The use of various insect traps for studying psocid populations

R. Roesli and R. Jones*

Abstract

The experiment reported here aimed to find the most reliable and cost-effective method of obtaining estimates of population densities of psocids, especially Liposcelidae, a group of small insects commonly found in very large numbers in humid tropical grain storage.

Sampling and trapping were done at silos (8 –10 m diameter) belonging to feed-milling companies in southern and northern Queensland. A 0.70 m compartmentalised spear sampler and three different insect traps, namely probe, pitfall and bait bag traps, were compared. Up to 68 spear samples were usually taken before, during or after trapping. Depending on the size of the silo, five or six of each type of trap were placed in the top 70 cm of the grain, and left to trap insects for 4 hours.

There were good correlations between density estimates obtained from trapping and spear sampling. When population numbers were very low, pitfall traps were best at detecting psocids. To estimate mean abundances, probe traps were the most reliable, and good estimates of mean density were obtained with two traps per silo.

Introduction

Psocids, especially *Liposcelis* spp., are small, soft bodied insects commonly found in very large numbers in humid tropical grain storage. These occurrences are often associated with grains regularly treated with insecticides and fumigants (Haines and Pranata 1982; Pranata et al. 1983). Until recently, psocids in storage were not thought to be pests. They had only been considered as an annoyance to the worker when found in large numbers, or as indicators for damp or bad storage conditions. However, McFarlene (1982), using small samples of milled rice, found that significant weight loss occurred due to heavy infestation of *Liposcelis bostrichophilus* Badonnel..

Studies that generate more information on the ecology and the biology of psocid in stores are needed to develop successful control measures. Such studies rely on the development of easy sampling or trapping methods that can give accurate population estimates.

Storage insect populations have usually been estimated by a spear sampling method. However, Hodges et al. (1985) suggest that large numbers of samples must be taken to obtain an accurate population estimate. Taking large numbers of spear samples is difficult, very time consuming and laborious, and the separation of insects from the grain samples presents a further problem.

* Zoology Department, James Cook University of North Queensland, Townsville, Q 4811 Australia.

This study aimed to find a psocid trapping method that will enable estimates of psocid population densities to be obtained reliably and easily.

Materials and Methods

Location and commodity

Sampling and trapping were carried out in silos (8 to 10 m diameter) belonging to feed milling companies of southern and northern Queensland. Three silos of a feed milling company located in Ayr, one silo at Clifton and three silos at Warwick were chosen for sampling and trapping. The types of grains that were sampled from each silo are listed in Table 1.

Table 1. Lists of silos, types of grain and numbers of sampling points of the experiment

Silo	Grain types	Number of sampling points
Ayr1	Sorghum	68
Ayr2	Sorghum	62
Ayr3	Barley	68
Clifton	Maize	40
Warwick 1	Oat	40
Warwick 2	Maize	40
Warwick 3	Oat	22

Spear sampling

The spear sampler used was about 70 cm long and originally designed for use with polypropylene bags. It was manually modified to a compartmentalised spear sampler with five compartments and an aluminium outer sleeve.

Samples were taken before (mostly), during or after the trapping was carried out. All samples were taken from the top 70 cm of the grain bulk. Numbers of sample points varied according to the size of silo, availability of time and sampling equipment during sampling, and infestation level (Table 1).

Using five funnels of 80 mm diameter supported by a wooden stand, grain samples obtained were removed separately from each of the five spear compartments into 30 mL plastic vials.

Separation of insects from the grain samples was done, soon after the samples arrived and were weighed in the laboratory, using extraction methods developed by Leong and Ho (1990). Insects were then preserved in 5 mL plastic vials, and psocids were counted using a low-power microscope.

Psocid trapping

Three insect traps, namely probe, pitfall and bait bag traps, were used in this experiment (Fig. 1.). The probe trap was a 370 mm × 27 mm diameter trap resembling the spear sampler, but with holes along the upper section and a glass tube inside

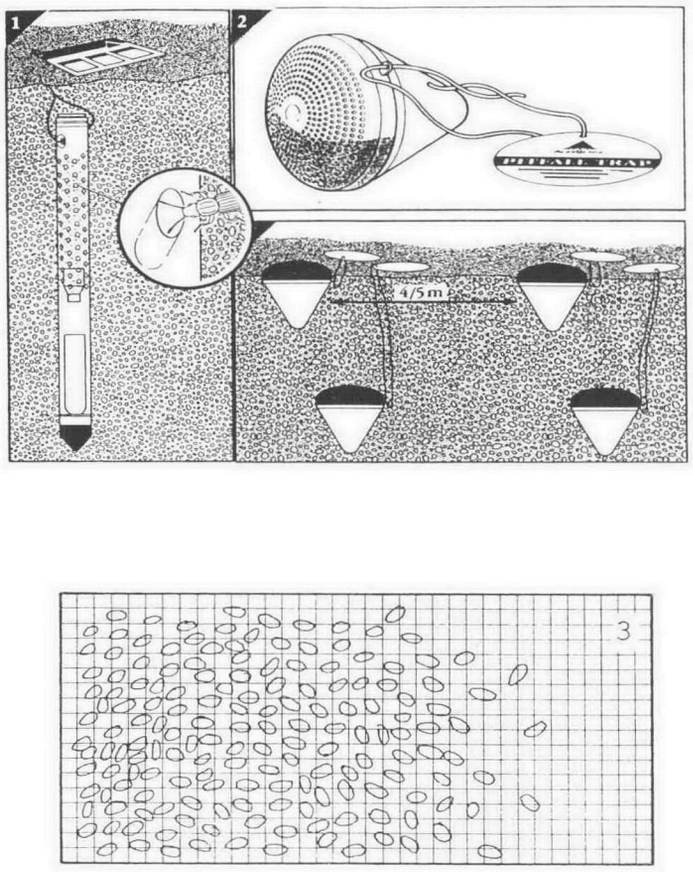

Fig. 1. Probe trap and pitfall trap (1 and 2, reproduced from commercial leaflet with permission of AgriSense), and bait bag trap (3).

the trap. The pitfall trap was a 95 mm × 125 mm, cone-shaped trap with catching holes through the top of the trap. The bait bag trap was a sealed envelope (8 × 16 cm) of netlon plastic mesh (2.00 mm apertures) containing 60 g of brown rice.

Six, for bigger silos like Ayr1, Ayr2 and Ayr3, or five, for the rest of the silos, of each type of trap were placed in the top 70 cm of the grain and left to trap insects for four hours.

At the end of trapping period, insects trapped in probe and pitfall traps were directly removed into 5 mL vials and preserved. Bait bag traps were removed from the grain, put into clickseal bags and sealed; insects were then removed from the trap by shaking the plastic bag approximately 20 times. The trap was then taken out of the bag, and insects were removed into 5 mL vials. Psocids were counted later under the microscope.

Data analyses

In order to find the correlation between the spear sampling result and the trap catches, simple linear regression analyses were done to the mean psocid numbers per trap and the psocid mean numbers per 100 g estimated from spear samples.

To evaluate the numbers of trap sample replicates needed to obtain reliable correlations with mean spear sample densities, analyses were repeated with randomly chosen subsets of the trap catches. This procedure was repeated 10 times for each subset size (1, 2, 3, 4, or 5 trap samples). The mean, standard error and range of the resultant R^2 value were then plotted against the number of trap samples per subset.

Results and Discussion

At least three species of *Liposcelis*, i.e. *L. bostrichophilus, L. entomophilus* (Enderlein) and *L. paetus* Pearman and one non-*Liposcelis* species were recognised from the samples and trap catches.

The results of the spear sampling are presented in Table 2. The highest psocid population was found in Ayr 1 silo, and the lowest in Warwick 3 silo.

The results of each trapping method are presented in Table 3. The highest psocid catches of all traps were also found in Ayr1 silo, and the lowest in Warwick 3 silo. The rank order of psocid mean numbers from probe trap catches (Table 3) is much the same as that of psocid numbers per spear compartment (Table 2).

The results (Tables 2 and 3) show that at very low psocid infestation, i.e. at Warwick 3 situation, most sampling and trapping methods, except pitfall trap failed to trace their presence. Pitfall traps may therefore be the most reliable method of detecting early infestations or reinfestations of psocids.

The regression analyses of trapping against sampling method are shown in Figures 2 and 3. There is significant correlation for all trap types between the mean trap catch and density estimates obtained from spear samples. However, the probe trap gave the best and most reliable correlation with

Table 2. The means and standard error of psocid numbers per spear compartment and per 100 g.

Silo	Psocids/compartment	Psocids/100 g
Ayr1	1.6030 ± 0.163	22.208 ± 2.249
Ayr2	0.119 ± 0.021	2.169 ± 0.375
Warwick 1	0.050 ± 0.015	3.554 ± 1.286
Ayr3	0.012 ± 0.006	0.203 ± 0.101
Clifton	0.010 ± 0.007	0.317 ± 0.224
Warwick 2	0.005 ± 0.005	0.100 ± 0.100
Warwick 3	0	0

Table 3. Mean numbers of trap catches and the standard errors of probe, pitfall and bait bag traps.

Silo	Probe	Pitfall	Bait bag
Ayr1	778.33 ± 673.97	168.83 ± 40.02	10.33 ± 7.33
Ayr2	27.33 ± 6.11	53.67 ± 18.33	2.67 ± 0.61
Warwick 1	12.40 ± 7.28	46.20 ± 42.00	1.40 ± 0.93
Ayr3	0.33 ± 0.33	1.00 ± 0.52	0.67 ± 0.67
Clifton	0.20 ± 0.20	2.20 ± 0.49	0.80 ± 0.48
Warwick 2	0.20 ± 0.20	4.40 ± 0.75	0.20 ± 0.20
Warwick 3	0.00 ± 0.00	0.60 ± 0.24	0.00 ± 0.00

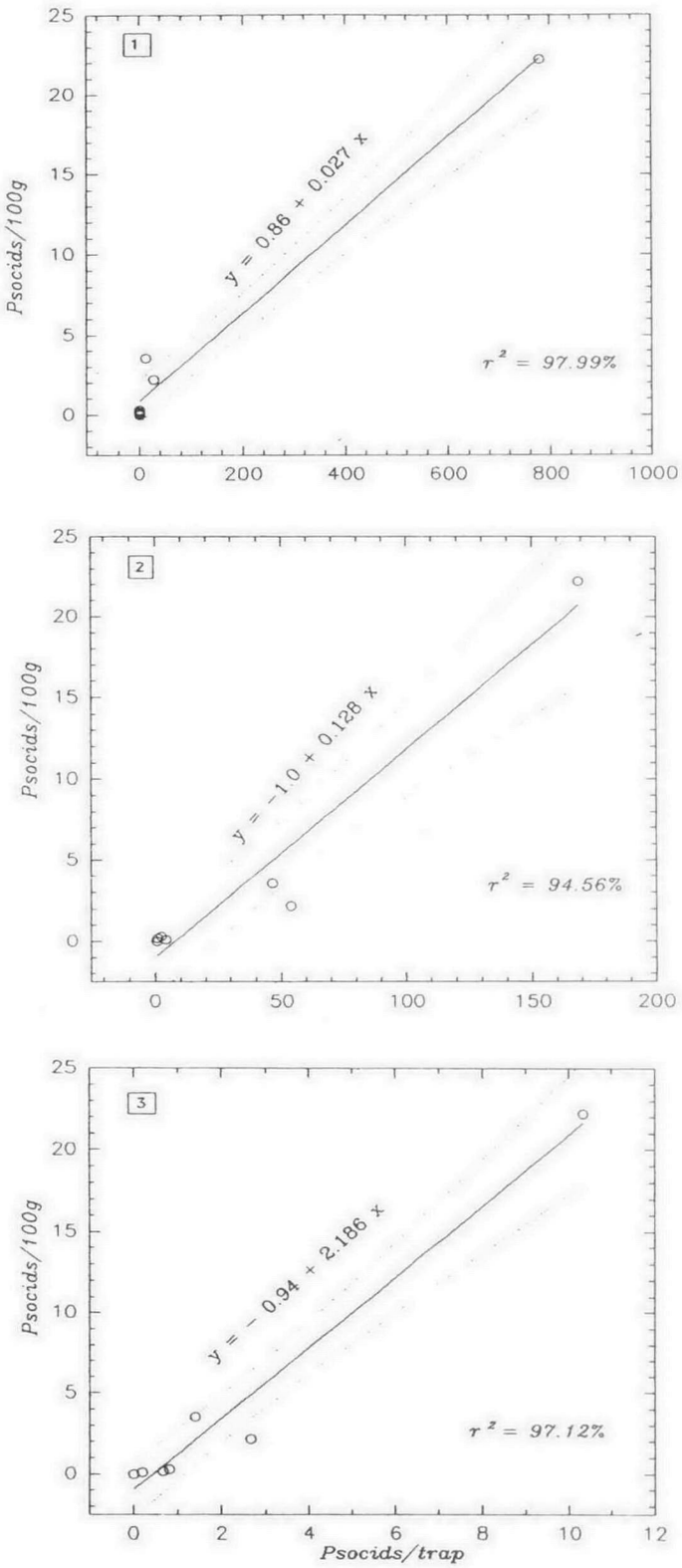

Fig. 2. Correlations between the mean trap catch of probe trap (1), pitfall trap (2), and bait bag trap (3); and density estimates obtained from spear samples.

spear sample densities. Even when only 1 trap was used, the average R^2 values exceed 90%. Little or no improvement in the R^2 magnitude or reliability was achieved by increasing the number of traps per silo above two.

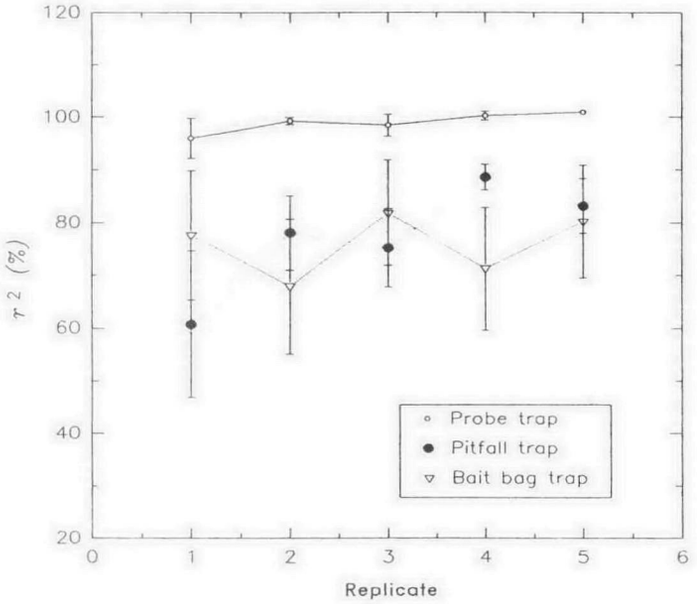

Fig. 3. The average R^2 (%) values of randomly chosen subsets of trap catches against replicate numbers of trap.

Conclusion

There are good correlations between density estimates obtained from trapping and from spear sampling, and therefore traps can be used to estimate psocid population densities.

When population numbers are very low (at early infestation), pitfall traps do best at detecting psocids.

To estimate mean abundances, probe trap are the most reliable, and good estimates of mean density may be obtained with sample sizes of two traps per silo.

Acknowledgments

The authors would like to thank Dr. R. Hodges, NRI the U.K., for his assistance; Mr Paul Cogan, MAFF, the U.K., and AgriSense the U.K., for providing free samples of traps; and the feed milling companies in Ayr, Clifton and Warwick for allowing us to sample the silos.

References

Haines, C.P. and Pranata, R.I. 1982. Survey of insects and arachnids associated with stored products in some parts of Java. In: Teter, N.C. and Frio, A.S. ed., Progress in Grain Protection. Proceedings of the 5th Annual Workshop on Grains Post-Harvest Technology. Southeast Asia Cooperative Post-Harvest Research and Development Program, Laguna, Philippines, 17–48.

Hodges. R.J., Halid, H., Rees, D.P., Meik, J. and Sarjono, J. 1985. Insect traps as an aid to pest management in milled rice stores. Journal of Stored Products Research 21 (4), 215–229.

Leong, E.C.W. and Ho, S.H. 1990. Techniques in culturing and handling of Liposcelis entomophilus (Enderlein) (Psocoptera: Liposcelidae). Journal of Stored Products Research 26 (2), 67–70.

McFarlene, J.A. 1982. Damage to milled rice by psocid. Tropical Stored Products Information 44, 3–10.

Pranata, R.I., Haines, C.P., Roesli, R. and Sunjaya. 1983. Dust admixture treatment with permethrin for the protection of rough rice and milled rice. In: Tetter, N.C., Semple, R.l. and Frio, A.S. ed.,. Maintaining Good Grain Quality. Puncak Pass, Bogor, Indonesia, South-East Asia Cooperative Post-Harvest Research and Development Program and ASEAN Food Handling Bureau (Proceeding of the sixth Annual Workshop on Grains Post-Harvest Technology), 132–136.