PEA PROTEIN COMBINED WITH PARASITOIDS TO CONTROL STORED-PRODUCT INSECTS.

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Bin test with barley

A protein-rich pea flour obtained from Parrheim Foods Ltd. (Saskatoon, Canada) was toxic and repellant to stored-grain insects (Bodnarky et al. 1999). Rice weevil (*Sitophilus oryzae*) was the most sensitive insect, followed by rusty grain beetle (*Cryptolestes ferrugineus*) which was more susceptible than red flour beetle (*Tribolium castaneum*). Insects held on wheat and barley showed similar sensitivities to pea protein, whereas insects held on maize were less sensitive. Granary tests were conducted from late August until late October. Granaries were filled with approximately 10 t of barley and treated with 0.1% pea protein (entire grain bulk), 0.5% pea protein (top half only) or untreated (2 granaries/treatment). Rice weevil, rusty grain beetle and red flour beetle were placed on the top surface of the grain (ca. 2 adults of each species/kg barley). The barley was sampled for insects at 4 times during the 2-month test (10 one-kg samples/granary). Grain samples from the bin were also incubated in the laboratory to estimate the number of offspring in the grain. Rice weevil was controlled at 0.1%, rusty grain beetle and red flour beetle were reduced at 0.1% pea protein (Fig. 1). The treatment of 0.5% was similar to the 0.1% treatment, but insects were able to reach the untreated grain. Pea protein also increased the movement of the three species tested, in both granary and laboratory trials.

Combination with parasitoids

The effect of pea protein on the survival, movement and fecundity of the parasitic wasps, *Cephalonomia waterstoni* (Hymenoptera Bethylidae) a parasitoid of rusty grain beetle, and *Anisopteromalus calandrae* (Hymenoptera Pteromalidae) a parasitoid of rice weevil was examined. Pea protein did not increase the mortality of the two parasitic wasps. When *A. calandrae* was given a choice between untreated wheat and wheat treated with pea protein, pea treated wheat did not yield fewer wasps.. In a non-choice test, the number of wasps emerging was slightly lower in grain treated with pea protein at 0.1% than in the untreated wheat. However, the number of rice weevils emerging from treated and untreated wheat were similar.

Given the minor effects of pea protein on the parasitoids, we examined the combined effects of the parasitoids and the pea protein on pest insects. Wheat in lots of 330 kg was treated with 0, 0.04 or 0.1% pea protein. Due to excellent

searching abilities of the parasitoids, we chose to have two separate sites, one without parasitoids and one with parasitoids. Rice weevil, rusty grain beetle and red flour beetle, were released onto the top of each barrel using a rate of two insects per kg of wheat for each species. Twenty-nine days later, at one of the sites the two parasitoids were released at the same density as the host insects. Grain samples were taken six weeks after the introduction of the parasitoids, and the number of adult insects counted. As in the bin studies with barley, 0.1% pea protein reduced the numbers of the three insects tested (Table 1). The rusty grain beetle was reduced by half by the introduction of *C. waterstoni*. The addition of pea protein in combination with the parasitoid further reduced the rusty grain beetle populations. Pea protein at 0.04% combined with the parasitoids reduced the rice weevil populations more than either treatment separately. At 0.1% pea protein, there was no added advantage to adding the parasitoids. Neither of the parasitoids attack the red flour beetle, so any changes in their population will be due to the pea protein or interactions with the rice weevil and the rusty grain beetle. The test will continue for an additional 2 months to determine if these trends continue.

Conclusions

- Pea protein is repellent and toxic to several stored-product insects.
- In bin tests with barley, pea protein at 0.1% reduced rice weevil by 90% and the rusty grain beetle and the red flour beetle by 50 to 75% compared to untreated grain.
- Treating the top half of the barley with 0.5% pea protein did not prevent insects from moving into untreated grain.
- Pea protein had little effect on two stored-product parasitoids.
- Pea protein combined with parasitoids did in some cases reduce pest populations more then single treatments of pea protein or parasitoids.
- More research is needed to confirm these results.

References

Bodnaryk, R.P., P.G. Fields, Y. Xie and K.A. Fulcher. 1999. Insecticidal factor from peas. USA Patent, 5 955 082.

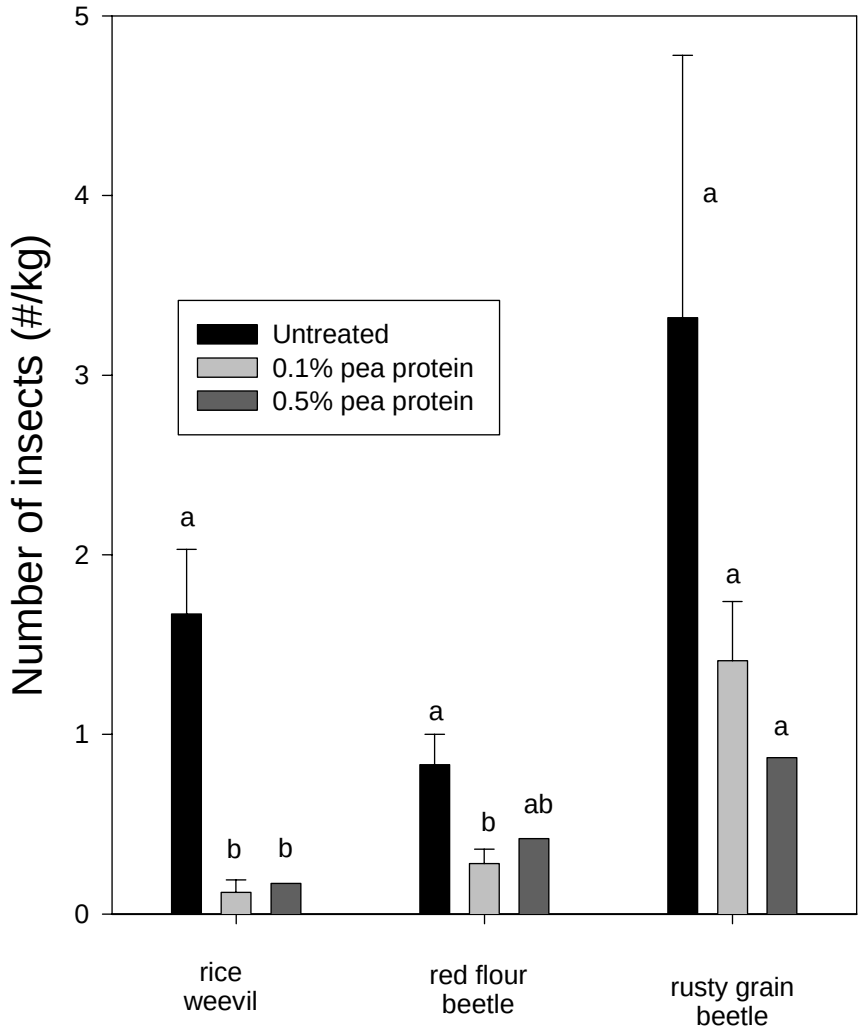

Figure 1. The number of adults found in the grain samples taken from bins with 10 t of barley. There were three treatments: pea protein at 0.1% all grain treated, 0.5% top half treated, or untreated.

Table 1. The number of live insects in grain samples as expressed as a percentage of the control in barrels with 330 kg of wheat treated with 0, 0.04 or 0.1% pea protein with or without the parasitoid of the rice weevil, *A. calandrae* and the parasitoid of the rusty grain beetle, *C. waterstoni*, six weeks after introduction of the parasitoids. (n=3)

Insects	Number of insects as percentage of control (±SEM as percent of mean)					
	Untreated	Pea Protein 0.04% No Parasitoids	Pea Protein 0.1% No Parasitoids	No Pea Protein Parasitoids	Pea Protein 0.04% Parasitoids	Pea Protein 0.1% Parasitoids
Rice weevil	100 ± 47	104 ± 61	17 ± 10	124 ± 60	49 ± 23	20 ± 17
Rusty grain beetle	100 ± 51	81 ± 33	31 ± 10	45 ± 18	37 ± 13	15 ± 5
Red flour beetle	100 ± 41	84 ± 42	37 ± 22	141 ± 80	198 ± 103	114 ± 64