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COCCIDS OF ECONOMIC IMPORTANCE AND THEIR CONTROL IN THE REPUBLIC OF GEORGIA

V.A. YASNOSH

Plant Protection Research Institute, Tbilisi, Republic of Georgia

ABSTRACT

The Republic of Georgia is divided by the Caucasus mountains into subtropical and drier regions. In citrus groves, where 18 species of coccids are recorded, the most harmful are *Lopholeucaspis japonica* (Cockerell), *Chrisomphalus dictyospermi* (Morgan), *Ceroplastes japonicus* Green and *C. sinensis* Del Guercio, whereas heavy infestations are caused locally by *Aonidiella citrina* (Coquillet), *Chloropulvinaria aurantii* (Cockerell) and *Ch, floccifera* (Westwood). Most of the other coccids are under good natural control. Sixteen species of entomophagous insects were introduced to improve biological control and several of them were established with good results. At present, a new integrated program of citrus pest control is being implemented. In tea plantations, *Ch. floccifera* is the most common species. It is followed by *L. japonica;* its infestation has decreased recently. The most harmful species on grapevine are *Planococcus ficus* (Signoret) and *Neopulvinaria inmtmerabilis* (Rathon), whereas others (about 10) have no economic importance. Against harmful coccids on grape, as well as on tea, only biological control measures (e.g. *Ciyptolaemus montrouzieri* Mulsant) are applied. About 30 pest species infest fruit trees, the most noxious being *Quadraspidiotus perniciosus* (Comstock), particularly in the eastern (dry) part of the country. *Parlatoria oleae* (Colvee) and *Epidiaspis leperii* (Signoret) are harmful, too. In coastal regions, damage is caused by *L. japonica, Pseudococcus afflnis* (Maskell), *Ceroplastes* spp. and others. About 10 coccid species are recorded on mulberry, but they have no economic significance. Recently, an infestation by *Pseudaulacaspis pentagona* (Targioni Tozzetti) was recorded near Batumi. The largest number of coccid species occurs on ornamental and urban plants. Control measures against pests were discussed. The complexes of natural enemies attacking coccids have been studied, in order to provide rational control measures.

KEY WORDS: Coccinea, harmfulness, biological control, chemical control, integrated control, Republic of Georgia.

Georgia, a relatively small mountainous country in the Caucasus, has a variety of landscape zones and a rich flora and fauna. It has a well developed horticulture, viticulture and tea-growing industry, and also grows citrus and other subtropical crops. The mountains divide the country into the western subtropical region, occupying the Black Sea coast and adjacent territory, and the eastern part with a drier climate.

Specific complexes of insect pests, including coccids, have formed over the years in the various zones of Georgia. About 60 species of coccids (Hadzibeyli, 1983) came to Georgia with

introduced plants, at the time when the littoral grounds were being brought under cultivation in the 19th century.

The spread of pest coccids without their natural enemies has always called for extensive application of classical biological control methods: introduction and use of beneficial insects and other biological agents. This was the principal line of biological control employed until recently. Twenty-five species of entomophagous insects were introduced into Georgia for the control of more than 20 species of coccids (Yasnosh, 1986). Successful results (complete or partial control) were obtained in more than 50% of the cases (14). Most programs were implemented in subtropical regions.

At present the study and utilization of the beneficial action of naturally occurring (native) populations of natural enemies is of great importance in integrated pest management programs.

The fauna of coccids and their natural enemies in eastern Georgia is formed predominantly by native speies and has evident connections with the arid regions of Central Asia.

Citrus. Among 25 harmful phytophagous insects and mites, 18 species of coccids are recorded. Recently, the more destructive are the armored scales, *Lopholeucaspis japonica* (Cockerell) and *Chrisomphalus dictyospermi* (Morgan), and the wax scales, *Ceroplastes japonicus* Green and *C. sinensis* Del Guercio. Locally, infestation is caused by *Aonidiella citrina* (Coquillett), the cottony scales, *Chloropulvinaria aurantii* (Cockerell) and *Ch. floccifera* (Westwood), and the mealybug *Pseudococcus affinis* (Maskell) (= *obscurus* Essig).

Most of the other citrus pests are generally under good natural control, if their balanced level with natural enemies is not being interfered with by pesticides (Yasnosh, 1986).

As a result of the introduction and acclimatization of bioagents, the damage caused by the following coccids was decreased: *Perycera purchasi* (Maskell) [predator — *Rodolia cardinalis* (Mulsant)]; *Pseudococcus calceolariae* Maskell (aphelinid parasitoid — *Coccophagus gurneyi* Compere); *P. affinis* (encyrtid parasitoid — *Pseudaphycus maculipennis* Mercet).

Recently, the density and damage of *L. japonica* has been significantly reduced due to the increase of the useful action of natural enemies and, among them, particularly to the new pathogenic fungus *Aschersonia* sp., earlier unknown in the Caucasus (Yasnosh and Tabatadze, 1994).

Integrated citrus pest control includes chemical, biological and agrotechnical measures and has the tendency to reduce pesticide application. Commonly four chemical treatments per year are sufficient to control the whole complex of noxious species and diseases in citrus groves. Combined application of mineral (petroleum) oil, phosphororganic insecticides and fungicides is being used. For biological control of mealybugs and of cottony and armored scales, the coccinellid predators *Cryptolaemus montrouzieri* Mulsant and *Lindorus lophanthae* Blaisd. are used. The beetles are propagated in biological laboratories.

At present a new integrated system of citrus pest control has been worked out by specialists of the Georgian Plant Protection Institute and is applied in the Adjaria region. It is based on the use of economic thresholds of pests and on criteria of efficiency of the natural enemy population to provide rational control measures. The implementation of this system allows to obviate one or two chemical treatments, above all — up to 80% — the amount of phosphororganic pesticides, which are most dangerous to the beneficial fauna.

To improve the biological control of *Ceroplastes japonicus* Green, the parasitoid *Microterys clauseni* Compere was successfully introduced from Japan.

Tea. Biological control only of pests in applied in Georgia. To control *Chloropulvinaria floccifera*, the main pest of tea, *Cryptolaemus* beetles are propagated and used. *Cryptolaemus*, introduced more than 50 years ago, has been established in some regions of the Black Sea coast, but because of the small numbers of the overwintering specimens, their economic importance is not high during the first half of the summer. The beetles are propagated in laboratories and released in the tea plantations during the period of oviposition of the pest (end of May–June), at a rate of 3000–5000 specimens per hectare. Pest density does not reach the economic threshold during the following 2–3 years. The second place as pest is occupied by *L. japonica* but the rate of infestation caused by this species has recently decreased.

Minor pests are *Aspidiotus destructor* Signoret and *Abgrallaspis cyanophilli* Signoret, against which *Lindorus* beetles are released.

Grapevine. About 10 scale insects are recorded. Among them *Planococcus ficus* (Signoret) and *Neopulvinaria innumerabilis* (Rathon) (= *N. imeritina* Hadzibeyli) are the dominant noxious species. To control them, *C. montrouzieri* is used. In the 1980s two parasitoids of mealybug (*Leptomastix dactylopii* Howard and *Leptomastidea abnormis* Girault) were reintroduced but they did not overwinter in Georgia. Their application against *P. affinis* by seasonal colonization in the humid regions of the sea coast (Abkhasia) allows to obviate one chemical treatment in the period when mealybugs injure the mature grapes (Loyk and Sanaja, 1986). The coccinellid *Nephus reunioni* was introduced from France for control of this pest but has not established itself. Its application by seasonal colonization is recommended for the dry eastern regions of Georgia, where the *Chryptolaemus* beetle is less effective (Orlinsky and Izhevsky, 1987).

The cottony scale is, as now known (Danzig and Matile-Ferrero, 1990), of American origin and penetrated into Georgia without its natural enemies. The indigenous entomophagous species are of little significance in regulating the pest's number.

Fruit trees. About 30 species of coccids can attack fruit trees, but the most noxious is *Quadraspidiotus perniciosus* (Comstock), particularly in the eastern interior regions of the country. *Parlatoria oleae* (Colvée) and *Epidiaspis leperii* (Signoret) are significantly harmful, too, in the commercial orchards often treated with pesticides. In the coastal regions the pest is *L. japonica*, as well. Locally infestation may be recorded by *Palaeolecanium bituberculatum* (Targioni Tozzetti) and *Sphaerolecanium prunastri* Fonscolombe, which have effective natural enemies. In the coastal regions damage is caused locally by *L. japonica*, *P. affinis* and *Ceroplastes* spp.

On the Black Sea coast natural enemies can reduce San José scale numbers to an economic threshold, but they are not effective enough in the interior regions of Georgia. The natural enemies complex comprises 11 species, which are represented by the predacious beetles *Chilocorus renipustulatus* Scriba and *Ch. bipustulatus*, the aphelinid parasitoids *Aphytis proclia* (Walker) and *Encarsia perniciosi* (Tower), and some others.

When required, the San José scale is specifically controlled by application of mineral light oil in combination with phosphororganic pesticides against the first-instar larvae in spring and summer. The same treatment is effective against other armored scales.

Mulberry. About 10 species of coccids are recorded. At present species of economic importance are not known in Georgia, with exception of a small territory near Batumi, where *Pseudaulacaspis pentagona* (Targioni Tozzetti) has penetrated from Turkey. This scale was

earlier recorded only as a pest of fruit trees in coastal regions and it was suppressed by *Encarsia berlesei* Howard, imported from Italy. The other earlier known serious pest of mulberry and many other plants, *Pseudococcus comstocki* Kuwana, has no importance as a noxious species due to control by the encyrtid parasitoid *Pseudaphycus malinus* Gahan introduced into Georgia in the 1960s.

Forest. Coccid infestation rarely occurs in the forests of Georgia in spite of many species distributed there. In the coniferous forests growing in the Central Caucasus and the so-called Small Caucasus, the same species occur as in the mountains of Europe: *Physokermes* spp., *Leucaspis* spp. and *Nuculaspis abietis* Schrank. In mixed and broad-leaved forests *Quadraspidiotus ostreaeformis* Curtis, *Q. caucasicus* Borchsenius and *Lepidosaphes ulmi*, which are suppressed by the aphelinid parasitoids belonging to the genera *Archenomus*, *Aphytis* and *Coccobius*, have minor economic importance.

Arid, so-called light forests in southeast Georgia, near Azerbajan, which consist of pistachio-nut trees (*Pistacea mutica*) on the background of semidesert and mountainous forest vegetation (*Juniperus* spp. and other) around them, have an original, very specific fauna of coccids and their natural enemies. More than 30 coccid species (Hadzibeyli, 1983) and about 100 species of chalcid parasitoids have been recorded there (Trjapitzin, 1968; Yasnosh, 1972 and others). Many of them have been described as new species.

Ornamental plants. These are attacked by many coccids (about 80 species). Most of them are the same noxious species mentioned above for other plants. However, the specific ones are: *Eriococcus buxi* Fonscolombe, which injures *Buxus sempervirens* in urban groves and has no natural enemies, and *Unaspis evonymi* (Comstock). *Dynaspidiotus britannicus* (Newstead) is of local economic importance on ivy. *Saissetia oleae* Bernard on oleander is now suppressed by *Scutellista cyanea* Motsch. reintroduced from France in 1977 and established on the Black Sea coast (Loyk, 1986).

CONCLUSIONS

At the end of the 1980s research was undertaken in several countries to specify the distribution and numbers of coccids injurious to fruit trees in European orchards, including Georgia. The aim of these investigations, initiated by the European Plant Protection Organization (EPPO) and headed by F. Kozár (Research Institute for Plant Protection, Budapest), was to elucidate the factors responsible for the fluctuations in coccid number and damage over large regions for practical use in plant protection. The findings of this work, in which the author participated, were published in several articles, including data from Georgia (Kozár et al., 1982).

The analysis and comparison of these materials and data of coccid distribution and damage allow to conclude that at present the species composition and economic importance of coccoids have changed somewhat.

The San José scale, *Q. perniciosus*, which is of quarantine importance, remains a main destructive species in fruit orchards in the eastern part of Georgia but causes much less infestations in the Black Sea coastal region. The harmfulness of *L. japonica* in Adjaria, Batumi region, is reduced significantly because of the increased activity of its natural enemies. The economic importance of new minor pests, recorded on fruit trees in 1976 — *Parlatoria theae* (Cockerell) and *Nilotaspis halli* (Green), did not increase. *C. japonicus* penetrated into the

eastern part of the country and damaged some ornamental and fruit trees in Tbilisi. *P. pentagona* penetrated into Adjaria and locally infested mulberry trees near Batumi. *P. affinis* lost economic importance due to its suppression by the parasitoid *P. maculipennis*, introduced from France in 1973 and well established by now.

P. comstocki, P. calceolariae and *P. purchasi* are suppressed by bioagents earlier introduced into Georgia and thus have no economic importance.

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