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Occurrence of coleoptera and lepidoptera species in rice stores at Calasparra (Murcia, Spain)

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Abstract

A study of the stored rice pests occurring in Calasparra (Murcia, Spain) was carried out during 2001 and 2002. Pitfall traps placed in paddy bulks catched the rice weevil (*Sitophilus oryzae* L.) early in January although populations peaked from April to September. The lesser grain borer (*Rhyzoperta dominica* F.) appeared later on in June and was particularly abundant during the summer. Secondary pests such as *Cryptolestes pusillus* Schönherr, *Tribolium castaneum* Herbst and *Oryzaephilus surinamensis* L. were also captured. Temperature and relative humidity were above safer limits for storage. Grain fumigation with phosphine was not completely effective, in particular against *R. dominica*. The angoumois grain moth (*Sitotroga cerealella* Olivier) and the indian meal moth (*Plodia interpunctella* Hübner) were frequently trapped in black stripe funnel traps although they were not recovered after incubation of grain samples, indicating lower damage risks than expected.

Key words: Sitophilus oryzae, Rhyzoperta dominica, Cryptolestes pusillus, Tribolium castaneum, Oryzaephilus surinamensis, Sitotroga cerealella, Plodia interpunctella, paddy, rice.

Introduction

Stored cereal pests cause weight and quality losses in grain. Main primary colonizers (attacking undamaged cereal grains) are the coleopters *Rhyzoperta dominica* and *Sitophilus granarius* (Rees, 1996) and the lepidopter *Sitotroga cerealella*. Among secondary pests (colonizing previously damaged cereals), Viñuela et al. (1993) mention *Tribolium castaneum, Tenebrio molitor* L., *Oryzaephilus surinamensis, Cryptolestes pusillus*, *Ephestia kuehniella* Zeller, *Plodia interpunctella* and *Acarus siro* L.

Riudavets et al. (2002) inspected samples from cereals, fruits, legumes and processed foods and obtained the known pests, *S.oryzae, R.dominica, T. castaneum, O.surinamensis* and *P. interpunctella* together with predatory mites and hymenoptera as natural enemies. Trematerra et al. (1999) surveyed stored cereals in central Italy and found *S.oryzae, Sitophilus zeamais* Motschulosky, *Sitophilus granaries* L., *O. surinamensis, T. castaneum, C. ferrugineus* as the main beetle pests. In a recent survey (Pascual-Villalobos and Del Estal, 2003) have identified 18 pest species and 4 natural enemies in rice stores of the guarantee of geographical origin Calasparra rice in Murcia (Spain).

In this paper, we report catches of Coleoptera and Lepidoptera species in traps placed in stores of Calasparra (Murcia, Spain) during the storing period

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(one year) and also insect development after paddy or rice incubation.

Material and methods

Location of stores

Rice is being produced in Calasparra (Murcia, Spain) since the XV century. This is a rural place in which agricultural practices are environmentally friendly and a high quality rice is obtained of the varieties Bomba (conventional production) and Balilla x Sollana (conventional and organic production). Only two milling and storage facilities exist within the area and both (store 1 and 2) were included in our research. Rice is stored in bulk on the floor. Relative humidity and temperature in the grain were registered every hour using Data Loggers (testostor 171-3), placed 10 cm deep in the bulks.

Sampling

Rice was harvested on November 2001 and it was stored from December 2001 to September 2002. Samples (250 g) of paddy, organic paddy and rice treated or untreated with phosphine were taken in April (after 5 months of storage) and they were incubated in the dark at 30 ºC during 4 months to follow insect development.

Trapping

Pitfall traps (CSL PC trap) were placed in pairs in stored paddy, one in the surface and another 10 cm deep. Black stripe moth traps (Agrisense), with *Plodia* or *Sitotroga* pheromone lures, were located hanging from the roof at 1.5 m height over rice bulks in the different rooms of the stores. Traps were inspected at monthly intervals.

Results and discussion

Beetle pests were abundant in bulk paddy in Store 2 (Table 1). *Sitophilus oryzae* was detected in January, peaking from April untill September. *Rhyzoperta dominica* appeared later on, in June, and populations increased towards the summer. *Cryptolestes pusillus* and *T. castaneum* live within the store during winter although populations were greater during the warmest months. Relative humidity values within the stores ranged from 60 to 80 % during winter, clearly favouring pest infestations. Also, the grain temperatures from 18 ºC up to 30 ºC occurring during the hottest summer days were not safer for storage.

Rice weevils (*S. oryzae*) and lesser grain borers (*R. dominica*) were the main primary pests found. Beckett et al. (1994) indicate that *S. oryzae* is favoured at cooler more moist conditions although

Table 1. Coleopter catches in pitfall traps placed in bulk stored paddy.

Store	Insect	Dec 2001	Jan 2002	Feb 2002	Mar 2002	Apr 2002	Jun 2002	Jul 2002	Sep 2002
1	*S. oryzae*				x^{b}				x^{b}
	C. pusillus					x^{b}	x^{b}		
	T. castaneum							x^{b}	x^{b}
2	*S. oryzae*		x^{c}	$x^{a,c}$	$x^{a,c}$	xx^{a}	$xx^{a,c}$	xx^{a}	$xx^{a,b}$
	R. dominica						$x^{a,c}$	xx^{a}	$xx^{a,b}$
	C. pusillus	x^{c}	x^{c}	$x^{a,c}$	$x^{a,c}$	xx^{a}	$xx^{a,c}$	xx^{a}	$xx^{a,b}$
	T. castaneum	x^{c}	x^{c}		$x^{a,c}$	x^{a}	$x^{a,c}$	xx^{a}	$xx^{a,b}$
	O. surinamensis				x^{c}		$x^{a,c}$	x^{a}	x^{a}

x = insect presence, xx = high numbers
[a] paddy variety Bomba
[b] paddy variety Balilla x Sollana
[c] organic paddy variety Balilla x Sollana

Table 2. Lepidopter catches in pheromone lured black stripe funnel traps in paddy stores.

Store	Insect	Dec 2001	Jan 2002	Feb 2002	Mar 2002	Apr 2002	Jun 2002	Jul 2002	Sep 2002
1	*S. cerealella*					x[a,c]	x[a,b,c]	x[a,b]	xx[a,b,c]
	P. interpunctella	x[b]				x[a]	x[a,c]	x[a,b]	x[a,b]
2	*S. cerealella*		x[a,b,c]		x[a,c]	x[a,c]	xx[a,b,c]	x[a,b,c]	xx[a,b,c]
	P. interpunctella					x[a,c]	xx[a,c]	xx[a,c]	xx[a,b,c]

x = insect presence, xx = high numbers

[a] paddy variety Bomba

[b] paddy variety Balilla x Sollana

[c] organic paddy variety Balilla x Sollana

Table 3. Effect of storage (Nov 2001 - Apr 2002) in pest development after sample (250 g) incubation during 4 months at 30 ºC.

Store	Sample (variety Balilla x Sollana)	Pest Species	Nº insects
1	rice treated with phosphine	*S.oryzae*	30
		R.dominica	150
		C.pusillus	6
	organic whole rice (untreated)	*S.oryzae*	30
		R.dominica	50
		C.pusillus	4
2	rice treated with phosphine	*R.dominica*	2
		C.pusillus	1
	rice untreated with phosphine	*S.oryzae*	12
		R.dominica	121
		C.pusillus	15
	paddy	*S.oryzae*	128
		R.dominica	53
	organic paddy	*R.dominica*	55
		C.pusillus	69

at 15 ºC the population increase can be completely suppressed (Nakakita and Ikenaha, 1997). Flat grain beetles (*Cryptolestes* sp.) commonly occured in stores at Calasparra. Such species like warmest areas within the grain bulk and move to the center during fall and winter (Flim and Hagstrum, 1998).

The angoumois grain (*S. cerealella*) and indian meal (*P. interpunctella*) moths, were catched in the funnel traps during spring and summer (Table 2). However, they were not developed after paddy incubation (Table 3) indicating that, although potentially dangerous, moths were not real threats for the grain in the stores under study.

Grain fumigation with phosphine seem to be only partly effective, for example in Store 1, many lesser grain borers and some rice weevils and flat grain beetles appeared after incubation (30 ºC) of treated rice (Table 3). Organic products, in which no treatment is allowed, are also infested with those pests. Lucas and Riudavets (2000) published that whole (brown) rice is preferred over white for insect feeding and oviposition.

To avoid or to minimize the problem of stored pests in Calasparra, we recommend: a control of temperature and r.h. under safer values, 13-20 ºC and below 50 % respectively (Fields and Muir, 1996), cleaning and hygenic practices and testing alternative fumigants.

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