

COMUNICAÇÃO CIENTÍFICA

ENHANCED ACTIVITY OF *Beauveria bassiana* (BALS.) VUILL. ASSOCIATED WITH MINERAL OIL AGAINST *Cosmopolites sordidus* (GERMAR) ADULTS

Antonio Batista Filho¹, Luis G. Leite¹, Adalton Raga¹ and Mário E. Sato¹

RESUMO

Incremento da Atividade de *Beauveria bassiana* (Bals.) Vuill. Associada a Óleo Mineral para Controle de Adultos de *Cosmopolites sordidus* (Germar)

Interações entre *Beauveria bassiana* (Bals.) Vuill. e óleo mineral foram avaliadas sobre adultos de *Cosmopolites sordidus* Germar. Quatro tratamentos foram repetidos cinco vezes, com 20 adultos por repetição, utilizando-se o delineamento inteiramente casualizado. Os tratamentos consistiram de: *B. bassiana* (linhagem CB-66; 5×10^6 esporos/ml), óleo mineral à 3%, *B. bassiana* + óleo mineral à 3% e testemunha. Os insetos foram coletados de um bananal cultivar 'Nanica', no município de Miracatu, Estado de São Paulo. Observações sobre a mortalidade foram feitas quatro, oito, 12, 16 e 20 dias após a aplicação, e os insetos foram considerados mortos quando não apresentavam qualquer movimento ao serem molestados. Também o desenvolvimento do fungo foi examinado nos insetos mortos. Aos quatro dias, não houve reduções significativas. A partir do oitavo dia, a ação combinada de *B. bassiana* e óleo mineral aumentou significativamente a mortalidade (teste Tukey) e reduziu o tempo letal em comparação com a ação de ambos agentes isoladamente. Aos oito dias, a mortalidade (fórmula de Abbott 1925) foi de 88% para *B. bassiana* + óleo (efeito sinérgico), 16% para óleo mineral isoladamente e 14% para *B. bassiana*. Um efeito aditivo ocorreu aos 20 dias, quando a mortalidade causada pela mistura foi de 98% em comparação com 70% por *B. bassiana* e 33% por óleo mineral.

PALAVRAS-CHAVE: Insecta, controle biológico, formulações, broca-da-bananeira.

Due to considerable damage and world-wide distribution, the borer weevil *Cosmopolites sordidus* (Germar) (Coleoptera: Curculionidae) is considered to be the most important pest in banana crops. The larval stage forms tunnels in pseudostems and rhizomes, thus causing reductions of crops (Batista Filho *et al.* 1991a, Batista Filho *et al.* 1992).

Received 04/27/94. Accepted 05/15/95.

¹Instituto Biológico, Caixa postal 70, 13001-970, Campinas, SP.

In laboratory conditions, biological control studies were set at the Instituto Biológico, São Paulo State, in 1984. The use of the fungi *Beauveria bassiana* (Bals.) Vuill. (strain CB-28) and *Metarhizium anisopliae* (Metsch.) Sorokin (strain CB-32) both cultured on rice or bean, showed good results, reducing up to 97% of *C. sordidus* adults by *B. bassiana* in bean media (Batista Filho et al. 1987).

Because *B. bassiana* was more easily cultured in rice media, Batista Filho et al. (1991b) tested five isolates of *B. bassiana*, in laboratory bioassay, which showed CB-66 to be the most effective strain against banana borer adults. The isolate was obtained from an infected *Hypothenemus hampei* (Ferrari) (Coleoptera: Scolytidae) adult. In the field, *B. bassiana* reduced by 67.17% *C. sordidus* adults after application of CB-66.

According to Prior et al. (1988), oil-based formulations of fungal pathogens would have the advantage of excellent adhesion to the hydrophobic cuticle of the pest as well as the logistical advantages of reduced volume application. Our preliminary studies showed that the fungus *B. bassiana* formulated in 3% and 5% emulsifiable concentrate mineral oil was capable of controlling *C. sordidus* adults over 70%, 16 days after application. The present study was undertaken to demonstrate the synergistic and additive effects between *B. bassiana* and mineral oil to control *C. sordidus* adults in laboratory conditions.

The weevils used in this experiment were collected from traditional infested banana plantation, cultivar 'Nanina' (Cavendish), at Miracatu, São Paulo State. Four treatments were replicated five times with 20 *C. sordidus* adults per replicate, in a completely randomized design. The treatments were: *B. bassiana* (CB-66 cultured on white rice, 5×10^6 spores/ml), 3% mineral oil (emulsifiable concentrate), *B. bassiana* + 3% mineral oil, and control.

The laboratory was kept at $25 \pm 1^\circ\text{C}$, 60% RH and 14:10 photoperiod. Treatment action was observed by placing the adults into a bioassay glass cages (6000 cc), open on top, containing a piece of banana pseudostem (23cm \varnothing) on its base. Five ml of each insecticide treatment were applied on the pseudostem surface. Twenty insects were transferred to each piece of pseudostem.

Observations for mortality were made at four, eight, 12, 16 and 20 days after exposure (24/05/93), and insects were considered dead if they did not move when disturbed. Fungus development was also examined in the dead insects. Data were transformed in $\sqrt{x + 0.5}$ and analyzed by Tukey's test ($P=0.05$).

Table 1. Average number of *Cosmopolites sordidus* adults per plot (N°) and mortality rate (%).

Treatment	Days after exposure ¹									
	4		8		12		16		20	
	N°	%M	N°	%M	N°	%M	N°	%M	N°	%M
Oil	20.0a	0.0	16.8b	16.0	16.6b	17.0	14.8c	26.0	13.4c	33.0
CB-66	19.6a	2.0	17.2b	14.0	14.2b	29.0	9.0b	55.0	6.0b	70.0
Oil + CB-66	19.8a	1.0	2.4a	88.0	0.8a	96.0	0.4a	98.0	0.4a	98.0
Control	20.0a	0.0	20.0b	0.0	20.0b	0.0	20.0c	0.0	20.0d	0.0
Variance ratio	0.88		17.88		12.29		14.13		14.07	

¹Within a column, numbers followed by the same letter are not significantly different ($P>0.05$; Tukey's test); mortality rate calculated by Abbott (1925).

Fungus *B. bassiana* showed excellent mycelial growth on pseudostems. Data of alive adults and percent mortality are presented in Table 1. At four days after application, treatments did not significantly differ from untreated control and only two insects (1.0%) showed mortality with symptoms in *B. bassiana* replications. Batista Filho *et al.* (1991b) observed that mortality of *C. sordidus* due to *B. bassiana* (CB-66) alone had begun on the sixty day after application. From eight days after exposure on the combined action of *B. bassiana* and mineral oil there were significantly increasing level of mortality. Synergistic interactions occurred at eight days, when the reductions were 88%, 16% and 14% for combination, oil and fungus alone, respectively.

Enhanced activity of fungus and oil occurred at 12 days, reaching 96% reduction in comparison to oil (17%) and CB-66 (29%). At 16 days after exposure, *B. bassiana* reduced by 55% the number of adults and the combination showed synergism (98%). At 20 days, CB-66 and combined agents induced 70% and 98% reductions, respectively. The effect was therefore considered to be additive, i.e., *B. bassiana* + oil mortality was similar to the addition of the agents acting alone. Also, the synergism resulted in shorter action time because the mortality observed for fungus alone at 20 days (70%) was lower than combined agents at eight days (88%).

At the end of the test there was no mortality in the untreated control (Table 2) and mineral oil presented four cadavers with *B. bassiana*. Thirty five percent of dead insects in combined agents showed no *B. bassiana* symptoms, a fact similar to cumulative mortality for oil alone (Table 2).

Table 2. Accumulated mortality (% \pm SE) of *Cosmopolites sordidus* adults.

Treatment	Mortality		
	With Symptom	Without Symptom	Total
Oil	4.00 \pm 1.87	29.00 \pm 2.39	33.00 \pm 3.15
CB-66	60.00 \pm 6.52	10.00 \pm 3.53	70.00 \pm 4.74
Oil + CB-66	63.00 \pm 7.52	35.00 \pm 6.71	98.00 \pm 1.22
Control	0.00	0.00	0.00

Prior *et al.* (1988) investigated the efficacy of *B. bassiana* against the weevil *Pantorhytes plutus* (Oberth) in cocoa, and showed an estimated value for LD₅₀ of oil formulation to be 36 times lower than that for the water formulation. The authors attribute this fact to the penetration of conidial suspension into mouthparts of the insect, facilitated by the cutinophilic properties of the oil, which allowed a much larger number of conidia to reach the susceptible intersegmental membranes. Leite *et al.* (1992) demonstrated that two applications of the mixture of soybean oil and *B. bassiana* reduced by 100% water weevil adults on irrigated rice fields.

According to Ramoska (1984) a higher level of relative humidity or more constant microhumidity near the exoskeleton, perhaps contiguous with host plant, provided an environment

amicable for *B. bassiana* germination.

The high infectivity of combined agents obtained in the present work suggested that field application on pseudostem traps could be tested advantageously because a natural spread of the entomopathogenic fungi would occur in wet environments. This combination would result in higher reduction and shorter time of action in comparison to the agents alone.

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