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AN INNOVATIVE APPROACH TO MONITORING INSECT PESTS IN SILOS

V. STEJSKAL
Research Institute of Crop Production,
Department of Stored-Product Pest Control, Drnovská 507,
161 06 Prague 6, Czech Republic

ABSTRACT

A new trap for monitoring pests in stored grain and other commodities was designed. A conical metal device is attached to a strong string which enables it to be used in silo bins holding deep grain masses. Usable as either a trap or a probe, this sampler enables simple, rapid and regular monitoring of stored grain to be done. The tool is also suitable for field evaluation of fumigation efficiency. Laboratory trapping data on this device's efficiency with four stored-product beetles are here presented.

INTRODUCTION

Early, precise detection of pests in bulk grain is a prerequisite for either successful fumigation or other protective measures. Traps are considered more sensitive than conventional sampling methods for detecting infestation. Insect pests can enter bins through openings above the headspace (Hagstrum *et al.*, 1994). Condensation at the surface layers of stored grain can encourage the build-up of infestations (Mills, 1990). Various surface traps, such as the grain probe trap, the PC trap, the cup trap and the pitfall trap, have been developed for monitoring insect pests in stored grains. These can all be used easily on the surface of bulk grain. However, their use in deep silos/bins is more problematic. Hagstrum *et al.* (1994) used sticky traps placed in the bin headspace. Wright (1991) used cardboard traps hung on strings to sample insect pests in empty silos. In the Czech Republic, 50% of the annual cereal production is stored by district agricultural trading companies (ZZN) in large silos and bins. No traps of any type have so far been used. Monitoring of pests (if done at all) is done by taking grain samples at the silo outlet since mobile vacuum samplers are considered by most storekeepers too time consuming for use in regular monitoring.

A new conical metal trap and sampler was developed in the Czech Republic to improve the quality of stored cereals. Initial testing has been carried out at the Research Institute of Crop Production in Prague. An evaluation of the efficiency of this trap in comparison with that of the "PC trap" (Cogan *et al.*, 1991) is here presented.

MATERIALS AND METHODS

Description and use

The metal conical trap/sampler is fastened to a long strong string. Its heavy tip permits it to be dropped from a height onto a remote grain surface. The basic set can be used by storekeepers in several configurations.

The hollow metal cone can be covered by a screw ring holding sets of removable wire-mesh lids with apertures of various sizes. This mode allows insect entry but retains grain (Fig. 1a). The metal cone can serve as a container for the "PC trap", thus giving results comparable with those obtained by that device (Fig. 1b). The final price for this mode, however, is higher than that of the preceding mode.

The plain cone can be fastened to the string (without the cover top, screw ring and wire sieve or PC trap). In this mode it can serve as a surface scoop for the quick and easy grain sampling required for periodic laboratory evaluation of moisture content, biochemical composition and hidden or mite infestation. This tool can also be used for field evaluation of fumigation results. Laboratory infested kernels (eggs/larvae/adults) enclosed in the trap chamber with the appropriate mesh for insect retention can be placed in the silo. After fumigation the samples can either be checked for insect mortality or incubated under favourable conditions until adult emergence.

Laboratory experiments

The laboratory experiments were carried out in complete darkness to avoid phototaxis in a controlled climate chamber (air, 26°C and wheat, 24°C with 50–60% r.h.). We

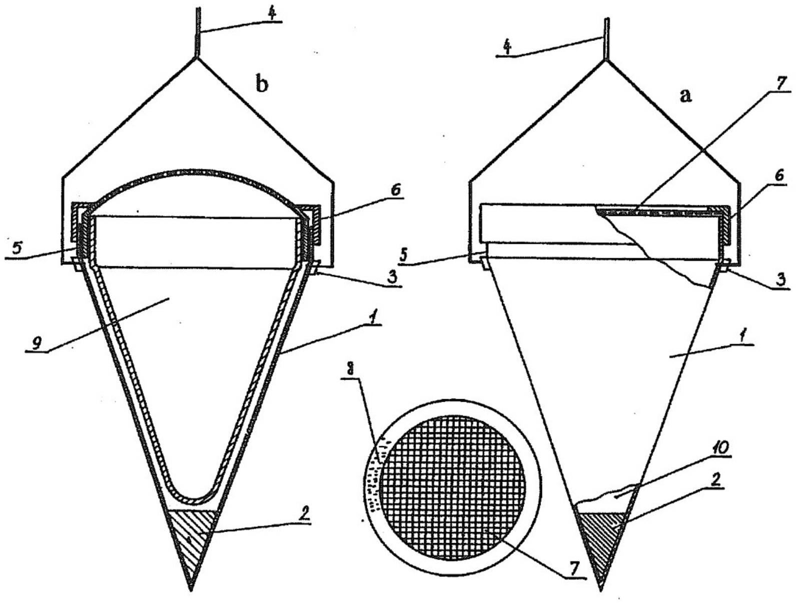

Fig. 1. Metal conical trap/sampler (a), with the PC trap (b) (1 = metal cone, 2 = heavy tip, 3 = ledge, 4 = string, 5 = thread, 6 = ring, 7 = mesh lid, 8 = rough surface, 9 = PC trap, 10 = chamber).

evaluated the responses of four species of stored-product beetles: *Tribolium confusum* J. duVal, *Sitophilus granarius* (L.), *Oryzaephilus surinamensis* (L.) and *Cryptolestes pusillus* (Schonherr). The strains were all insecticide-susceptible, having been mantained in the laboratory for many generations. A metal conical trap (in the first mode) was compared with a plastic PC trap (F. & B. Eng., Slough, UK). Five kg of sterilised wheat in plastic bags were placed in 22-cm diameter cardboard bins. At the start of each experiment, 50 adults of one of the above species were released and mixed into each bin so that the average infestation density reached 10 beetles/kg wheat. After 3 d of conditioning, either one "PC" or one "metal cone" trap was inserted into each bin. Each experiment consisted of three replicates. The traps were checked daily except on weekends.

RESULTS

Figure 2 shows the capture rates for the four beetle species in the two tested traps. The trapping curves were very similar for *T. castaneum* and *S. granarius*, but differed considerably for *C. pusillus* and *O. surinamensis*. Figure 3 shows the difference in capture rates between the traps after 30 d during which there was a significant difference only for

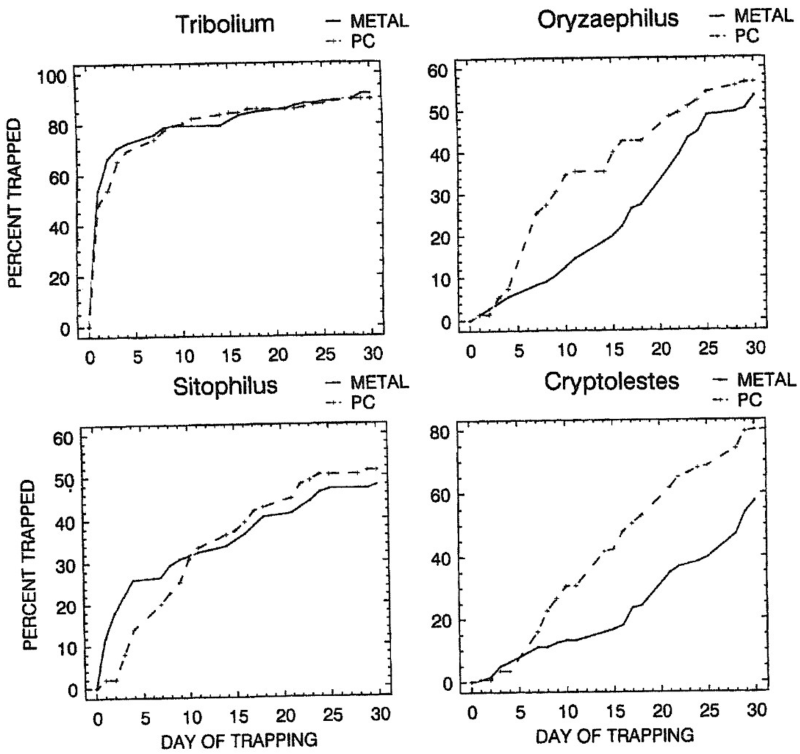

Fig. 2. Capture rate of *Tribolium confusum, Sitophilus granarius, Oryzaephilus surinamensis* and *Cryptolestes pusillus* in tested traps.

C. pusillus. After 30 d, the catch of the tested beetle species in both traps was, in descending order, *T. castaneum*, *C. pusillus*, *O. surinamensis* and *S. granarius*. However, as is clear from the curves in Fig. 4, because trapping response differed with time and species the trapability order was also time-variable.

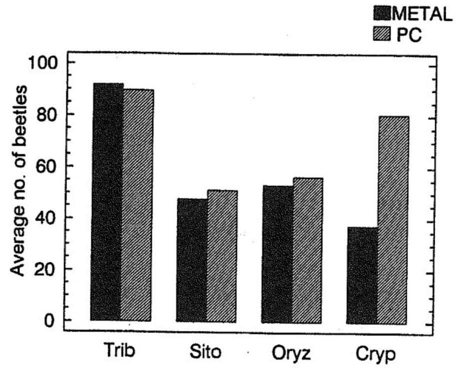

Fig. 3. Number of trapped insects after 30-d trapping period.

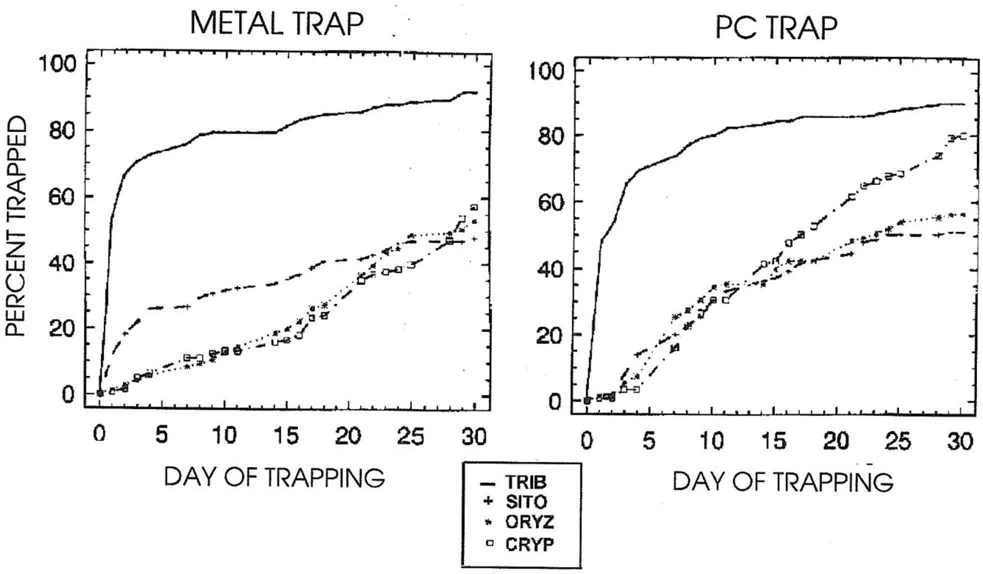

Fig. 4. Capture rate of four tested stored-product beetles in the PC trap and metal conical trap.

DISCUSSION

An increasing variety of insect traps with poor or no efficiency documentation has appeared on the Czech market (Stejskal, 1993). Nevertheless, there seems to be a widespread tendency to demand accurate interpretation of trapping results in terms of population density (Wilkin, 1990). It is known that trap efficiency and catch interpretation depend on trap type as well as other parameters (Barak *et al.*, 1990) including the environmental conditions for each pest species (Cuperus *et al.*, 1990; Stejskal, 1995). The increasing product proliferation exacerbates the number of unknown variables (Wright and Cogan, 1995). In order to avoid adding to this trend, we compared our trap to the PC trap data of Cogan and Wakefield (1994). The first laboratory results indicate that the metal cone trap/sampler is similar in efficiency to the PC trap for all the tested species of stored-product beetles except *C. pusillus*.

Barak *et al.* (1990) stressed that traps must be both easy to use and cost effective. The metal cone trap enables easy sampling of inaccessible grain surfaces in silos. It can facilitate examination for hidden larval infestations at low temperatures by monitoring of commodities or grain samples. This increases its effectiveness. Acoustical detection devices may become a more promising monitoring method for large silos and bins (Fleurat-Lessard *et al.*, 1994) because they provide population density estimates without disturbing the grain bulk. Nevertheless, in many cases traps will continue to be the cheapest and most easily used monitoring alternative.

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