Nysius cymoides (Spinola) on *Chenopodium quinoa* Willd. cultivated in Italy

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Abstract

Quinoa (*Chenopodium quinoa* Willd.) (Family: Amaranthaceae – APG classification) is an Andean grain recently introduced on the European market and cultivated in experimental fields. In one of these experimental fields, in San Giorgio Piacentino (Italy), a heavy bug infestation was observed. The species was identified as *Nysius cymoides* (Spinola) (Heteroptera Lygaeidae), a polyphagous species known as a pest of different crops. It occurs in the Mediterranean area from the sea level to the alpine meadows.

Introduction

Quinoa (*Chenopodium quinoa* Willd.) is an Andean grain grown in South America for thousands of years. It has been a staple food for local people in Peru, Bolivia, Chile, Ecuador and Colombia, throughout history.

Nowadays, the popularity of this Andean grain is worldwide growing, as more and more people become interested in its extraordinary nutritional properties, first of all, its lack of gluten (Jacobsen, 2003; Bendevis *et al*., 2013). Quinoa seeds have in fact a high content of well-balanced proteins (Jancurová *et al*., 2009; Christiansen *et al*., 2010), whose quality is close to milk ideal protein (Koziol, 1992). Quinoa is a candidate crop for nutritional and agricultural diversification also in Europe (Bois *et al*., 2006), as well as in other world regions, where it can lead the transition to a more sustainable agriculture, thanks to its lower inputs requirement than conventional crops (Spehar, 2006). Interest in this culture has also been prompted by Food and Agriculture Organisation (FAO), who identified Quinoa as one of the most effective measures to improve food security (Jacobsen, 2003), and declared 2013 International Year of Quinoa (Bendevis *et al*., 2013; Small, 2013). Moreover, for at least 20 years the University of Copenhagen, Denmark, has been conducting studies about Quinoa adaptability to European temperate environmental conditions, selecting varieties capable of yielding up to 2.5 t/ha (Christiansen *et al*., 2010; Jacobsen *et al*., 2009; Jacobsen, 1997). Many other successful experiences of growing Quinoa outside its region of origin have been documented up to now: tests have been conducted in Morocco (Hirich *et al*., 2014), United Arabian Emirates (Rao and Shahid, 2012), Brazil (Spehar, 2006), Poland (Krzysztof, 2008), Kenya, Netherlands and United States (Jacobsen, 2003).

C. quinoa is infested by numerous insects in the Andean area, and the main pests are *Eurysacca melanocampta* Meyrick and *E. quinoae* Povolny (Lepidoptera Gelechiidae) that cause grain losses (Rasmussen *et al*., 2003; Costa *et al*., 2009). In research fields in Northern America different plant bugs, leaf miners, aphids, and noctuids caused significant injury (Robinson, 1986; Cranshaw *et al*., 1990; Oelke *et al*., 1992). Currently reports from Northern Europe include *Cnephasia* sp. (Lepidoptera Tortricidae), *Aphis fabae* L. (Homoptera Aphididae) and *Lygus rugulipennis* Poppius (Hemiptera Miridae), *Scrobipalpa atnplicella* (Röslerstamm) (Lepidoptera Gelechiidae) and *Cassida nebulosa* L. (Coleoptera Chrysomelidae) (Sigsgaard *et al*., 2008) and from Southern Europe *Epitrix subcrinita* Le Conte (Coleoptera Chrysomelidae), and leafhoppers (Homoptera Cicadellidae) (Rasmussen *et al*., 2003).

For the above-mentioned reasons, some field experiments have been carried out in North Italian conditions with the aim of assessing the possibility to optimize the agro-techniques, including strategies for Integrated Pest Management. In one of these experimental fields, during summer 2014, a bug infestation was observed on the panicles. The paper aims at describing the main results obtained in terms of identification and classification of this parasite, to be considered new for the quinoa cropping system in Italy.

Materials and methods

The quinoa field was placed in Emilia Romagna Region (North of Italy), located in the Po valley (45° 60' - 44° 77' lat. N; 7° 65' - 12° 22' long. E), in the municipality of San Giorgio Piacentino. Titicaca cultivar of quinoa was sown in May using a universal drill with the density of 100 plants m^{-2}; the control of weeds was carried out manually and crops were irrigated 3 times. The harvest was carried out by wheat harvester and the yield was about 3 t/ha. The crop was regularly controlled from sowing to harvest.

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Results

Bug infestation was observed during two visits to the field, at the end of June till the first week of July, close to harvest. Each panicle was infested by 1 to 5 adults identified as *Nysius cimoydes* (Spinola) (Hemiptera Lygaeidae) (Figure 1).

The genus *Nysius* Dallas 1852 belongs to the suborder Heteroptera, infra-order Pentatomomorpha, superfamily Lygaeoidea, Family Lygaeidae, Subfamily Orsillinae. It contains approximately 106 species throughout the World; about 10 live in the Euromediterranean sub-region (Péricart, 1998). Like other seed bugs, there are some species in the genus that have proven to be crop pest of wheat and other grains, as well as many vegetables. The species are generally fully winged except two closely related species found on the island of Hawaii, which are different from the rest of *Nysius* by exhibiting reduced nonfunctional wings, and feed on dead and dying insects (Polhemus, 1998).

The species *N. cymoides* (Figure 2) was described as *Artheneis cymoides* by the Italian entomologist Massimiliano Spinola: original series, collected in Genova, was probably lost. Synonyms are: *Nysius albidus* Dallas, 1852; *Heterogaster exilis* A. Costa, 1853; *Nysius fuliginosus* Fieber, 1861; *Nysius thoracicus* Horvàth, 1882.

N. cymoides differs from other Euro-Mediterranean species for the modest size (3.5-4 mm) and for the following characters: i) dorsal parts whitish-translucent colored; ii) general shape elongate and slender; iii) pronotum little, strongly transverse, its width is around two times the height; iv) membrane of the hemelytra hyaline and transparent, it clearly surpasses the apex of the abdomen; v) bucculae, in the lower part of the head, reduced progressively backward.

The species is present in the Holomediterranean region, extending into Macaronesian Islands, Central Europe, Middle East, Middle Asia, and Central Africa. According to Linnavuori (2007), *Nysius cymoides* lives in steppes, meadows, and fields. Péricart (1998) reports several wild host plants cited by various authors: *Centaurea solsticialis*, *Artemisia absinthium*, *Gossypium* sp., and *Tamarix* spp. (Lybia and Turkmenistan), bearing fruits. Schaefer and Panizzi (2001) report that it seems probable that this species is univoltine in contrast to other species of *Nysius* of tropical regions. This would be a useful adaptation to the Mediterranean climate of Southern Europe and adjacent areas. Rivnay (1962) observed that the nymphs were only present in the spring; adults in the field in summer did not reproduce so he concluded that this insect goes into an adult diapause in the dry summer and becomes reproductive in the spring.

Discussion and conclusions

Nysius cymoides is a polyphagous species that causes economic losses in the Mediterranean basin. In Israel, a mass infestation of *N. cymoides* occurred on cabbage and cauliflower grown for seeds, on wild mustard, and on grapevines. Sucking sap can cause losses of around 80%. It was also collected on clover and alfalfa (*Medicago sativa* L.) fields in the summer (Rivnay 1962). The same author stated that bugs preferentially attacked cruciferous inflorescences and pods when seeds are in the *milk*

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Figure 1. ***Nysius cymoides*** **(Spinola) adults on quinoa panicles.**

Figure 2. ***Nysius cymoides*** **(Spinola).**

stage. In Negev (Gilat and Louis 1974), it attacked the introduced river red gum, *Eucalyptus camaldulensis* Dehnh., and the flat-topped *E. occidentalis* Endl. More recently, Razmjoo (2012) confirms that this species, in Iran, is present on cultivated alfalfa. Demìrel (2009) observed that adults of *N. cymoides* were recovered on four *canola* varieties (*Brassica napus* L.), cultivated in Hatay province of Turkey, as an important oil crop grown for animal feed, oil, and biodiesel. The species was recorded during the whole sampling period and its population peaked in the middle of May. The study demonstrated that *N. cymoides* was the only observed Lygaeidae species on canola plants, and its population density gradually increased and peaked during the harvest time, from late April to the beginning of May. Subsequently, Özgen (2012) quotes the first record for Mardin province (Turkey) in vineyard area. This author lists this species in Diyarbakır, Şanlıurfa and Kilis provinces where it was known in weeds. In Egypt, *N. cymoides* is part of a complex of pests of leguminous plants (Harakly and Assem, 1978). In Italy, the bug was studied by Parenzan (1985) who reported attacks to the newly introduced buxaceous plant *jojoba*, *Simmondsia chinensis* (Link.) Kellog (=*Simmondsia californica* Nutt.). The bug appeared to have built up large populations in the plantation on the weed *Portulaca oleracea* L., and then had migrated to jojoba. The damage caused by these piercing-sucking insects included wilted and necrotized tissues. Seedpods were also attacked. Some edaphic behaviors of this insect in crops are known: generally, there is a natural tendency to dioecism. Rivnay (1962) reported that the plants in a garden were totally covered with this pest. One year, millions of nymphs developed in the wild mustard fields and, when the short-lived mustard plants died back, the nymphs migrated en masse to adjoining vineyards, destroying them. Host plant quality can affect *N. cymoides* development as it was showed on different canola cultivars (Mollashai *et al*., 2016).

Even if this species was already recorded on *Chenopodium* spp., attacks to quinoa by *N. cymoides* were until now unknown. Only another species of the same genus (*N. raphanus* Howard), reported by Cranshaw *et al*. (1990), destroyed stands of this plant in Colorado, USA. Since it can feed on different crops causing heavy damages, it must be monitored from milky stage to harvest to avoid economic losses.

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