Monitoring of arthropod infestations on high quality hard wheat in southern Italy

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Abstract

The results of a survey in 2006-2009 on high quality hard wheat, coming from 31 different storage centers located in Southern Italy, are reported. About 300 samples were analyzed by visual test, while 891 by both sieving and biological test. For the three different kinds of test the infesting species are listed and their relative incidence on the samples is reported. The most widespread species in the samples belonged to the order Coleoptera, i.e. *Sitophilus granarius*, *Rhyzopertha dominica* and *Oryzaephilus* spp., while Lepidoptera were less abundant. The results are discussed with the aim of providing the storage centre operators with helpful information on the correct monitoring strategies to adopt in case of arthropod infestations in high-quality hard-wheat warehouses.

Keywords: Stored grain, Insects, Sampling, Coleoptera, Italy

1. Introduction

Durum wheat (*Triticum durum* Desf.) in Italy represents one of the main crops. In Sicily, in particular it is an important resource both in terms of contribution to the agricultural income and for the preservation of the landscape and rural traditions. This region produces 17% of the total hard wheat and together with Marche, Molise, Apulia and Basilicata regions, it provides more than 60% of the national production (ISTAT, 2008). Preservation and promotion of this important sector is possible with product or system certification, and with technological and innovatory systems to monitor the quality of the product in all the steps of its production, transformation and distribution (Sgrulletta et al., 2002).

The grain crop value is strictly influenced by the insect infestation that causes quantity and quality losses of the product. Intense insect activity not only consumes grain affecting quality through depletion of specific nutrients, but it is also responsible of different levels of contamination due to the presence of their metabolic by-products and body parts. Infestation often causes the development of hotspots and growth of microflora, making the products unsuitable for human consumption. Worldwide every year, about 10–30% of produced grains are lost due to insect damage (White and Leesch, 1995). Several cosmopolitan insect species are reported as pests of stored wheat, and their presence is highly influenced by different parameters like the storage duration, grain temperature, and grain moisture content, while observation of their presence depends on the grain sampling method used for detection. In the current study, we report the results of a survey carried out in different storage centers, with the aim of documenting the levels of arthropod fauna infesting high quality hard wheat.

2. Materials and methods

Monitoring surveys were carried out in 2006-2009 on high quality hard wheat coming from 31 different storage centers located in Southern Italy. The investigations were conducted using conventional survey methods which consisted of visual, sieving and biological testing of 297 cereal lots. Visual testing was carried out on 5 kg samples of hard wheat collected from each single lot (n=297), while sieving and biological tests were conducted on three different 50 g sub-samples (n=891) from each sample.

The visual test was carried out distributing the sample upon an illuminated table and observing it using magnifying glasses. All the arthropods present were collected and successively identified with the aid of a stereo-microscope. The sieving analysis was conducted using a series of sieves placed in decreasing size (2.30, 1.80 and 0.30 mm), from top to bottom, in a mechanical sieve shaker. Each sample was sieved for 10 minutes with 150 vibrations per minute. After the sieved material reached the pan, the arthropods retained in each sieve were then collected in Petri dishes and subsequently counted and identified. In

order to perform the biological test, samples were placed in jars at 26 ± 1°C and 75% relative humidity (r.h.) to allow the development of immature stages and then sieved at regular intervals (3-4 days) during an incubation period of 60 days, sufficient to complete the life cycle of the most common wheat insect pests (Süss and Locatelli, 2001). The data on the infestation levels obtained, were processed using the classes proposed by Gelosi & Süss (1991) based on the quantity of living arthropods present for each kilogram of hard wheat examined.

3. Results

The highest infestation rate was revealed by the visual test (87.54%) compared with the biological (58.36%) and the sieving tests (47.03%). According to the classification of the infestation level (Gelosi and Süss, 1991) (Fig. 1), only 13% of the total samples examined were not infested while 23% and 37% presented relevant and heavy infestation levels containing 4-10/kg, or >10/kg of live arthropods respectively.

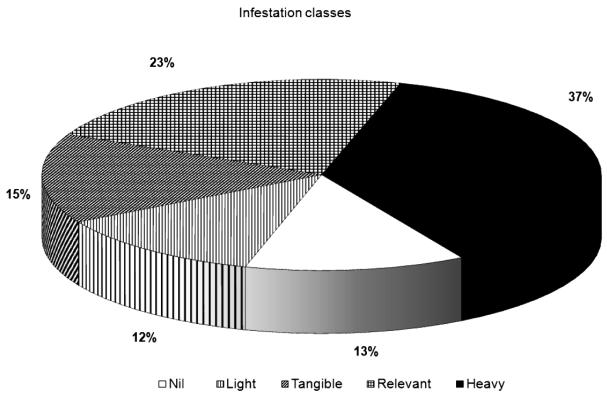

Figure 1 Infestation levels of the grain samples coming from 31 different storage centres, processed using the classes proposed by Gelosi and Süss (1991).

A total of 8 insect pests species were found (Fig. 2), mainly Coleoptera, all of them commonly reported as primary and secondary phytophagous pests typically associated with stored products. The most common internal grain feeders found were the granary weevil *Sitophilus granarius* (L.) and the lesser grain borer, *Rhyzopertha dominica* (F.) Regarding the external grain feeding insects, the main species that were found were Coleoptera; *Tribolium castaneum* (Herbst), *Tribolium confusum* Jaquelin du Val, *Tenebroides mauritanicus* (L.), *Oryzaephilus surinamensis* (L.), *Cryptolestes ferrugineus* (Stephens) and in few samples Lepidoptera; *Plodia interpunctella* (Hübner).

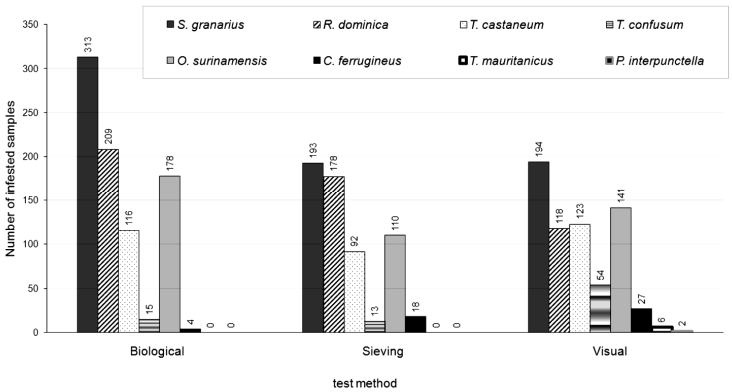

Figure 2 Total number of insect pest species recovered on the grain samples analyzed during the survey in Southern Italy in 2006-2009.

4. Discussion

More data were obtained by the visual test, and this is probably related to the greater sample size used samples (5 kg), which was considerably bigger than that used for the other survey methods (50 g). In relation to the recovered species, the most abundant were granary weevil and lesser grain borer confirming their presence and distribution in warmer areas of Italy, where their numbers increase progressively as a function of the optimal environmental conditions present in Southern Italy (Trematerra and Gentile, 2006). On the other hand, the high number of the saw toothed grain beetle *O. surinamensis* and of *Tribolium* spp., intercepted in the visual test has to be referred not only to the larger sample size, but also to the fast and frequent adult movements that make these species easily visible. The high infestation level recorded in the present study on some of the analyzed samples could probably be due to the longer storage of the product which allowed hatching and subsequent propagation of these insect populations.

In contrast, the total absence of mites as well as beetles belonging to the family of Trogiidae that also feed on mould mycelium, in all the samples examined showed, at the least in terms of moisture presence in the storage centers, that the cereal lots were correctly managed; in fact none of the checked samples, showed mould development that, as well known, represents the main substrate for these arthropods species. In this framework, in order to slow or deter the loss of quality of the grain, some techniques such as the use of extreme temperatures, could represent one important approach to follow for insect pests management. In fact, it has been shown that the use of the high temperatures against the grain insects living outside the kernels does not harm the quality of the grain. However, when this technique is used to control the insects developing inside kernels, it can cause a slight decrease in the germination rate, although this is insignificant for grain to be used as food and animal feed (Mourier & Poulsen, 2000). Moreover, other techniques, some of them actually employed for organic production in Italy, i.e. inert dusts, modified atmosphere based on carbon dioxide (CO2) or nitrogen (N2), could provide a valid support to the control programs of insect pests on grain.

In conclusion, the results indicate that the general hygienic conditions and control measures adopted by these different storage centers against stored-product pests should be revised, at least in terms of preventive interventions, keeping in mind how an early detection and the knowledge of the life histories and habits of the arthropod species present in the storage centers are essential for correct control procedures and for protection of the products involved. The results also indicate the importance of faunistic and bioecological research on arthropods associated with stored durum wheat, considering the economic and sanitary importance of these pests that considerably affect the quality of the product.

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