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Psocids: weight losses of grain and biological control by pseudoscorpions

M.J. Pascual-Villalobos¹

Abstract

Psocids are common pests of stored rice in Spain. Weight losses of grain were measured after two week infestations. Milled rice lost 0.75 % of weight when the grain was exposed to a population of 256 psocids / gram of grain, whilst there was not any measurable damage for paddy in the same conditions. The pseudoscorpion *Whitius piger* E. Simon preyed on psocids causing 74-100 % of mortality (in the presence or absence of rice grains) in confined glass vials in the laboratory.

Key words: Psocoptera, Weight losses, *Whitius piger*, Pseudoscorpion, Biological Control.

Introduction

Psocids are cosmopolitan secondary pests for stored cereals. Liposcelid species (e.g. *Liposcelis bostrychophila* Badonnel) and *Lepinotus reticulatus* Enderlein are distributed worldwide, some of them reproduce by partenogenesis and are abundant during summer and autumn (Sinha, 1988).

In recent years, heavy infestations have been common when repeated poor phosphine fumigations are applied to grain (Rees, 2002). Presence of such insects causes undesirable contamination in stored food products. Moreover, several authors have reported that psocids also

produce weight and quality losses (Rees and Walker, 1990), particularly if the moisture level is high (Turner, 1999). Mills et al. (1992) associated psocid damages with the presence of localised fungal growth which is a good food for the booklice.

Aspects related to the biological control of psocids remain unknown. *Whitius piger* E. Simon (Pseudoscorpionidea: Whithiidae) was reported for the first time in the Iberian Peninsula (Pascual-Villalobos et al., 2005) associated with psocids on organic paddy at Calasparra (Murcia, Spain).

The objective of the experiment was to study: the weight losses of rice grain caused by psocids on rice and also the potential of *W.piger* as predator of psocids.

Material and methods

Effect of psocids on rice weight

Paddy and milled rice (1 g samples) were exposed to increasing populations of psocids (*Liposcelis entomophila* Enderlein): 0, 4, 16, 64 or 256 insects. For each population, 5 replications of either paddy or rice were placed inside a tapered glass vial (15 ml volume) and stored at 25 °C in the dark for two weeks. The samples were weighted at the beginning (before exposure to psocids) and afterwards, at the end of the experiment. Regression analysis were done on

¹ Instituto Murciano de Investigación y Desarrollo Agrario y Alimentario, Estación Sericícola, 30150 La Alberca, Murcia, Spain (Fax: +34968366792; E-mail address: mjesus.pascual@carm.es).

weight losses against the number of psocids.

Predation of pseudoscorpions on psocids

Different combinations of one pseudoscorpion (*W.piger*) with one or ten psocids, in the presence or absence of whole rice grains, were tested to see if effective predation (after 1-6 d) occurred, comparing with natural mortality of psocids without *W.piger*. The experimental unit consisted of one 4 ml glass vial with the insects inside (and 10 rice grains if appropriate) together with a paper filter disc of 2 cm diameter. Five or 10 replications per treatment were prepared and the vials were stored at 20 °C and 75 % r.h. in the dark till the number of dead insects were counted after 1, 2 or 6 d. Data were summarized as means and Mann Whitney U tests to compare treatments with the control.

Results and discussion

Effect of psocids on rice weight

A decrease on rice weight was obtained after the grains were infested with psocids for two weeks (Figure 1). Losses accounted for less than 1 % of weight, for example 0.14 % when 16 insects were in contact with the grain or 0.75 %

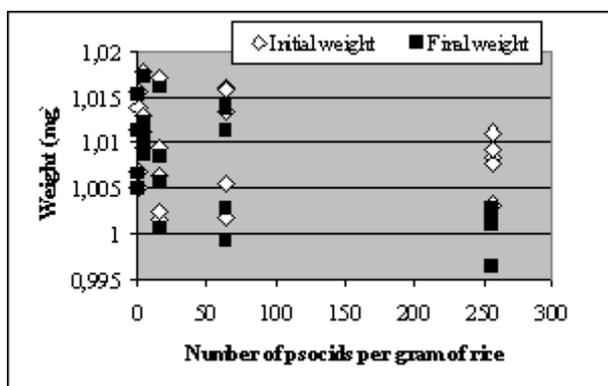


Figure 1. Rice weight loss after two weeks exposure to psocid populations.

for 246 insects. Other authors reported greater losses because their study period was longer, for example 5 % weight loss in milled rice after 6 months of infestation (McFarlane, 1982) or 9.7 % losses after six months (Kucerova, 2002).

Data of our experiment were fitted following a simple linear regression model (Table 1) and therefore increasing populations of insects also damaged the rice quantitatively more. This agrees with the observations of Kucerova (2002) that correlated the weight loss with increasing progenies of booklice.

Psocids have a preference to feed on the seed germ, though in this experiment we have proved that they are also able to attack the undamaged endosperm (since milled rice was used).

Predation of pseudoscorpions on psocids

Natural mortality of psocids was low (0-22 %) and therefore the results were statistically significant (Table 2) and were attributed to the predatory effects of *W.piger*. *Whitius piger* prey on psocids causing 82-100 % mortality with a reduction to 74 % in the presence of rice grains in such confined vials. It remains to be studied how such natural enemies perform in the presence of other insects or in bulk paddy to test their potential to be used in biological control.

Rees (1994), in a pocket reference, listed pseudoscorpions as predators on mites, booklice, insect eggs and small larvae. According to Turner (1994), *L.bostrychophila* falls prey to spiders and predatory mites but there have been no published records to support this view. Psocids feed on mite eggs and storage fungi (*Aspergillus* and *Penicillium*) and some predatory mites such as *Cheyletus* sp. feed on psocids; the interaction of mites and fungi with psocids has influence in regulation of the insect numbers (Sinha, 1988). Primary pests, such as *Tribolium*, eat psocids as well and keep the populations very low (Turner, 1999); hence, outbreaks of psocids could be sometimes a consequence of the absence of other more damaging pests.

Table 1. Simple linear regression [rice weight loss = a + b (number of psocids)].

	Estimate	s.e.	t test
a	0.711	0.168	4.23 ***
b	0.02489	0.00142	17.52 ***

Table 2. Predation of *Whitius piger* E. Simon (Pseudoscorpionidea: Whitiidae) on psocids.

	Number of dead psocid			
	After 1 d		After 6 d	
	Mean(n=5)	U test	Mean(n=5)	U test
0 pseudoscorpion: 1 psocid	0	-	0	-
1 pseudoscorpion: 1 psocid	1	0**	1	0**
0 pseudoscorpion: 10 psocids	1	-	2.2	-
1 pseudoscorpion: 10 psocids	3	2*	8.2	0**
	After 2 d		After 6 d	
	Mean(n=10)	U test	Mean(n=10)	U test
0 pseudoscorpion: 10 psocids	1.2	-	1.1	-
1 pseudoscorpion: 10 psocids	9.9	0***	10	0***
0 pseudoscorpion: 10 psocids and 10 whole rice grains	0.3	-	1.3	-
1 pseudoscorpion: 10 psocids and 10 whole rice grains	6.1	1.5***	7.4	3.5***

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