Insect control on stored malting barley with diatomaceous earth in southern Brazil

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Abstract

Alternative methods for controlling insects on stored malting barley were tested in southern Brazil. Three treatments were compared: a salt water diatomaceous earth (DE) formulation from Brazil, at 1500g/t, applied as dust; a slurry DE application, at 300g/t; and a mixture of 10 ml/t of deltamethrin plus 15ml of fenitrothion/t, all applied over the grain on the conveyor belt Insects were sampled with plastic probe traps from the three treatments plus a control stored for six months in 90 t metallic bins, every 15 days. On the same date, grain samples were taken for moisture determination, percentage of germination and protein content. The silos treated with the DE formulation and with the mixture of insecticides had very low numbers of insects, with no significant difference between them On the other hand, the control silo presented high numbers of insects, mostly *Sitophilus* spp. The results suggest that DE can be used as an alternative control of stored grain insects on malting barley, either as dust or slurry, with the advantage of being non toxic, without any chemical residues, and no resistance

Introduction

Inadequate storage of barley seeds and grain malt results in high qualitative and quantitative losses for the beer industry. Insects and their fragments, fungi, and mycotoxins contribute for the low quality and reduction of dry matter of stored products (Christensen & Kaufmann 1969).

Stored product insects are characterised by high reproductive potential with many generations in a short period of time These characteristics associated with continuous insecticide application can select for resistant populations and cause resurgence of occasional pests

Integrated pest management, including monitoring and sound control measures, is the best strategy for maintaining the quality of a product (Almeida 1989) Alternative control measures have been studied in order to reduce the number of treatments and to avoid insecticide resistance and residues in the grains and sub-products Inert dusts, such as diatomaceous earth (DE) show great potential as an alternative measure It is a sediment material formed by the deposition of testes of diatomaceous algae, composed mainly of hydrated amorphous silica (Alexander et al. 1944, Wigglesworth 1947, Ebeling 1971)

According to Alexander et al. (1944), the particle size or granulometry affects the adherence of the dust to the insect body and determines the efficiency of the product Abrasion occurs when the insect moves within the intergranular spaces (Wigglesworth 1947). The inert particles adsorb the lipids from the epicuticle, causing dehydration and death (Ebeling 1971) Long exposure time to the product increases the percentage of mortality (White & Loschiavo 1989)

This experiment was designed to evaluate the effect of a commercial formulation of Brazilian DE on insects of stored barley, to compare it to the conventional chemical treatment, and indicate its potential as an alternative control measure

Materials and Methods

The experiments were carried in four 90 t silos filled with barley seeds, at a large beer company in the south of Paraná, Brazil The following treatments were applied on the conveyor belt: a powder of 1500 g/t of inert dust (Keepdry®); a slurry of 1500 ml/t of water solution of inert dust (300g/t); conventional chemical treatment of 10 ml of deltamethrin and 15ml of fenitrothion / t; and a control without any application.

Samples were taken every 15 days with probing traps inserted into the seed bulk, at different depths, during 171 days The kind and number of insects, germination level, moisture, and protein level of the barley were evaluated

Results and Discussion

The number of insects caught in the traps, in each treatment is presented on Table 1 In the silos treated with

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Keepdry® (dust and slurry) and with deltamethrin/fenitrothion, the insect populations were significantly reduced compared to the control The most abundant insect was *Sitophilus* spp., representing 94% of the total number of insects trapped on the control silo (Table 2). Moisture, germination and protein were kept constant during the period. The results of this research agree with other authors working with inert dust formulations applied as dust or slurry (Subramanyam et al. 1994, Golob 1997).

Table 1. Number of insects detected in malting barley silos after treatment with inert dust and conventional insecticides.

Days after treatment	Dust* 1,500g/t	Slurry* 300g/t	Insecticides 25ml/t**	Control	Total number of insects
16	5	0	0	5	10
24	2	0	0	3	5
43	1	0	0	10	11
58	0	0	0	3	3
78	7	6	0	18	31
91	5	0	0	22	27
101	0	0	0	48	48
114	0	0	0	62	62
128	0	0	0	177	177
142	4	0	0	171	175
155	0	0	0	787	787
171	0	1	0	458	459
Totals	24	7	0	1,764	1,795

* Diatomaceous earth Keepdry®

** 10 ml of deltamethrin + 15ml of fenitrothion / t

Table 2. Number of individuals of each insect species collected with probing trap on malting barley in the control silo.

Days after treatment	*Sitophilus* spp	*Oryzaephilus surinamensis*	*Tribolium* spp.	Total number of insects
16	5	0	0	05
24	2	1	0	03
43	9	0	1	10
58	3	0	0	03
78	17	1	0	18
91	20	1	1	22
101	47	1	0	48
114	51	10	1	62
128	173	4	0	177
142	114	57	0	171
155	769	18	0	787
171	452	5	1	458
Total	1,662(94.2%)	98(5.6%)	04(0.2%)	1,764

Conclusion

Although there was no significant difference between the treatments with the inert dust and the chemical, the former has the advantage of being efficient against insects, but without selecting for resistance or leaving toxic residues in the barley seeds for malting. Also, the application does not require special equipment and can be applied either as a powder or slurry Inert dust can be used alone or associated with other products as alternative control measures in IPM of stored product insects.

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