

## NEW AND UNUSUAL REPORTS

**Evidence and Symptoms of Pasta Infestation  
by *Sitophilus oryzae* (Curculionidae; Coleoptera)  
in the Czech Republic**

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STEJSKAL V., KUČEROVÁ Z., LUKÁŠ J. (2004): **Evidence and symptoms of pasta infestation by *Sitophilus oryzae* (Curculionidae; Coleoptera) in the Czech Republic.** Plant Protect. Sci., 40: 107–111.

Heavy infestation of pasta by the internally feeding pest *Sitophilus oryzae* (Coleoptera: Curculionidae) was recorded for the first time under field conditions in the Czech Republic. Symptoms of hidden infestation (eggs, larvae, pupae and adults) and a comparison of optical methods to detect them are described for the use by farmers, plant health and phytoquarantine inspectors. Photo-documentation is included.

**Keywords:** *Sitophilus oryzae*; pasta; symptoms of infestation; photo-documentation

Stored product pests have the capacity to infest both raw and processed agricultural products. Infestation can follow the whole production network; from grain stores (STEJSKAL *et al.* 2003), mills to bakeries and other food processing factories and also to feed mills (TREMATERRA & FIORILLI 1999). It should be stressed that the ability to effectively monitor and control infestations of processed products is important not only for the food industry but also for primary agriculture. This is due to the fact that storage pests can spread both down and up the food production chain. Spoiled processed products are commonly sold back to farms as feed for animals; pasta and other cereal products are not exempt from this practice. Once they reach a farm, the infested products may eventually become a source of re-infestation of stored primary agricultural products (e.g. stored grain, pulses, oils, seeds etc.).

In the Czech Republic, scientific documentation of infestation and development of stored-grain product pests on pasta exists only for externally feeding pests (e.g. *Tribolium* spp., *Oryzaephilus* spp.), while for internally feeding pests such evidence is not available. It is a common experience and belief that internally feeding pests develop only inside kernels of grains. Although Italian scientists (ROTUNDO *et al.* 1995; BONAFACCIA *et al.* 1999; SUSS & LOCATELLI 1999) indicated the potential of some internally feeding pests to develop in processed cereal products possessing a compact physical structure, the risk of cross-infestation of a raw product from processed pasta by internally feeding pests was generally considered to be zero in the Czech Republic. Therefore, we found it worthwhile to (i) report the case history of a heavy infestation of pasta by an internally feeding pest, *Sitophilus oryzae*, recorded for the first time under field conditions in

the Czech Republic, and (ii) to describe symptoms of the infestation of pasta for the use by farmers, plant health and phytoquarantine inspectors.

## MATERIAL AND METHODS

An infested sample of pasta (315 g) was sifted by machine (Retsch AS 200 digit.; time 2 min, sieve  $200 \times 50$  mm, mesh size 2 mm) to extract insects. These were counted and determined (Gorham 1991). The whole sample was then investigated under a stereomicroscope (Nikon SMZ 800) to detect particular developmental stages (eggs, larvae, pupae and adults) directly inside pasta units (= macaroni pieces). Injury (i.e. infestation symptoms) due to feeding by and development of the pest were documented with a digital camera (Olympus Camedia C5050Z). Characterisation of pasta units: short pieces of macaroni type pasta made from durum wheat (for photo see Figure 4), weight of one pasta unit (= macaroni piece) was  $0.658 \pm 0.02$  g, size was  $2.05 \pm 0.08$  cm  $\times$  0.8 cm, its wall was about 1 mm thick.

## RESULTS

### Quantitative and qualitative characterisation of infestation

The investigated sample of pasta product was infested solely by one species of stored product pests: rice weevil, *Sitophilus oryzae* L. (Curculionidae, Coleoptera). The sample contained developmental stages (eggs, larvae, pupae and adults) of *S. oryzae*. We consider this as evidence that *S. oryzae* is able to complete its whole life cycle on a pasta prod-

uct under field (i.e. non-laboratory) conditions of the Czech Republic. The infestation level reached 1945 specimens (all developmental stages) of *S. oryzae* per 1 kg of pasta. Most of the pasta units (= macaroni pieces) revealed symptoms of damage; only 1.9% of the units were unaffected. Interestingly, we found that *S. oryzae* may cause significant damage not only by larval but also adult feeding: 8.1% of the sample was damaged by adult feeding without any evidence of larval development. The infestation ranged from one to seven individuals of all stages of *S. oryzae* per unit of pasta; most frequent (33%) were two individuals per unit (Figure 1). The maximum of emerged adults was five individuals per unit of pasta. Eggs and larvae were the most frequent developmental stages found in pasta (Figure 2). The highest recorded loss in weight of a pasta unit was 8.5% (Figure 3).

### Symptoms of infestation

**Egg.** The female bores a hole into the pasta surface, using its biting mouthparts. One egg is laid in this hole, which is then plugged with a jelly-like substance that seals the egg inside the pasta. Figures 4a and 4b show a comparison of two optical methods (upper or bottom illumination under a stereomicroscope) to detect the hidden infestation of pasta by eggs that can be easily employed by plant health or phytoquarantine officers. We found bottom lighting to be more effective.

**Larva.** After hatching the larva feeds and pupates within the pasta. The larval corridors are visible through the pasta surface because of their milk-white colour (Figure 4c). The evidence of hidden infestation is again better visible with bot-

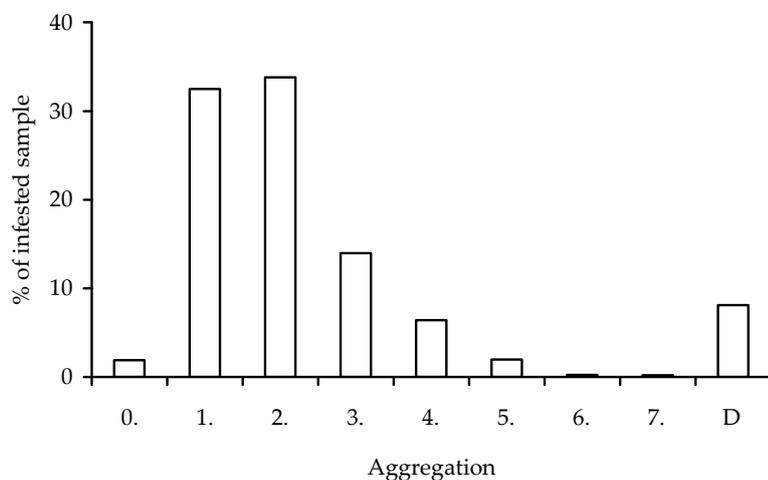


Figure 1. Frequency of aggregation of *Sitophilus oryzae* in infested pasta sample (0–7 various developmental stages per one unit of pasta [= macaroni piece], D – only feeding damages)

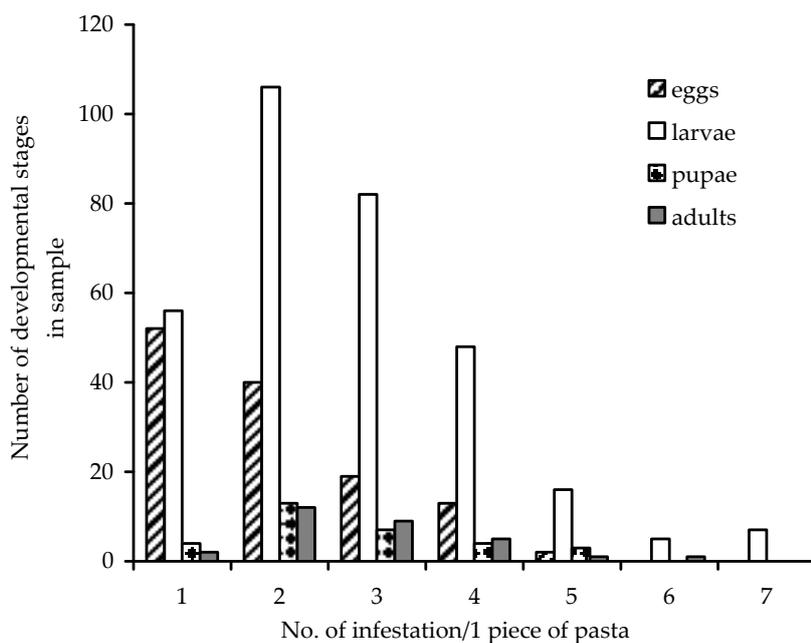


Figure 2. Abundance distribution of particular developmental stages of *Sitophilus oryzae* in an infested sample of macaroni type pasta

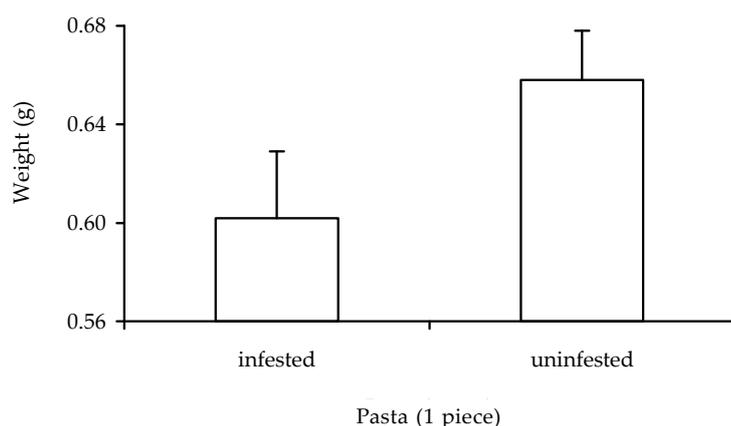


Figure 3. Weight damages due to pest presence in pasta sample (e.g. three to four breeding cavities per pasta unit)

tom lighting, by which the corridors appear dark (Figure 4d). The larval feeding corridors reach up to 1 cm in length (Figure 4d).

**Pupa, adult.** Both developmental stages (Figures 4e, f) are visible as dark spots in pasta units (Figures 4g, h). Figures 4c and 4d show the oval hollows and caverns, and the holes made by the adult beetles at emergence.

## DISCUSSION

This case history reveals that *Sitophilus oryzae* is able to develop on macaroni type pasta under field conditions of the Czech Republic. The infestation by this pest can negatively influence characteristics of both quality (aesthetic appearance, hygienic contamination and health hazard) and quantity

(weight loss) of stored pasta products and their market value. The hidden infestation of pasta by *S. oryzae* is impossible to be cleaned off and, as a consequence, the infested pasta is unsuitable for human consumption. However, highly infested pasta may not be suitable even as animal feed because of a possible health hazard to animals. It was documented that e.g. mite-infested feed may have a negative impact on the health of chicken and pigs (Žďárková *et al.* 1979, 1992). In addition, the infested pasta, when used as feed for farm animals, has the potential to become a source of cross-infestation of stored grain products by internally feeding pests. The potential for multiplication of *S. oryzae* on pasta was found to be high. Whereas *Sitophilus* species are able to lay more eggs on a single kernel of grain, there is usually

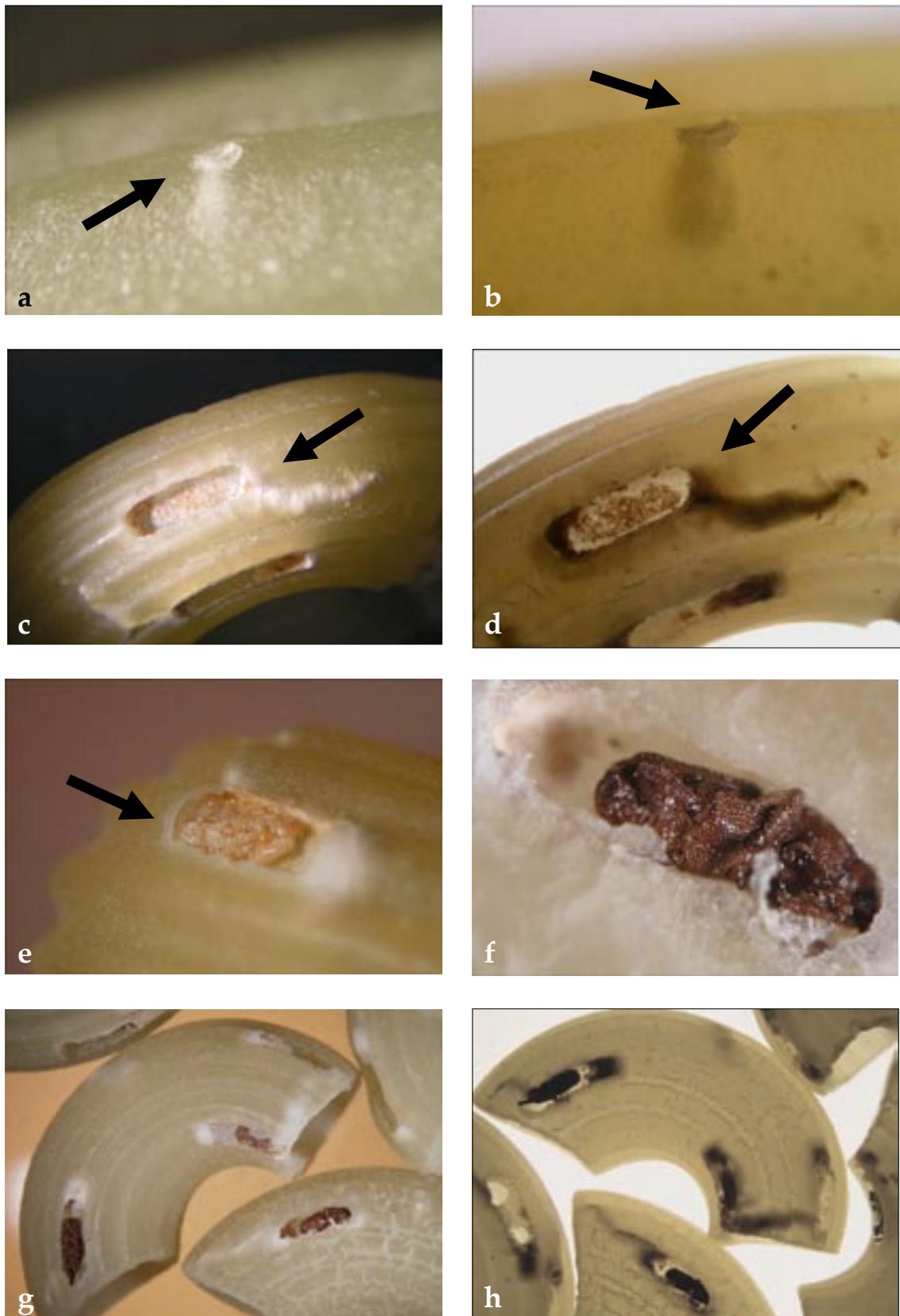


Figure 4. Symptoms of infestation: a, b – egg plug on pasta surface (upper and bottom lighting); c, d – larval corridor and hatching hollow after adult emergence (upper and bottom lighting); e – pupa, f – adult; g, h – detection of hidden infestation of pasta (comparison of upper and bottom lighting)

only one emerged adult per kernel (STEJSKAL & KUČEROVÁ 1996). However, in this study we found that macaroni type pasta units are large enough to allow development of several individuals of this pest. Symptoms of infestation of pasta by *Sitophilus oryzae* differ from symptoms on infested kernels of grain. Also, the feeding behaviour of larvae differs between pasta and grain because of their size and shape. In grain, the larva usually bores towards the centre of the kernel and hollows it out while feeding; the amount of larval food is limited by the size (i.e. length) of the kernel. On the other hand, the larva in macaroni type pasta is restricted by the thickness of the pasta wall (1 mm) but not by the length of the unit, so that the feeding corridor is longer until the larva reaches sufficient weight for pupation.

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### Souhrn

STEJSKAL V., KUČEROVÁ Z., LUKÁŠ J. (2004): **Evidence a symptomy napadení těstovin pilously *Sitophilus oryzae* (Curculionidae; Coleoptera) v České republice.** *Plant Protect. Sci.*, **40**: 107–111.

Silné napadení těstovin pilously (*Sitophilus oryzae*, *Coleoptera*: *Curculionidae*) je poprvé dokumentováno z provozních podmínek v ČR. Pro diagnostické účely jsou popsány příznaky skrytého napadení (vajíčko, larva, kukla, dospělec) včetně porovnání optických metod k jejich detekci (fotodokumentace).

**Klíčová slova:** pilous; *Sitophilus oryzae*, těstoviny; příznaky skrytého napadení; fotodokumentace

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