

In some locations, *Grapholita funebrana* and *G. molesta* reduce the yield of plums and peaches by about 60% to 70%, in the absence of chemical controls. Although parasites (*Ascogaster*) do play a role in reducing the numbers of the pests, their beneficial effect is reduced as a result of extensive use of nonselective pesticides, and at present control by the parasites does not exceed 5%. Good results in controlling these pests are obtained by use of entobacterin-3 and its mixture with a lower concentration of Sevin (1% + 0.02%): such chemical treatments as 50% Cidial, 50% Mesurool [methiocarb], 35% phosalone (Zolone), and 75% chlorophos (Dipterex) are also used with good results. The combined mixture of entobacterin and Sevin has demonstrated no noticeable negative action on parasites and predators. Because of this, entobacterin with Sevin can be included in a system of integrated control.

A promising approach to the control of fruit moths is the application of pheromones for their disorientation, the successful testing of which is being conducted in Georgia. Positive results have been obtained from funemone (Cis-8-dodecenylacetate, 3-5% trans-isomer) used for the control of *Grapholita funebrana*, and from orfamone (92% Cis-8-dodecenylacetate, 7-8% trans-8-dodecenylacetate and dodecenol) used for the control of *G.*

molesta.

On the basis of the above discussion, the integrated system of control developed in Georgia can be said to include such measures as: the use of such farming practices as the turning of soil which destroys overwintering pests (*Grapholita funebrana*, *Lycia hirtaria* and others); pruning of the annual growth increment which reduces the number of overwintering aphid eggs by about 30%; collection of winter nests and eggs of *Euproctis chrysorrhoea*, *Aporia crataegi* (L.), *Malacosoma neustria* (L.) and *Lymantria dispar* for rearing of their parasites for subsequent release in fruit orchards; placement of trapping bands (without pesticides) to provide warning for establishment of dates for control of fruit moths; application of the microbiological preparations entobacterin and dendrobacillin for the control of leaf-feeding insects, as well as their mixture with sublethal concentrations of chemicals for control of fruit moths; application of the comparatively selective pesticide Sayfos for the control of sucking pests; and use of pheromones for disruption of the normal behavior of fruit moths; etc.

The good performance of such measures reliably protects fruit trees from harmful organisms without disturbing fruit orchard biocenoses and without polluting the environment.

The Use of Biological Methods for Control of Pests of Fruit Crops in Armenia

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Fruit farming is one of the major agricultural industries in the Armenian S.S.R. The presence of a number of altitudinal zones and the great variety of fruit crops predetermines an abundant variety of pests. Fruit crops in the Republic are mainly damaged by: *Cydia* (= *Laspeyresia pomonella* (L.))¹, *C.* (= *L.*) *pyrivora* (Danil.), *Grapholita* (= *Grapholitha funebrana* Treitschke, *G. molesta* (Bucsk), *Yponomeuta* (= *Hyponomeuta malinella* Zeller, *Y. padella* (L.), and *Hoplocampa testudinea* (Klug). In addition to these, some damage is caused to fruit crops by some species of phytophagous mites and scale insects. In the absence of any control, or with unsatisfactory control of *C. pomonella* and *G. molesta*, damage to fruit varies between 80% and 100%. Effective control of all the above-mentioned pest insects in the Armenian S.S.R. is carried out by the application of chemical preparations.

Considering the well-known negative effects of the chemical method of control conducted at present against fruit crop pests, the Armenian Scientific-Research Institute of Plant Protection has developed biological methods of control and extensively applied these methods in farming practices with a high degree of effectiveness. In particular, different preparation forms of entobacterin, dendrobacillin and BIP [B.I.P.-837]² are highly effective for the control of the major leaf-feeding pests, such as *Yponomeuta malinella*, *Y. padella*, *Malacosoma neustria* (L.), *Lymantria* (= *Ocneria*) *dispar* (L.), *Euproctis chrysorrhoea* (L.) and others.

For a number of years, cooperative studies on the isolation, selection, testing and application of new entomocidal bacteria have been conducted between the Institute of Microbiology of the Armenian S.S.R. Academy of Sciences, the Institute of Plant Protection of the Armenian S.S.R. Ministry of Agriculture and the Armenian Branch of the All-Union Scientific-Research Institute of

Hygiene and Toxicology of the U.S.S.R. Ministry of Health. A complex of scientific and experimental-industrial studies have been conducted on microbiology, entomology, toxicology and technology, and cultures of a new variety of bacterial preparation originating in the Caucasus,³ which has been named BIP, have been developed. As a result of laboratory and extensive field experiments, the virulence, specificity and range of entomopathogenic action have been established, and the technology for application has been developed for the new bacterial preparation in the Republic.

The toxicity of BIP preparations, entobacterin, dendrobacillin, insectin and various preparation forms of entobacterin has been determined. A 100% mortality of caterpillars of *Yponomeuta malinella*, *Y. padella* and *Malacosoma neustria*, with symptoms of toxicosis, occurs on the third or fourth day after treatment with suspensions of the preparations in a concentration of 0.5%. Caterpillars of *Euproctis chrysorrhoea* and *Lymantria dispar* are also sensitive to bacterial preparations. However, the period prior to mortality is extended, near total mortality (93% to 100%) occurring within 12-15 days due to septicemia. Caterpillars of *Cydia pomonella* are also susceptible to bacterial preparations. However, because of their hidden mode of life, the effectiveness of bacterial preparations used against this species is low in field experiments.

The effectiveness of the bacterial preparations studied for the control of *Yponomeuta malinella*, *Y. padella* and *Malacosoma neustria* on apple and apricot trees is high—97% to 100%. When treated with bacterial preparations, the leaves of these crops retain insecticidal properties for 20 days. For the suppression of these pests, a single application of bacterial preparations at the rate of 3.5 to 4.5 kilograms per hectare (700-900 liters per hectare) is sufficient.

It has been established that in a fruit orchard protection system, the combined application of BIP preparations and entobacterin with Sayfos (70% wettable powder) and a 20% kelthane concentrate, can control aphids and mites. Also, when BIP preparations are applied together with Bordeaux mixture, their pathogenic properties are not decreased.

¹Editor's Note: See Proceedings' Preface for notes on scientific names used in this and other papers by Soviet authors.

²Editor's note added in bracket; see Proceedings' Preface for notes on pesticide names used in this and other papers by Soviet authors.

³Editor's Note: "*Bacillus thuringiensis* var. *caucasicus*," teste A. I. Smetnik, personal communication, 1981.