

Tritrophic Interactions and Storage Pest Control: Interaction of the Fungus *Beauveria bassiana* with Resistant Oat Varieties for Control of *Oryzaephilus surinamensis*

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BACKGROUND

The sawtoothed grain beetle, *Oryzaephilus surinamensis* (Coleoptera: Silvanidae), is a common pest of stored oats. Use of resistant cultivars or entomopathogenic fungi each provide partial control of this pest.

Objectives:

- We tested the hypothesis that the entomopathogenic fungus, *Beauveria bassiana*, would be more efficacious on oat cultivars on which the immature development period of the sawtoothed grain beetle was prolonged.
- We also conducted dose-response tests with the fungus to determine optimal application rates for control of *O. surinamensis* on cracked and whole oats.

METHODS – TRITROPHIC INTERACTIONS

- We investigated the efficacy of *B. bassiana* (isolate GHA) for control of *O. surinamensis* on two whole oat cultivars on which there were differences in immature development time in a previous study (24 days on cv. Paul vs. 30 days on cv. Don), on two whole oat cultivars on which there were differences in numbers of progeny produced (13 on cv. Don and 40 on cv. Brawn), and on two cracked oat cultivars on which there were differences in number of progeny produced (67 on cv. Paul and 147 on cv. Valley). Oats were treated with 0 or 10 ppm of unformulated conidia.
- Ten females oviposited for 72 h on 20 g of oats equilibrated to 30°C and 76% rh; F₁ adult progeny were removed from the samples daily.

METHODS – DOSE-RESPONSE STUDIES

We tested six rates of *B. bassiana* (0, 25, 50, 100, 150, and 200 mg of conidia/kg) on cracked Paul oats, and we tested seven rates of *B. bassiana* (0, 25, 50, 75, 100, 150, and 200 mg of conidia/kg) on whole Paul oats.

Oryzaephilus surinamensis

Sawtoothed grain beetle



Photo credit: <http://www.uark.edu/depts/entomology/museum/Sawth33a.jpg>

RESULTS – TRITROPHIC INTERACTIONS

- Presence of the fungus reduced the number of progeny produced on whole Paul and Brawn oats, but not on cracked oats or on whole Don oats (see table below). Presence of the fungus did not affect development time of the beetles in any test.
- We had hypothesized that the fungus would be more effective on whole Don than on whole Paul oats because immature development time in a previous test was longer on whole Don than on whole Paul. However, this was not the case. Percentage reduction in number of progeny produced was similar – 43% on whole Don and 38% on whole Paul treated with fungus.
- The percentage reduction in progeny production was larger on whole Brawn (67%), the cultivar that had a large number of progeny produced in the previous test (40), than on whole Don (43%), the cultivar that had only 13 progeny produced in the previous test. However, we have no explanation for this difference in progeny production.
- There was no effect of the fungus on insects developing on cracked oats.

Oat Condition and Cultivar	Number of progeny produced by 10 females		ANOVA results (df = 1, 6): Fungus vs. no fungus	
	No fungus	Fungus	F	P
Whole Paul	61.8 ± 6.3	38.3 ± 5.6	7.9	0.03
Whole Don	10.5 ± 2.0	6.0 ± 1.8	2.8	0.15
Whole Brawn	45.0 ± 1.6	14.8 ± 2.3	121	< 0.01
Cracked Paul	117.8 ± 3.1	129.3 ± 10.1	1.2	0.32
Cracked Valley	143.3 ± 6.7	123.0 ± 8.3	3.6	0.11

CONCLUSIONS – TRITROPHIC INTERACTIONS

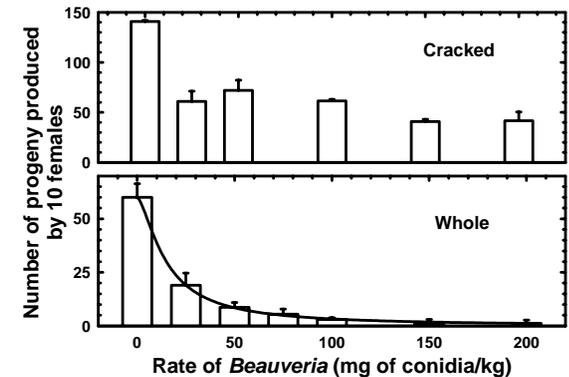
Our hypothesis that the fungus would be more efficacious on oat cultivars on which larval development was prolonged was not supported by our data.

Beauveria bassiana-infected sawtoothed grain beetle after exposure to high humidity to stimulate sporulation



RESULTS – DOSE-RESPONSE STUDIES

- Number of progeny produced generally decreased with rate of *B. bassiana* on cracked Paul oats, and means ranged from 42 to 141 (see figure below).
- Number of progeny produced decreased as rate of *B. bassiana* increased on whole Paul oats, and means ranged from 1 to 60.



CONCLUSIONS – DOSE-RESPONSE STUDIES

Adding 150 mg of conidia/kg to cracked or whole Paul oats resulted in a 70 and 98% reduction, respectively, in number of progeny produced. No further reduction was obtained by adding 200 mg of conidia/kg to cracked or whole Paul oats.

OVERALL CONCLUSIONS

A previous study showed that cleaned oats should limit insect population growth to allow long-term storage of oats without insect damage. However, the current study shows that if the oats are not cleaned, and not cleaning oats is the normal storage practice, then the fungus *Beauveria bassiana* could be used to help control sawtoothed grain beetles.