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Current status of scale insects (Hemiptera: Coccoidea) in the Italian vineyards

Abstract - Nine species of Coccoidea occur in the Italian vineyards. Among the Pseudococcidae, the most important and widespread species is *Planococcus ficus*. *Heliococcus bohemicus* seems to be localized and is usually not considered as a pest. Among the Coccidae, *Neopulvinaria innumerabilis* was recorded as pest in north-eastern regions in the 1990s. *Pulvinaria vitis*, *Parthenolecanium corni* and *Parthenolecanium persicae* are less frequent. Infestations of the diaspidid *Targionia vitis* are sometimes recorded. Among natural enemies of grape mealybugs, *Anagyrus pseudococci* (Hymenoptera, Encyrtidae) is common on *P. ficus*. Predators belonging to Neuroptera Chrysopidae and Hemerobiidae, Coleoptera Coccinellidae and Diptera Chamaemyiidae are also frequently recorded on the same species. Concerning natural enemies of Coccidae, the parasitoid *Coccophagus lycimnia* (Hymenoptera, Aphelinidae) is often recorded On *P. corni* and *N. innumerabilis* as well as various species belonging to Chrysopidae, Coccinellidae and Chamaemyiidae. *Coccophagoides similis* (Hymenoptera, Aphelinidae) has been found associated with *T. vitis*. A number of predators are also reported as feeding on this species. Native natural enemies have a low impact on *P. ficus* populations in commercial vineyards, probably because their activity is affected by the use of pesticides. The role of natural enemies in controlling other Coccoidea seems to be more important. The impact of chemical control measures against Coccoidea is discussed within IPM strategies.

Key words: grape, Coccoidea, economic importance, natural enemies.

INTRODUCTION

The Grape Berry Moths (GBMs) *Lobesia botrana* (Denis & Schiffermüller) and *Eupoecilia ambiguella* Hübner are major pests in Italian vineyards. Concerning cicadellids, the importance of *Empoasca vitis* (Göthe) is restricted to some areas whereas that of *Scaphoideus titanus* Ball has dramatically increased during the last years due to spread of "Flavescence dorée". Mite infestations are frequent where non-selective pesticides are employed. Scale insects are considered secondary pests of vineyards, but in some areas and years they cause some crop losses. Nine species, belonging to the families Pseudococcidae, Coccidae and Diaspididae, are associated with the grapevine.

Pseudococcidae

Planococcus ficus (Signoret)
Planococcus citri (Risso)

The first outbreaks of grape mealybugs in Italy were reported in the 1950s (Rui, 1948; Manzoni & Carli, 1952; Gambaro, 1953). The species causing severe crop losses, considered to be *Planococcus citri* Risso, reached the economic importance of downy mildew (Manzoni & Carli, 1952). In the subsequent years the impact of grape mealybugs appeared lower until the 1970s when outbreaks were reported in Italy and other countries (Tranfaglia & Viggiani, 1978). De Lotto (1975) found that *P. ficus* was typically associated to grapevines. Tranfaglia (1976) confirmed that *P. ficus* was much more frequent than *P. citri* in southern Italian vineyards.

Observations on the life history of *P. ficus* were reported by Tranfaglia *et al.* (1980) for central and southern Italy. The life cycle and the phenology of *P. ficus* were studied in details in northern Italy to develop a sampling program predicting damage level and making decision on insecticide application (Duso, 1989). Females, and to a lesser extent nymphs, overwintered under the bark, more frequently on the cordon or in the upper trunk. During the vegetative season basal leaves and leaves opposite to the grape bunch were colonised by mealybugs more continuously than leaves located on upper parts of the shoots. Grape bunches close to the trunk and located over the cordon were more infested than those located far from the trunk or under the cordon. Overwintering females, protected under the bark, started to lay eggs in mid-April. Nymphs spread on leaves but their density was not relevant. The first generation completed development in June. Females of this generation laid eggs from late June onwards mostly remaining under the bark. Newly hatched nymphs migrated along the shoots in July and completed their cycle mostly in the bunches. In these protected sites, females laid eggs in August and nymphs were recorded on leaves from late August onwards. Additional migrating nymphs originated from the reproduction of females on the cordon or the trunk. Females of the third generation were noticed from September onwards. Population densities on leaves showed three peaks respectively in May, mid-July and early September, corresponding to 3 generations. In southern Italy, *P. ficus* can develop 4-6 generations (Tranfaglia & Viggiani, 1978; Tranfaglia *et al.*, 1980; Longo *et al.*, 1991).

Crop losses associated to *P. ficus* infestation may be important because mealybugs feed actively and excrete honeydew that promotes the growth of sooty mould (Tranfaglia & Viggiani, 1978). In addition, *P. ficus* can transmit two viruses: leaf roll and corky bark (Rosciglione & Castellano, 1985; Rosciglione & Gugerli, 1989; Tanne *et al.*, 1989).

Among factors affecting mealybug increases in the 1970s and 1980s, the nitrogen fertilization and the use of some grapevine training systems were suggested (Tranfaglia & Viggiani, 1978; Deligia *et al.*, 1980). The impact of insecticides on mealybug natural enemies was also suspected (Laccone *et al.*, 1982) but infestations were also recorded in unsprayed vineyards (Duso, 1989).

The influence of climatic conditions on grape mealybug populations is relevant. Migration phases of nymphs are affected by frequent and heavy rains (Manzoni & Carli, 1952). Heat regulation, trough irrigation, caused a reduction of *P. ficus* populations when performed continuously after blooming onwards (Duso *et al.*, 1985). In contrast, irrigation after grape ripening did not reduce the pest densities. Watering of the foliage affected the migration of juveniles into grape bunches and probably their survival and development.

In central and southern Italy natural enemies (mainly Coccinellidae, Chamaemyiidae and Encyrtidae) were not able to prevent *P. ficus* outbreaks (Tranfaglia & Viggiani, 1978). In northern Italy, natural enemies are sometimes effective in reducing the stock of overwintering females (Duso, 1989). Among predators recorded in northern Italy we could mention *Mallada prasinus* Burm. (Neuroptera, Chrysopidae), *Sympherobius pygmaeus* Ram. (Neuroptera, Hemerobiidae), *Leucopis alticeps* Serv. (Diptera, Chamaemyiidae) and *Scymnus* spp. (Coleoptera, Coccinellidae). The most important parasitoid was *Anagyrus pseudococci* Girault (Hymenoptera, Encyrtidae) (Duso, 1989). Numerous mealybugs were infected by pathogens, mainly belonging to Entomophtorales.

In Israel, the release of two hymenoptera, i.e. *Coccidoxenoides peregrinus* (Timberlake) (= *Pauridia peregrina*) and *Leptomastix dactylopii* (Howard) provided successful results in controlling *P. ficus* (Gol'berg *et al.*, 1981). Results obtained by Tranfaglia & Viggiani (1978) contrast with these findings since *L. dactylopii* did not respond to *P. ficus* populations.

Chemical control is often necessary to reduce the impact of grape mealybugs. Dormant insecticide applications, e.g. mineral oils, were not effective. In-season insecticides should be applied when nymphs are spreading on the vegetation and penetrating in the grape bunches (Tranfaglia & Viggiani, 1978; Laccone *et al.*, 1982). Empirical economic thresholds ranging from 1-5 % of infested bunches have been proposed (Tranfaglia & Viggiani, 1978). In northern Italy a single insecticide application in mid-July can control GBMs and mealybugs (Girolami *et al.*, 1989). Moderate use of insecticides can allow for an effective response to infestations by natural enemies. In a Sardinian vineyard, *P. ficus* populations were controlled by the coccinellid *Cryptolaemus montrouzieri* (Muls.), which had been previously released in contiguous citrus orchards (Deligia *et al.*, 1980).

Heliococcus bohemicus Sulč

This species has been recently recorded in Italy in vineyards of the Veneto region (Marotta & Tranfaglia, 1990). It is also present in Piedmont, Lombardy, Emilia-Romagna and Tuscany. Its main host plants are grapevine, plane tree, poplar, oak, and black locust (Kosztarab & Kozár, 1988).

In the Veneto region *H. bohemicus* develops 2 generations per year. Nymphs overwinter under the bark. Males occur from the late March to mid April, females from April to June. Oviposition starts in late May and lasts till June. Females lay eggs under their bodies and the crawlers migrate to the vegetation preferring leaf

undersurfaces. Females complete their development from late July onwards and oviposition starts soon. The first nymphs of second generation are present at the beginning of August. Most of them migrate inside bunches and then to the trunk to overwinter (Camporese, 1994).

No important damage has been observed even on highly infested grapevines probably because the excretion of honeydew is low. The transmission of Leafroll virus (GLRaV-1, GLRaV-3) has been shown (Sforza & Greif, 2000).

Heliococcus bohemicus is parasitized by *Leptomastoidea bifasciata* (Mayr) and *Ericydnus* sp. (Hymenoptera, Encyrtidae), but at very low rate of parasitization (Camporese, 1994). Chemical control is not necessary.

Coccidae

Parthenolecanium corni (Bouché)

This species is widely distributed in Italy where it can be found on several ornamental shrubs and deciduous trees. In Italian vineyards it develops 1-2 generations. The life cycle of *P. corni* has been studied into details in Apulia (South Italy), where the species develops 2 generations (Nuzzaci, 1969). Second-instar nymphs overwinter on branches. The first adult females occur in April. Oviposition can be observed from late April to early June. Reproduction is often parthenogenetic. A single female can lay several hundreds of eggs (maximum 3000). During June and July the crawlers spread to leaves and settle mostly along the veins on leaf undersurfaces. Nymphs become adults from July onwards. Oviposition lasts from late July to late season and the crawlers settle on the leaves. Later, nymphs migrate to branches where overwintering will take place.

Presently, its importance in vineyards is lower than in the past when outbreaks, associated to sooty mould growing on the honeydew, were recorded in southern Italy (Nuzzaci, 1969). Moreover, *P. corni* is a suspected vector of Leafroll virus (Fortusini *et al.*, 1996).

Predators and parasitoids can control *P. corni* populations. The most active predators are the coccinellid *Exochomus quadripustulatus* (Linnaeus) and *Chilocorus bipustulatus* (Linnaeus). Among the parasitoids, *Scutellista caerulea* (Fonscolombe). (Hymenoptera, Pteromalidae) and *Coccophagus lycimnia* (Walker) (Hymenoptera, Aphelinidae) are reported (Nuzzaci, 1969).

Summer insecticide applications against GBMs or cicadellids control *P. corni* populations. In contrast, the scale densities can increase where mating disruption of GBMs is applied (Varner *et al.*, 2001).

Parthenolecanium persicae (Fabricius)

This species is common in Italian vineyards but its economic importance is low. It has been reported on several plant species (Kosztarab & Kozár, 1988). *Parthenolecanium persicae* develops one generation per year. The third-instar nymphs

overwinter on the trunks and on branches. Adult females are observed in the following April-May. Reproduction is usually parthenogenetic and fecundity is quite high (1000-2600 eggs per female according to Pellizzari, 1997). Oviposition starts in late May and continues through June. The crawlers occur from late June onwards and are typically located along the veins on the leaf undersurfaces. Before leaf drop, the third-instar nymphs migrate to the grapevine branches where they overwinter.

Damage caused by this species is similar to that of *P. corni* as well as control measures.

Neopulvinaria innumerabilis (Rathvon)

This polyphagous species (grapevine, maple, walnut, willow, black locust, etc.), apparently of Nearctic origin, has been recently recorded in vineyards of some Italian regions such as Veneto, Friuli-Venezia Giulia and Lombardy (Pellizzari Scaltriti, 1977; Zandigiacomo *et al.*, 1992; Pavan *et al.*, 1996). *Neopulvinaria innumerabilis* develops one generation per year. Fertilized females overwinter on the branches. Females produce a large white ovisac containing a high number of eggs (3000-9000). Oviposition takes place from late May to late June. Nymphs spread to leaves and their colonisation depends on leaf structure (i.e. hair density). Nymphs become adult in September and fertilized females migrate to the branches to overwinter in October.

The occurrence of *N. innumerabilis* is associated with large sooty mould growth on leaves and bunches. Large populations reduce shoot development, bud fertility and the yield of the current year and of the subsequent season (Pavan *et al.*, 1996). Moreover, the species is suspected to transmit Leafroll virus (Fortusini *et al.*, 1996).

Natural control is not effective. Egg predators such as *E. quadripustulatus* and *Leucopis* sp. and parasitoids, e.g. *C. lycimnia*, are unable to keep this pest at low levels. When chemical control is needed mineral oils activated with OPs before sprouting are effective. Summer application towards nymphs can be performed by using some OPs.

Pulvinaria vitis (Linnaeus)

This species is widespread in Italy on grapevines and other host plants (alder, birch, hazelnut, poplar, willow, etc.). It caused infestations especially in the first half of the last century (Silvestri, 1939).

Pulvinaria vitis has one generation per year. Females overwinter on branches. Female body size increases during spring. Oviposition occurs from the end of April to early June and each female may lay 3500-5000 eggs in a white waxy ovisac. Eggs hatching takes place from May onwards. The crawlers settle along veins of leaf undersurface and young shoots. Adults mate in September and later females migrate to the branches to overwinter (Pellizzari, 1997).

Symptoms by *P. vitis* can be recognized by sooty mould covering the vegetation. The pest can transmit Leafroll GLRV-3 virus (Belli *et al.*, 1994). Outbreaks are seldom reported probably because natural control is effective. The complex of natural enemies includes some species of Coccinellidae, Chamaemyiidae, Aphelinidae and Encyrtidae (Pellizzari, 1997).

Diaspididae

Diaspidiotus viticola (Leonardi)

This species is known from Southern Italy (Campania) only. According to Zinna (1962) it develops three generations per year, overwinters as young female and infests more frequently *Vitis labrusca* Linnaeus. It has no economic importance.

Targionia vitis Signoret

It was recorded as pest of vine in various Italian regions (Lombardi, 1938; Jannone, 1967; Arras, 1976; Ferrari, 1987; Moleas & Baldacchino, 1994; Pellizzari & Dalla Montà, unpubl. data). In addition to the grapevine, *T. vitis* has been collected on beech, oak, plane tree and other woody trees.

Targionia vitis has one generation per year on grapevine. The fertilized females overwinter on the trunk or on branches. In the spring (April-June) the ovoviviparous females produce about 200 offsprings that, after a short wandering, settle mostly on the bark of the trunk and branches. The nymphs reach maturity in July. Rarely early born females can give rise to a second generation. At high population density *T. vitis* forms thick stratification under the bark, on the trunk and on the branches that swell. The stratification may increase every year because of the tendency of young populations to insert themselves under the old populations. In this case, the species damages the grapevine with consequent reduction of grape production (Lombardi, 1938; Jannone, 1967; Arras, 1976; Ferrari, 1987; Moleas & Baldacchino, 1994).

Natural enemies are represented by predators as *C. bipustulatus* and *E. quadripustulatus* and parasitoids, the most important of these is *Coccophagoides similis* Masi (Hymenoptera Aphelinidae). The efficacy of natural enemies is low, because the scales are hidden under the bark flakes (Zinna, 1962; Ferrari, 1987).

Chemical control can be performed against young nymphs by using organophosphates (e.g. chlorpyriphos-methyl) or buprofezin (Guario *et al.*, 1996).

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