6] Later named camphechlor to refer to the chemical structure of the mixture of chlorinated camphanes.

[7] Of these organophosphate esters mentioned, schradan is an insecticide active ingredient, while Pestox and Systox are formulated insecticide products. Schradan (originally named OMPA – octamethylpyrophosphoramide, and later renamed to schradan as a tribute to its inventor, and "father of the organophosphate insecticides", Gerhard Schrader) became known as the active ingredient, used for a short time in formulated products Pestox, Pestox III, and Systam, while the formulated insecticide Sytox (active ingredient: demeton-S-methyl) was only marketed until 1981 – see: Tomlin, C.D.S. (Ed), (1997): The Pesticide Manual, 11th

looking forward to quite much from chemical research. These compounds, which become systemically absorbed into the plant body through the root or leaf and stored there for a longer or shorter period, would also possess the generally claimed advantage of not exerting harm to parasitoid and predatory insects, but exact studies discussing this problem in an ecology-coenology aspect hardly exist. That is to say, we do not yet know, in most cases, the extent and range of the mildness of these agents to parasites and predators. Namely, it is assumable that if, for example, predator or parasitoid imagoes may partially escape or do not die on trees treated with systemic agents, their further reproduction may become questionable if they lay their eggs into poisoned host animals. Although Ripper *et al.* (1949; 1950) claim that ladybug[8] adults and hover fly[9] larvae survive on trees treated with schradan, recent studies by Ahmed et al. (1954; 1955) regarding beneficial insects confirmed the increased hazards of Systox relative to schradan. The above results undoubtedly indicate that systemic insecticides represent a viable way due to being less detrimental to beneficial insects, but also reveal that the related insect ecology and population dynamics studies need to be completed, or rather commenced in Hungary.

Once insects have become resistant, the problem of control can be approached from a chemical and a biological aspect, apart from the “rat race” against newer agents. From a chemical aspect, the pursuit of synergistic effects or the selection of different effective active agents both represent cases of symptomatic treatments. A fundamental approach to the problem can be anticipated here also from the biological aspect. It needs to be researched, which are the physiological processes that promote and ensure the development of resistance. Knowing these, their disruption or avoidance may also become possible.

THE ROLE OF THE BIOLOGICAL ASPECT IN PLANT PROTECTION

So far, we have touched on the disadvantages of chemical plant protection, as well as the requirements that should be the main focus of research to modernize chemical control. In what follows, we turn to the theoretical and practical requirements that would allow biological insight to become more prevalent in pest control and, consequently, to implement more rational, effective, and less costly control methods. A sharp distinction cannot be made, of course, between theoretical and practical tasks or solutions because, as we will see below, the proposed practical ideas also presuppose or entail theoretical (ecological) studies. In addition, we also touch on some organizational issues that cannot be silently passed by when observing pest control issues in their context.

As for the theoretical aspect, the widest possible introduction and implementation of the coenosis approach, praised on several occasions by Szelényi (1955a; 1955b) and Ubrizsy (1954), is of the greatest significance. Very fortunate conditions would help us in Hungary to open an internationally recognized, modern research direction in this field. Balogh's (1958) textbook titled Zoocoenology is a first step, also in an international context, which has collected the results and useful methods that emerged mainly from the study of natural biocoenoses. At the Department of Zoology of the Plant Protection Institute, Szelényi (1955a; 1955b´) and Jermy (1956) paved the way, mainly by the theoretical establishment of agrobiocoenosis research, for this new and fundamental research direction, one of the main goals of which being the quest for the elucidation the quantitative and qualitative interactions of populations that live together in one place in agrocoenoses, being related to each other mainly along food chains, in close association with operational plants and the weeds among them.

Only agrocoenologists are capable to carry out the research task, which is very closely related to plant protection already that examines the immediate and more distant effects of the broad variety of protection methods, particularly those by chemical control. In this context, we need to answer the questions about the quantitative and qualitative changes in the different animal populations, but not only the pest populations, in the protected crop culture; what recovery phases of the zoocoenosis undergo after the direct effect; and what conditions are perpetuated in a zoocoenosis upon the ongoing chemical treatments e.g., in an orchard. These are incredibly interesting and, from the aspect of plant protection, fundamental research tasks that have to be solved by Hungarian researchers here on the Hungarian land, in the orchards of the Nyírség, and on the cereal fields of the Great Hungarian Plain.

Based on the extension of the ecological approach and the more intensive insect ecological research, we can hope for new and apparently bold control methods. We do not intend to discuss the possibilities of biological control here; this can be found in the study of Rubtsov (1950) or the Hungarian literature by Jermy (1955a) and Ubrizsy (1954). Pest control procedures using antibiotics or various vibrations and radiations are still largely in the experimental stages. Of the latter, however, we must highlight the first attempt to use nuclear (gamma) irradiation to control the fly *Cochliomyia hominivorax*,[10] a causative agent of a very

edition, British Crop Protection Council. Farnham, Surrey, UK

Kardos, C., Darvas, B. (2014): Pesticide active ingredients in Hungary.´ I. Insecticides and acaricides. Biokontroll, 5 (2), 49-62. http://www.ecotox.hu/biokontroll/journal/nr/114_2/bK0502.pdf (Accessed 12 May 2022)

[8] or the seven-spotted ladybird (*Coccinella septempunctata*) in the family Coccinellidae

[9] or flower fly in the family Syrphidae

[10] The New World screw-worm fly in the family Calliphoridae, a parasitic fly, the cause of myasis. In the

serious disease to humans, on the 170 square mile[11] island of Curaçao (Knipling, 1955). Based on the preliminary experiments of Bushland and Hopkins (1951; 1953) and then under their guidance, millions of the males of the said fly sterilized by gamma irradiation, previously cultured and irradiated in a laboratory, were released from an aircraft over the said island. Although the females mating with these sterile males laid eggs, no larvae hatched from those eggs. Researchers concluded that this hazardous fly can be counteracted not only on the island of Curaçao but also in several other endangered continental areas.

Before discussing practical approaches to the biological approach, we need to refer to the barriers to applied insect ecology research that stem from pseudo-economic rhetoric or superficiality. Neither their organizational difficulties nor the risk of a few hundred kilograms of fruits or other crops should be an obstacle to our researchers to carry out their bolder experiments. To carry out pest control experiments on the farm and to ensure the continuous monitoring of pests in the open field, it would be necessary to have farms cultivating all kinds of operational crops, in which the experimental aspects of plant protection would be the main focus and these aspects could be fully enforced. In these farms, of course, a strict and segregated order should be maintained, especially for chemical control experiments, to avoid the possibility that no negative control experiment could be set after all, as mentioned by Solomon (1955) because the residual effect of pesticides can often take years long.

Our researchers are able to more and more often visit related institutions in neighbouring and even in distant countries and can give accounts on the mistakes they observed, or above all on the organizational and managerial conditions, more modern equipment, research methods making more effective progress possible, better support of the research activities, that sometimes may be more advanced than ours, and the partial introduction of which here would perhaps not cause foreigners blaming us that we imitate them. It is too convenient and perhaps irresponsible to trivialize these things that have been seen abroad and are also considered good examples at home, to devote nothing or too little for their acquisition and introduction, and to entrust everything to that sacrificial, virtuous Hungarian research spirit.

After mentioning these organizational shortcomings that may appear as a digression, but can be considered to some extent as a bagatellization and negligence of the biological approach, we would like to point out the role of local conditions and endowments in pest control. All production cooperatives, state, experimental and forestry farms of ours are located on vast areas of land, encompassing specific, individual pieces of given landscape types. Thus, almost every state farm has its own natural history. Due to their landscape, soil, location, and hydrography, each is predestined for more favourable cultivation possibilities of certain crops (e.g., the onion region of Makó, the vineyards of Hegyalja, the apples of Nyírség, etc.). These agricultural crops that can be cultivated with different results in different regions not only allow the development of specific gradocoenoses, but also the barren lands, tree belts, pastures, wetland meadows, grasslands, forests, streams and rivers enclaved among cultivated fields, with their own specific fauna should be identified from region to region, in each state farm, and have to be considered from the aspect of pest control. Damage by the tussock moth[12] threatens farms only from the neighbourhood of meadows, the Moroccan locust[13] devastates regions of saline pastures, and the refugee areas of the winter months can be found in the nearby deciduous forests.

We allude to the agronomist, familiar with biology and not changing his farmland exceedingly often; who can gradually, year after year, compile the building blocks of experience; who can keep an eye on the major alterations in wildlife upon the anthropogenic activities that transform nature; who can record changes in the bulk of pests, their disappearance and reemergence; and who could observe the impacts of plant protection work with a critical eye. In all this work, one could, of course, find an effective consultant and manager specialists among the experts of the Plant Protection Institute.[14] After taking the initial steps, the work could obviously be deepened only if the interest of agronomists in this direction were supported by appropriate short courses and textbooks. Related and similarly oriented activities of agronomists from neighboring farms on roughly similar landscapes could, of course, be combined, which would substantially improve the level of the nature exploratory work via exchange of experience and on the basis of the concept of “joint thinking pays”. Agronomists of plant protection stations could also play a leading role in these local landscape-based plant protection surveys.

These monitoring and testing “units” encompassing individual or several farms, possibly communities could contribute to the widening and local precisioning of the bases of the foundations of insect prognoses. It is quite obvious that all enthusiastic and capable volunteers (biology

original version, Nagy used the species name *Calitroga hominivorax*.

[11] approx. 440 km^2

[12] *Penthophera morio* species in the family Erebidae

[13] *Dociostaurus maroccanus* in the family Acrididae

[14] Nagy is referring to the Plant Protection Institute in Budapest, Hungary, the research institute in which he has spent his almost entire professional career. At the time of the writing of the article, the institute belonged to the Ministry of Agriculture and Food Industry, it joined the research institute network of the Hungarian Academy of Sciences (HAS) in 1982, it became a member of the Centre for Agricultural Research of HAS in 2012, and of the the Eötvös Loránd Research Network in 2019. See also: Komives, T., Király, Z. (2019): Cultural heritage – the first research campus in Hungary. Ecocycles, 5 (2): 6-11. DOI: 10.19040/ecocycles.v5i2.145

lecturers of universities, colleges, techniques, high schools, as well as teachers, foresters, and other habitants of the area who know and willingly care about nature) could be involved in such landscape-biogeographical exploratory work.

Thus, specific plant protection problems of given smaller areas would be gathered over the years from the work of the experts of research institutes, agronomists, and local helpers, which would make it possible to experiment and develop crop protection modules more or less different from the template, the official country-specific control procedures, yet much more expedient and compatible with local circumstances. Local diversification and differentiation of crop protection experience in pest management to smaller landscape regions by expertise on the pests would allow favourable possibilities for the greater implication of the biological approach in plant protection practices.

Given methods and principles of the implication of the biological approach and ecological plant protection are described below.

PRACTICAL EXAMPLES OF FIELD APPLICATIONS

Separative treatments lead to better and more economical protection. Pest control using separation in time or space is possible or necessary in the case of different plant species occurring in parallel, as well as in the case of spatial accumulation of a pest. Thus e.g., control steps against the plum sawflies[15] would have been easier to be carried out at the same time for organizational and technical reasons in a plum orchard in Újfehértó, yet, the flowering biology of plum cultivars and consequently differing periods of infection justified two separate dates of spray application. In another case, in the orchard of Dolinapuszta in Pomáz, larger-scale accumulation and infestation by the apple blossom weevil[16] was observed on the apple trees near the forest, while their damage was negligible in the rest of the orchard. In this and similar cases, only the edges near the forest had to be protected by spraying, which, given the vast extent of this orchard, meant quite substantial savings in material and labour. Exploration of the distribution of infection by cultivars also results in benefits. Thus e.g., a highly strong infestation by the apple sawfly[17] appeared on the Canadian ranet[18] and Easter rosemary apple varieties in 1954-1955 in a larger orchard at Parádfürdő, while the infestation of the other major varieties was negligible. In this case, protection had to be focused on the former apple varieties only.

Related to the above procedure, to some extent, is the approach of leaving certain *refugium* zones for parasitoids and predators in the protected culture or area. These areas of refuge, as also pointed out by Dowden [1952] in relation to forest pests, are smaller patches of the field to be protected, where the parasite and predator population is particularly significant and from which its *obstant* populations (as termed by Szelényi[19]) may re-emerge after the effect of the chemical has worn off. Such view considerations were aroused in us by the study of the destructive *Chloridea*[20] populations in the Kiskunmajsa area in 1954. While the *Chloridea* caterpillar populations examined in several places in the Danube–Tisza Interfluve region were almost completely free of scavenger fly infestation, in this area, 50-70% of the developed *Chloridea* caterpillars carried *Tachina* eggs on their bodies. Contact poison treatment of such a heavily parasitized caterpillar population would, in our opinion, have caused more harm than good: it would not have reduced the damage any further to the melilot, but it would have much more injured the parasitoid flies.

Leaving the above-mentioned refuge areas within the areas treated with chemicals would therefore allow the parasite population to be rescued. Increasing the efficacy of natural limiting factors could be supported by biology-based initiatives not requiring any rather expensive equipment and by .rational organization. It is not necessary to think of a large parasitoid wasp breeding farm right away when biological control is mentioned. Such a method, not requiring any particular investment, is suggested by Ullyett (1947) and Biliotti (1952) for the control of the diamondback moth[21] and the black arches and pine processionary moths,[22] respectively. Both merely emphasize the correct choice of the timing of control, a circumstance that contributes in itself significantly to the conservation of the *obstant* populations and their more complete impact onset. Susoev (1953) developed a detailed, gentle spray-

[15] The plum sawfly (*Hoplocampa flava*) and the plum fruit sawfly (*Hoplocampa minuta*) species in the family Tenthredinidae

[16] *Anthonomus pomorum* species in the family Curculionidae

[17] or European apple sawfly (*Hoplocampa testudinea*) in the family Tenthredinidae

[18] also known as ranett, renet (from *reinette* in French and *renette* in German)

[19] Szelényi, G. (1956): Az agrozoocönológia alapvonalai [The outline of agrozoocoenology]. Szelényi G. Emlékalapítvány, Budapest. pp. 1-287. Publ. 2015. [in Hungarian] ISBN: 9789631237252 https://books.google.hu/books/about/Az_agrozooc%C3%B6nol%C3%B3gia_alapvonalai.html?id=MB4CtAEACAAJ&redir_esc=y (Accessed 12 May 2022)
Nagy very well know this book from its manuscript, but could not cite it, as it has remained a manuscript for nearly six decades before being published by the Foundation established to foster the memory of the late Gusztáv Szelényi.

[20] *Heliothis* species in the family Noctuidae, a polyphagous pest that caused damage in the given case on yellow melilot.

[21] *Plutella xylostella* in the family Plutellidae

[22] *Lymantria monacha* and *Thaumetopoea processionea* (in the families of Erebidae and Notodontidae, repectively

dusting system for the protection of *Cryptolaemus*,[23] a useful predator of the mealybugs. This is why we emphasize the need for the treatments, either mechanical or chemical, in the control of the fall webworm[24] to be carried out in the first third of the caterpillar's lifecycle, because this way we not only achieve greater caterpillar mortality but also promote the protection of its parasites; for the essential parasitic function falls into the late caterpillar and pupal stages. Parasitoid protection in the control of *Hyphantria* could similarly be extended by the retention of the emerging moths with a 3 mm mesh wire net, which allows parasites to be released (Nagy, 1953). We must strive to find processes based on biological-ecological research, practically pest by pest, that allow the greatest use of natural limiting factors by restraining chemical treatments to the narrowest and most appropriate schedule. In our article, we describe some methods and principles of the implementation of a biological approach and ecological plant protection.

Finally, we end our message with a statement in Solomon's repeatedly quoted article that entomologists must commit everything they can to spread and raise awareness that pest control is primarily an ecological problem and that control methods must be based on a biological approach; only in this way, we can develop plant protection from its current empirical stage into real science.

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[23] members of the family Coccinellidae
[24] *Hyphantria cunea* in the family Erebidae
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