Arthropod monitoring in an automated pasta warehouse

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Abstract

Pest monitoring was carried out in an automated pasta warehouse. It is managed with a logistic process and can contain more than 30,000 pallets. Good pest monitoring is difficult in this environment particularly because of the height (more than 20 m). Several sticky traps were placed on the floor under the shelves to monitor the presence of arthropods. Monitoring was done twice, once in March and once in November, each time for two weeks. Results showed the presence of stored-product pests, but also the occurrence of other arthropods.

Keywords: Pest monitoring, Stored-product pests, Automatic warehouse, Arthropods, Insects.

1. Introduction

In every environment where food is processed and stored, insects, mites and rodents are unwelcome intruders. Italy is an important producer and exporter of pasta and great deal of effort has gone into studying pest problems (Frilli, 1965; Dal Monte, 1985; Süss and Locatelli, 1996; 1997; Trematerra, 2002; 2004, Trematerra and Süss, 2006). Pasta factories, as any other food industry, can be infested by insects that are able to follow manufactured goods (packaged pasta) in stocking warehouses. Economic and commercial consequences of infested pasta can be very negative.

Monitoring traps are normally placed to promptly show the possible presence of pests. Also in automated warehouses, where manufactured foodstuffs are kept, infestation can occur, but monitoring is often impossible to carry out. In fact, pheromone traps for Lepidoptera and Coleoptera can be placed mostly only at the entrances or in some no-transit areas, but certainly not evenly-spaced in the whole warehouse. This is due to the enormous dimensions of the shelf facilities which reach great heights and have transit lanes among shelves. The situation is even more complex in the warehouses where pallets are placed automatically by trailers with a computerized system. In these cases, the presence of insect pests can be detected only when a pallet is collected from the trailer to be sent to the customer.

This study aims at verifying the presence of pests in an automated pasta warehouse, using unbaited sticky traps. Among the captured arthropods, the goal in particular was to highlight which ones are potential pests of pasta and which ones are occasional pests and to show the control measures that can be taken.

2. Materials and methods

The study was conducted in an automated pasta warehouse in Italy. The warehouse is 20 meters high and divided into 4 aisles. It contains more than 30,000 pallets of pasta that can be stored for different lengths of time up to several months. During this time, pasta pallets can be moved automatically to other positions, according to what the computerized system decides, in order to optimize space and storage. The warehouse receives continuously pallets from the pasta factory through an opening in which the conveyor belt passes. The conveyor belt arrives in the warehouse from the left side under the inspection gangway. The outgoing pallets leave the warehouse through a dedicated opening in the center, in the warehouse front. The movement of the pallets is steady and automatic. The warehouse has, in addition, a security exit on the opposite side that is kept closed.

Pest monitoring in the warehouse was carried out through 3 pheromone traps for moths and 3 anobiid traps, that were placed at the plant entrance where there is a narrow gangway among the operating controls of the entire system. The number of traps was certainly not enough to cover the whole warehouse area and inadequate to give information about a possible presence of pests.

To monitor the presence of pests, 54 unbaited sticky traps made of cardboard (13 cm x 10 cm) were placed on the floor of each aisle (216 in total), at a regular distance, in order to capture insects and other possible arthropods present in the area.

The sticky traps were placed in spring (March 2009) and in autumn (November 2009). They monitored the presence of arthropods for 15 days. The placement of the traps and their recovery required the whole computerized system to be shut down in order to enter the aisles between the shelves.

All traps were brought to the laboratory and observed with the stereoscopic microscope. Insects were divided into Orders and Families and classified to species, only if they were pests of pasta.

3. Results

A total of 1668 arthropods were collected in spring and 1591 in autumn. They belong mainly to Insecta, followed by Arachnida. In the autumn, 2 young geckos were also found: they were present in the warehouse as predators of arthropods (Table 1). In spring, among Arachnida, there were many spiders belonging to different species: they were probably preying on many of the insects present in the warehouse.

Table 1 Total amount of animals collected in the pasta warehouse in spring and autumn.

Class	Order	Spring	Autumn
Insecta	Thysanura	0	8
	Collembola	625	101
	Pscoptera	177	280
	Orthoptera	2	2
	Dermaptera	30	113
	Heteroptera	20	117
	Lepidoptera	1	2
	Diptera	348	283
	Hymenoptera	24	67
	Coleoptera	214	464
	Siphonaptera	1	0
Arachnida	Araneae	217	136
	Ixodida	9	4
Malacostraca	Isopoda	0	14
Reptilia	Squamata (Fam. Gekkonidae)	0	2

The collected insects belong to the orders of Thysanura, Collembola, Psocoptera, Orthoptera, Dermaptera, Heteroptera, Lepidoptera, Diptera, Hymenoptera, Coleoptera and Siphonaptera (Table 1). Most insects captured in spring belong to the order of Collembola (43%), followed by Diptera (24%), Coleoptera (15%) and Psocoptera (12%), whereas in autumn the majority of insects were Coleoptera (32%), Diptera (20%) and Psocoptera (19%) (Fig. 1, 2).

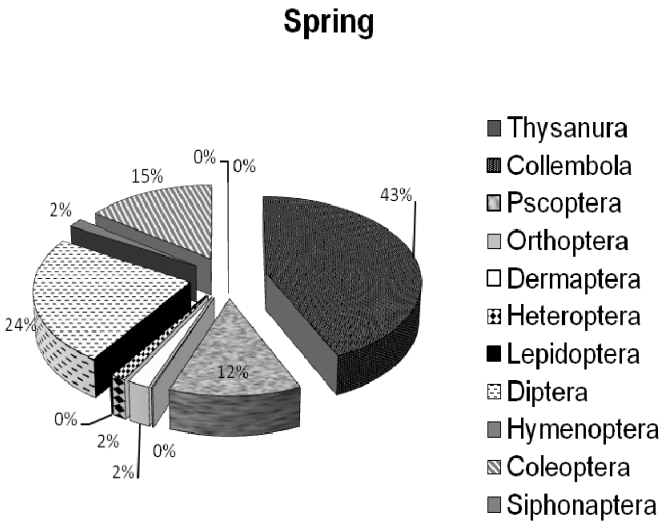


Figure 1 Insects collected in spring.

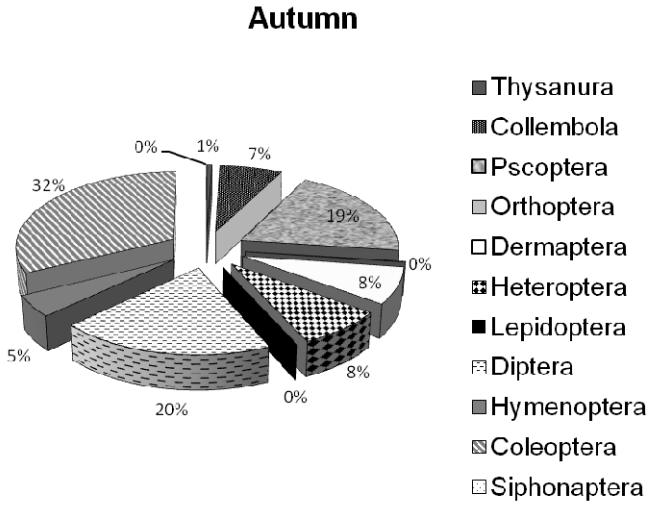


Figure 2 Insects collected in autumn.

The high number of Collembola, with species belonging to the genus *Hypogastrura*, and Psocoptera, especially *Liposcelis bostrychophila* Badonnel, is linked to the high relative humidity of the warehouse floor, caused by some rainwater seepage from the walls. Psocoptera were found throughout the whole warehouse both in spring and in autumn (Tables 2, 3); Collembola were present mostly in spring and, in different positions, more than 10 individuals/trap were captured (Tables 4, 5). It is reported that *L. bostrychophila* is the principal psocid pest species in Europe (Turner, 1998). At high density *L. bostrychophila* taints foodstuffs with waste products and may elicit allergic reactions in sensitized persons.

Furthermore, other species, mostly mycophagous and debris-eating, were found both among Diptera and among Coleoptera. In fact, the majority of Diptera belonged to the Mycetophilidae, albeit in autumn there were also Culicidae (*Culex pipiens* L.) that overwinter as adults in protected areas.

Among Coleoptera we found lathridiid beetles, cryptophagid beetles, *Typhaea stercorea* (L.) and *Ahasverus advena* (Waltl). They are mycophagous and their presence indicates moldy conditions. They do not feed directly on stored foods and their occurrence in commodities may be considered accidental contamination. Both in spring and in autumn, they were found throughout the warehouse, but in small numbers (21 traps in spring and 48 in autumn with less than 5 insects/trap) (Tables 6, 7).

Moreover, there were carabid beetles and staphilinid beetles, predators of insects. Their presence grew significantly in autumn, especially for staphilinid beetles that were found in 102 traps, placed throughout the warehouse (Tables 8, 9). Carabid beetles were found in 45 traps, that were placed more or less evenly throughout the warehouse (Tables 10, 11). The higher presence of these beetles in autumn may have been due to their inclination to find shelter to overwinter.

Heteroptera belonged basically to the families of Pentatomidae and Lygeidae; they were found in high numbers in autumn because they are insects that overwinter, as adults, in protected points and thus found shelter in the warehouse.

The number of species infesting foodstuffs was generally limited. Among the species that attack stored products, there were many *Oryzaephilus surimanensis* (L.) and *O. mercator* (F.), that fed on debris on the floor. They were present both in spring and in autumn. In spring, *Oryzaephilus* spp. was present in all the four aisles but concentrated especially in the first half of the warehouse, towards the entrance, with a density generally less than 5 insects/trap (Table 12). Only 6 traps captured from 5 to 10 individuals, mostly in the first half of the second aisle. In autumn, they were even more spread out as they were present in 79 traps compared to 70 in spring. They were found along the whole length of the warehouse, especially in the first and third aisle (Table 13). Trap number 36 captured more than 10 individuals, the other two traps captured from 5 to 10 individuals and the remaining ones less than 5.

Among pests of pasta, which are mainly *Sitophilus* spp., *Rhyzopertha dominica* (F.), *Lasioderma serricorne* (F.) and *Stegobium paniceum* (L.), there was occasionally only *S. oryzae* (L.). It was present mostly in the spring, in the first half of the first aisle (Table 14). In this area, pallets were heavily infested in the previous year. The infestation was managed by removing infested pasta and treating the floor with pyrethroids. In the autumn, captures of *S. oryzae* were very rare; they were found only in 6 traps, and less than 5 insects/trap (Table 15).

Table 2 Distribution of Psocoptera (*Liposcelis* spp.) in spring.

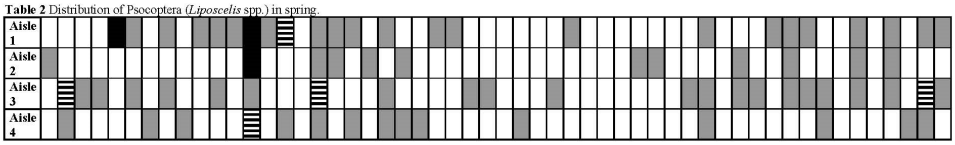


Table 3 Distribution of Psocoptera (*Liposcelis* spp.) in autumn.

Table 4 Distribution of Collembola (*Hypogastrura* spp.) in spring.

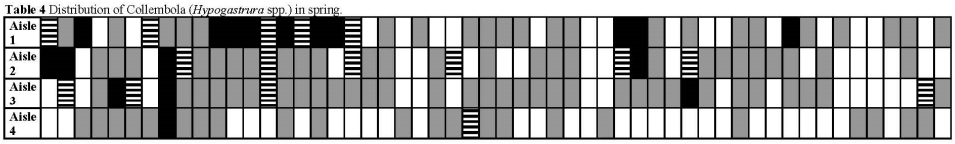


Table 5 Distribution of Collembola (*Hypogastrura* spp.) in autumn.

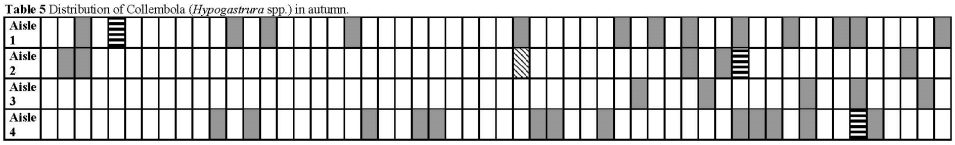


Table 6 Distribution of Lathridiidae, Cryptophagidae, *A. advena*, *T. stercorea* in spring.

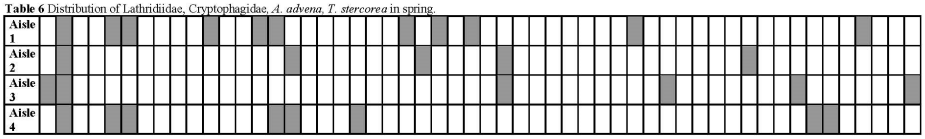


Table 7 Distribution of Lathridiidae, Cryptophagidae, *A. advena*, *T. stercorea* in autumn.

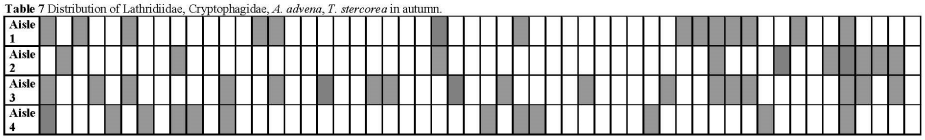


Table 8 Distribution of Staphilinidae in spring.

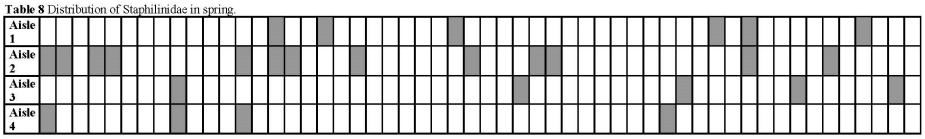


Table 9 Distribution of Staphilinidae in autumn.

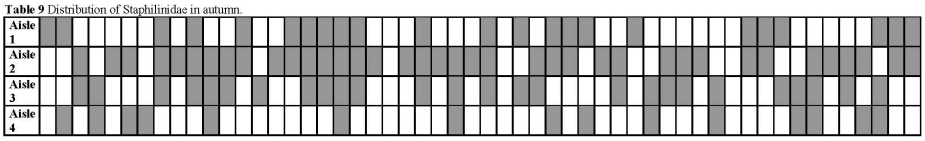


Table 10 Distribution of Carabidae in spring.

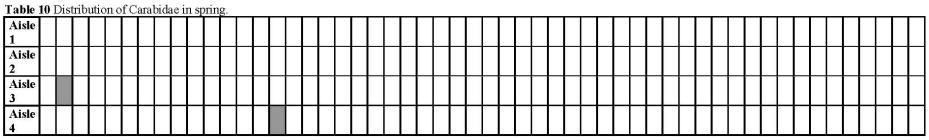


Table 11 Distribution of Carabidae in autumn.

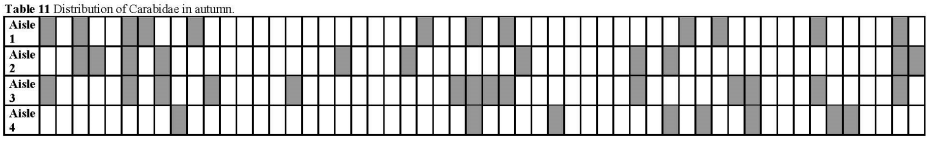


Table 12 Distribution of *Oryzaephilus* spp. in spring.

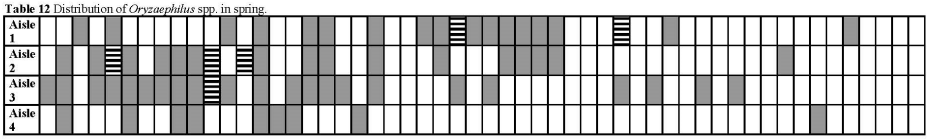


Table 13 Distribution of *Oryzaephilus* spp. in autumn.

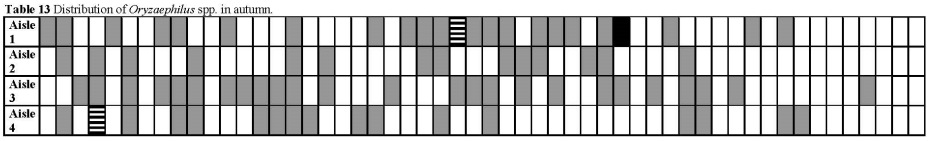


Table 14 Distribution of *Sitophilus oryzae* in spring.

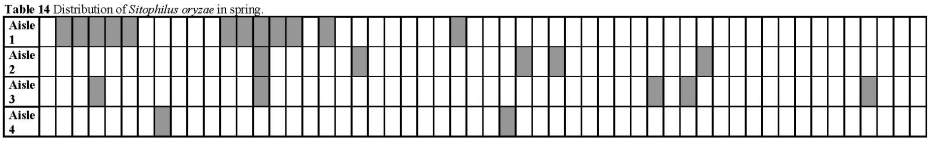
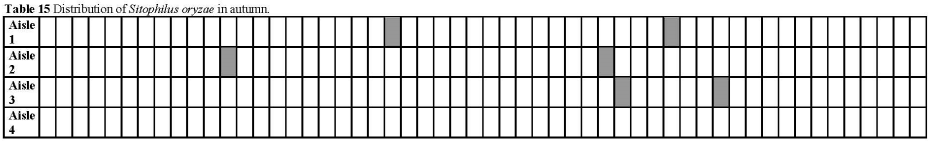


Table 15 Distribution of *Sitophilus oryzae* in autumn.



Distribution of insects collected in each aisle of the pasta warehouse: every square represents the position of a sticky trap.

- no insects
- < 5 insects
- 5-10 insects
- > 10 insects

Furthermore, the finding of a rodent flea in spring gave some cause for concern because it could be linked to the presence or passage of a rodent in the warehouse, although no traces of its activity were noticed. The presence of some hard ticks (*Ixodes* spp.), both in spring and in autumn, can be the sign of the presence of stray dogs outside the warehouse (Table 1). The warehouse is indeed located in an industrial area surrounded by non-tilled fields where some stray dogs were noticed.

The capture of several individuals belonging to different species of pentatomids, lygeids, carabids and staphilinids can thus be explained with the presence of non-tilled areas outside the warehouse. They develop in the countryside and look for nesting areas in autumn to overwinter.

4. Conclusions

This study showed which arthropods were present in the automated warehouse and their distribution. As a result of this study, monitoring is now carried out continuously (every two weeks) by the company. A technician is responsible for placing the traps, collecting them, and examining trap catch. Monitoring is carried out every two weeks. Identification of species is made only for insects infesting pasta (*Sitophilus* spp., *R. dominica*, Anobiidae), so that traps can be replaced more quickly (1-2 days are necessary to replace them). According to the operative protocol established by the Company, if insects infesting pasta are found, all the pallets above the monitoring point and immediately on the right or on the left are to be taken outside the warehouse and examined by trained staff. If a pallet has only one infested package, it is completely removed. The area of the floor where insects are captured is treated with pyrethroids (deltamethrin). Before this management procedure, without this kind of monitoring, there were heavy losses and widespread attacks. Since this new management has been implemented, the number of complaints has significantly decreased. For this reason, although it is an onerous and demanding practice, it continues to be used by this company.

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