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The Dictyospermum Scale *Chrysomphalus dictyospermi* (Morgan) (Coccinea: Diaspididae), pest of fruit and ornamental plants in the Black Sea coast of Georgia: a review

Abstract - Dictyospermum scale is the main scale pest in the citrus groves and also injures many ornamental plants on the Black Sea coast. Two to three generations of scales are developed yearly without winter diapause. Nymphal mortality in the winter is high, up to 78%. Fecundity is between 100 and 200 eggs per female. The enemies of Dictyospermum scale include six species of hymenopterous parasitoids, four predators, and also mites and spiders. Sixteen species of fungi were recorded from the scale: *Trichotecium roseum* Link is among the most common. The Aphelinidae parasitoids are *Aphytis aonidiae* Mercet, *A. chrysomphali* Mercet, *A. mytilaspidis* Le Baron, *Encarsia citrina* (Grow), *E. aurantii* (Howard), and *E. fasciata* (Malenotti) and the predators are *Chilocorus renipustulatus* Scriba, *C. bipustulatus* L., *Exochomus quadripustulatus* L., and *Rhizobius lophantae* Blais. (Coleoptera, Coccinellidae). The significance of entomophagous insects in controlling the pest was studied. Natural enemies may considerably limit the presence of Dictyospermum scale, but they do not appear to be capable of eradicating it. Sometimes the use of additional control measures is necessary.

Key words: Scale insect, natural enemies, economic importance, citrus.

INTRODUCTION

Georgia, a relatively small mountainous country in the Caucasus, has a variety of landscape zones and is rich in flora and fauna. The mountains divide the country into the western subtropical humid region, occupying the Black Sea coast and the eastern part with a drier climate.

Many insects, including coccids, appeared in Georgia comparatively recently together with introduced plants, when the sea-coast lands were being brought under cultivation in the 19th century. Among them was Dictyospermum scale, *Chrysomphalus dictyospermi* (Morgan). Probably this scale originates from Southeast Asia (Danzig, 1993). At present, the scale is distributed in the whole Black Sea coast of Georgia and

Krasnodarsky territory of Russia, and is also known as a pest in greenhouses of many towns. The host plants of Dictyospermum scale in Georgia are different species of citrus, fruits trees (*Diospyros lotus, Cornus mas, Laurocerasus officinalis*), many ornamental plants (*Euonymus japonica, Hedera helix, Buxus sempervirens*), palms, *Magnolia* spp. and others (Tavamaishvili,1970; Hadzibeyli,1983). Presently the Dictyospermum scale is one of the more destructive species in the Citrus groves in Georgia (Yasnosh *et al.*, 1986; Yasnosh, 1995; Chkhaidze,1999).The aim of this paper is to provide information on the biology, natural enemies and their role in regulation of Dictyospermum scale in the citrus groves of Georgia.

Remarks on the biology of Chrysomphalus dictyospermi

The Dictyospermum scale settles on upper side of leaves and on fruits. It damages the branches, leaves and twigs as well as fruits. Under heavy infestation, about 70% of leaves fall, leading to desiccation of citrus trees.

Dictyospermum scale is a bisexual and ovoviviparous species. The scale develops 2-3 generations/year. Each female lays 100-200 eggs. The crawlers of the first generation appear in the second half of May. The crawlers of the second generation appear in August and the crawlers of the third generation in September-October. The scales overwinter as adult females and nymphs, but about 70% of the nymphs die if the temperature reaches -7 ^{0}C. The females are more resistant to low temperatures. In the orchards treated by pesticides, the density of scale was often higher than the economic threshold of harmfulness of the scale (11-25 scale/leaf) (Chkhaidze, 1984). In untreated orchards the density of the scale may be lower than the economic level due to the action of natural enemies.

Natural enemies and their role in the Black Sea Coast

Scale populations are limited by climatic factors, such as temperature fluctuations in winter and spring, heavy rains and wind in the period of mass crawlers hatch. The mortality of the nymphs may reach 77.4-78.5%, and the mortality of females 61%. Populations of this pest are regulated considerably by parasitoid and predator insects and by mites, spiders and fungi.

Table 1 - List of insect natural enemies recorded in Georgia.

Parasitoids **Hymenoptera, Aphelinidae**	**Predators** **Coleoptera, Coccinellidae**
Aphytis aonidiae Mercet	*Chilocorus renipustulatus* Scriba
A. chrysomphali Mercet	*Ch. bipustulatus* L.
A. mytilaspidis Le Baron	*Exochomus quadripustulatus* L.
Encarsia citrina (Grow)	*Rhizobius lophantae* Blais.
E.aurantii (Howard)	
E fasciata (Malenotti)	

The natural enemies complex of Dictyospermum scale on the Black Sea coast of the Caucasus was studied by Gaprindashvili (1960), Tavamaishvili (1970), Yasnosh (1983). The natural enemies complex is reported in Table 1.

Parasitoids are important regulating factors of the Dictyospermum scale population. All species of *Aphytis* are external parasitoids and have a similar biology and 4-5 generations/year. *A. chrysomphali*, distributed in the Black sea coast of the Caucasus, was first discovered parasitising the Dictyospermum scale in Batumi, Adjaria, in 1936. Since 1939 it was successfully established in Sukhumi, Abkhasia, where the parasitoids collected in Batumi had been released (Gaprindashvili,1956). It is a specific parasitoid of this scale (Nicolskaya & Yasnosh,1966; Yasnosh,1994). Everywhere *A. chrysomphali* has suppressed the scale on citrus and other plants. Extensive use of non-selective pesticides (especially phosphorganic insecticides) and, sometimes, low winter temperatures have considerably reduced the number of this parasitoid. It has become rare in citrus orchards. Recently, application of a new integrated system of protective measures have allowed an increase of this effective parasitoid. The level of parasitization may reach 15.1% in May and 28.5% in October (Chkhaidze,1982; Yasnosh,1994; Yasnosh *et al.*,1986). The other recorded *Aphytis* species (*A. aonidiae* and *A. mytilaspidis*) are generic parasitoids of armoured scales. They are rare in the Dictyospermum scale population and do not have any economical importance in its regulation.

Encarsia species are widely distributed in the Caucasus. At present, *Encarsia citrina*, an oligophagous species, is the major effective parasitoid of Dictyospermum scale. Parasitism often reaches 55% in untreated groves. This species is parthenogenetic in the Caucasus. There are 2-3 generations per year. Fifteen species of armoured scales are recorded as hosts of *E. citrina* in Georgia (Nikolskaya & Yasnosh,1966).

Coccinellids are important regulating factor of scale populations and are more effective than parasitoids. The effectiveness of coccinellids depends on the scale population density. At high pest density the predators develop intensively. Their beneficial role increases and the coccinellids consume 48.6-51.8% of the total scale population. At low scale density their beneficial role decreases and they do not remain on the plants. In Georgia the coccinellid number is regulated by the parasitoids *Tetrastichus coccinellae* (Kurjumov) and *Homalotylus flaminius* (Dalman) (Chalcidoidea: Encyrtidae).

Rhizobius lophantae Blais., introduced from Italy in 1947, has established in the Black Sea coast and now controls some armoured scales, predominantly *Aspidiotus nerii* Bouché, *Diaspis boisduvali* Signoret, *Aspidiotus destructor* (Signoret). The adults overwinter on ornamental plants, but not in the citrus groves infested by Dictyospermum scale. Therefore *L. lophantae* is reared in biolaboratories and periodically released in the citrus groves at levels of 10-15 adults/tree, against the first and second generation of the scale (Rubtzov,1954, Gaprindashvili,1977). *Lindorus lophantae* is not affected by parasitoids.

The population of Dictyospermum scale is also reduced by entomopathogenic

fungi. Sixteen species of them were recorded (Khuchua,1984). *Trichotecium roseum* Link., *Phomo sp., Rusarium larvarum* (Fusk.), *Cladosporium sp., Aspergillus flavus* Lk. are common among them. Infestation by the complex of fungi reaches 30%. A new pathogenic fungus, *Aschersonia* sp.f. *georgica* Yasnosh & Tabatadze, was also recorded on Dictyospermum scale in the last years (Yasnosh & Tabatadze, 1997).

CONCLUSION

Taking into account the above-mentioned factors, one can note the significant importance of the complex of natural enemies in the Dictyospermum scale number reduction in untreated citrus groves. Nevertheless, they do not appear a permanent factor of scale mortality. The use of additional control measures, such as the introduction of new entomophagous species or the use of selective insecticides is sometimes necessary.

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