Note

SELECTION OF *Beauveria bassiana* (BALS.) VUILL. AND *Metarhizium anisopliae* (METSCH.) SOROK. FOR THE CONTROL OF THE MITE *Mononychellus tanajoa* (BONDAR)

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ABSTRACT: The green mite, *Mononychellus tanajoa* (Bondar) (Acari: Tetranychidae), is considered to be one of the key pests in cassava, *Manihot esculenta* Crants, leading to considerable field losses. In this study, ten *Beauveria bassiana* (Bals.) Vuill. and ten *Metarhizium anisopliae* (Metsch.) Sorok. isolates were evaluated with regard to their potential as biological control agents against adult *M. tanajoa* females. The total mortality percentage of *M. tanajoa* caused by *B. bassiana* ranged from 13.0 to 97.0%, with confirmed mortality rates extending from 9.0 to 91.0% and LT_{50} varying from 4.2 to 17.0 days. The *M. anisopliae* isolates showed total mortality percentages ranging from 12.0 to 45.0% with confirmed mortality rates extending from 8.0 to 45.0%, and LT_{50} varying from 8.6 to 19.8 days. Lethal Concentrations (LC_{50}) of 3.93×10^6 conidia mL^{-1} and 7.44×10^8 conidia mL^{-1} were determined for *B. bassiana* and *M. anisopliae*, respectively. *B. bassiana* isolate 645 was the most efficient, being an alternative for use in biological control programs against the cassava green mite.
Key words: entomopathogenic fungi, cassava green mite, microbial control

SELEÇÃO DE *Beauveria bassiana* (BALS.) VUILL. E *Metarhizium anisopliae* (METSCH.) SOROK. PARA CONTROLE DO ÁCARO *Mononychellus tanajoa* (BONDAR)

RESUMO: O ácaro verde *Mononychellus tanajoa* (Bondar) (Acari: Tetranychidae) causa desfolhamento em mandioca *Manihot esculenta* Crants, proporcionando perdas na produção. Esse trabalho objetivou selecionar isolados dos fungos *Beauveria bassiana* (Bals.) Vuill. e *Metarhizium anisopliae* (Metsch.) Sorok. para utilização no controle desse ácaro. Foram utilizados dez isolados de *B. bassiana* e dez isolados de *M. anisopliae* , sobre fêmeas adultas de *M. tanajoa*. A percentagem de mortalidade total por *B. bassiana* variou de 13,0 a 97,0%, com mortalidade confirmada de 9,0 a 91,0%, e o tempo letal (TL_{50}) variou entre 4,2 e 17,0. Os isolados de *M. anisopliae*, provocaram 12,0 a 45,0% de mortalidade total e 8,0 a 45,0% de mortalidade confirmada e TL_{50} entre 8,6 e 19,8 dias. Estimaram-se os valores das concentrações letais (CL_{50}) de $3,93 . 10^6$ conídios mL^{-1} e $7,44 . 10^8$ conídios mL^{-1}, para os isolados 645 de *B. bassiana* e CG 321 de *M. anisopliae*, respectivamente. O isolado 645 de *B. bassiana* foi mais eficiente, sugerindo sua utilização em programas de controle biológico do ácaro verde da mandioca.
Palavras-chave: fungos entomopatogênicos, ácaro verde da mandioca, controle microbiano

INTRODUCTION

Brazil is one of the world's greatest cassava (*Manihot esculenta* Crantz) producers, with an annual yield of over 20 million tons, which places this crop among the main agricultural products explored in the country (FNP Consultoria e Comércio, 2002). Depending on the use of different technologies and management practices, cassava productivity can vary from 8 to 25 t/ha (Silva & Santos, 2000). The Brazilian Northeastern Region stands out as the greatest producing region, with a 59% share of the country's cassava-growing area and 46% of the country's yield, on average (Cavalcanti & Araújo, 2000). In different producing regions, the crop is infested by a large number of arthropods, some of which cause considerable damage, as, for example, *Erinnyis ello ello* L., *Phenacoccus* spp., and *Mononychellus tanajoa* (Bondar) (Farias, 1991; Bellotti et al., 1999). Among these, *M. tanajoa* constitutes one of the major problems for the crop in the Northeast Region (Moraes & Flechtmann, 1981).

The cassava green mite *M. tanajoa* occurs preferably in the apical bud of the plant. Infested leaves become chlorotic, do not attain normal development, with a usually distorted growth, and may fall progressively from top to bottom. Attacked stalks lose their green color and become coarse and brownish, with a furrowed bark. The plant may completely exhaust its reserves and die (Flechtmann, 1989; Gallo et al., 2002). In the back country of the State of Pernambucano, infestations occur with greater intensity from July to November, and may cause root yield losses in the order of 51% (Veiga, 1985).

Several tactics are used in the control of cassava green mite, such as: resistant cultivars (Nukenine et al., 2000), cultural practices (Veiga, 1985; Toko et al., 1996), biological control using predators (Farias et al., 1981; Moraes, 1991), and entomopathogens, such as the fungus *Neozygites* sp. (Delalibera Jr. et al., 2000). Chemical control is economically not viable, due to the crop's low yield, long cycle, and to the limited resources of producers (Bellotti et al., 1999).

The use of entomopathogenic fungi is an important practice that should be incorporated into integrated management, with the objective of reducing the populations of pest insects and mites in economically important crops (Alves, 1998). Within this context, Odongo et al. (1998) mentioned the potential for controlling *M. tanajoa* using the entomopathogenic fungus *Hirsutella thompsonii* Fisher, as well as the use of *Entomophthora* spp., *Beauveria bassiana* (Bals.) Vuill., and *Metarhizium anisopliae* (Metsch.) Sorok. (Odindo, 1992).

In a paper involving different control methods against the mite *Brevipalpus* spp. in Mexico, Acevedo & Rosas (2000) concluded that control with *H. thompsonii* was superior to organophosphate chemical products. The fungus significantly reduced populations and the damage caused by the mites *Brevipalpus phoenicis* Geijskes and *B. obovatus* Donnadieu in citrus. *Neozygites* sp. epizootics are also frequent in *M. tanajoa* populations (Delalibera Jr. et al., 1992; Yaninek et al., 1996; Elliot et al., 2000). Several studies involving this fungus have been conducted; however, differently from *M. anisopliae* and *B. bassiana,* its challenging production on artificial medium makes it difficult to use it in green mite biological control programs (Oduor et al., 1996; Leite et al., 2000).

The fungi *B. bassiana* and *M. anisopliae* have been studied recently for the control of tetranychid mites (Alves et al., 2002; Oliveira et al., 2002). Notwithstanding, these entomopathogens have not yet been studied for the control of the cassava green mite. Hence, the present research had the objective of evaluating the effect of different *B. bassiana* and *M. anisopliae* isolates on *M. tanajoa* in the laboratory.

MATERIAL AND METHODS

The experiments were carried out in Recife - PE, Brazil.

Mite rearing

The rearing of *Mononychellus tanajoa* colonies in the laboratory was developed on cultivar Santo Estevão cassava plants, *Manihot esculenta*, planted in plastic pots containing soil and cattle manure at a 2:1 ratio. One 10-cm plant cutting was placed in each pot; pots were maintained in the greenhouse. After 20 to 30 days, the plants were taken to the laboratory to be infested with mites. This process was repeated every seven days to maintain plant quality and to ensure a stock colony of mites. The pots containing infested plants were maintained in the laboratory at a temperature of 26 ± 1ºC, 63 ± 5% relative humidity, and 12-hour photophase.

Obtaining and production isolates

The *Metarhizium anisopliae* and *Beauveria bassiana* isolates came from the fungus culture collection of the Insect Pathology Laboratory at the Plant Protection Division of UFRPE (Table 1). The isolates were plated into Petri dishes containing potato–dextrose–agar + streptomycine sulfate and incubated in a B.O.D. chamber at 26 ± 1°C and a 12-hour photophase for seven days. Next, they were reinvigorated on third-instar *Diatraea saccharalis* (F.) caterpillars in order to maintain the pathogens' virulence. The isolates were later stored in glass vials containing PDA culture medium and Nujol ® oil; in order to be used in the experiments, they were multiplied in plates containing complete culture medium (CM), consisting of yeast extract, glucose, minerals, agar, and water, according to Alves et al. (1998). Conidial viability was verified under the optical microscope, by means of the percentages of germinated and non-germinated conidia 24 h after plating on PDA + antibiotic and incubation for 24 h in a B.O.D. chamber at the same temperature and photophase previously mentioned.

Selection of the most pathogenic isolates

Ten *M. anisopliae* and 10 *B. bassiana* isolates were used (Table 1). One experiment was installed for each fungus, in a completely randomized design, consisting of the isolates and one control with 5 replicates; each plot consisted of 20 mites, totaling 100 mites per treatment. The suspensions were prepared by adding 15 mL of sterilized distilled water plus Tween 80 at 0.01% to the conidia. The suspensions were filtered through sterilized gauze; counts were made in a Neubauer chamber, and the suspensions were standardized at 10^8 conidia mL^{-1}. Cassava leaf discs 3.5 cm in diameter were inoculated with the pathogen by immersion in 20 mL of the suspension for 5 seconds. The discs were then placed in Petri dishes containing two layers of filter paper circles, moistened with distilled water

Table 1 - Hosts and origins of *Metarhizium anisopliae* and *Beauveria bassiana* isolates used on *Mononychellus tanajoa* in laboratory experiments.

Isolates	Hosts	Source
M. anisopliae		
E9	*Deois flavopicta* (Stal)	ESALQ-USP (Piracicaba - SP)
866	*Atta* sp.	Goiânia - GO
1022	*Phyllophaga* sp.	ESALQ-USP (Piracicaba - SP)
CG 423	*Schistocerca pallens* (Thunberg)	CENARGEN (Brasília - DF)
3027	*Deois flavopicta*	ESALQ-USP (Piracicaba - SP)
860	*Scarabaeidae*	ESALQ-USP (Piracicaba - SP)
IPA 204	*Mahanarva posticata* (Stal)	IPA Company (Recife - PE)
CG 321	*Cerotoma arcuata* (Olivier)	CENARGEN (Brasília - DF)
PL 47	*Mahanarva posticata*	ESALQ-USP (Piracicaba - SP)
1189	Soil sample	ESALQ-USP (Piracicaba - SP)
B. bassiana		
512	*Solenopsis invicta* (Buren)	ESALQ-USP (Piracicaba - SP)
561	*Solenopsis invicta*	ESALQ-USP (Piracicaba - SP)
CG 001	*Deois flavopicta*	CENARGEN (Brasília - DF)
634	*Solenopsis invicta*	ESALQ-USP (Piracicaba - SP)
604	Soil sample	ESALQ-USP (Piracicaba - SP)
447	*Solenopis invicta*	ESALQ-USP (Piracicaba - SP)
IPA 198	*Cosmopolites sordidus* (Germar)	IPA Company (Recife - PE)
645	Soil sample	ESALQ-USP (Piracicaba - SP)
635	*Solenopsis invicta*	ESALQ-USP (Piracicaba - SP)
IPA 205	*Cosmopolites sordidus*	IPA Company (Recife - PE)

and left to dry for twenty minutes in a laminar flow chamber. Adult mites aged 0-24 h after emergence from the stock colony were transferred to the arenas with a brush; twenty females per leaf were placed on the abaxial surface of the leaf. The females were sexed visually, by observation of the shape of the opisthosoma, which is round in females but different in males, that have funnel-shaped opisthosomas. The discs were placed and centralized onto polyethylene dishes 9 cm in diameter and 1.5 cm tall with a pin previously attached to the dish with silicone glue; the dishes contained 30 mL distilled water, which served as a physical barrier for the mites and to maintain leaf disc turgidity; the water level was completed daily.

Leaves were replaced on the fifth day after installation to ensure the quality of the substrate, and evaluations were carried out for eight days. The dead mites were placed in a wet chamber to confirm the causal agent and to determine confirmed mortality.

The daily mortality values were accumulated during the experiments to allow LT_{50} calculation, by Probit analysis, using the Mobae computer program (Haddad et al., 1995). The mite mortality data were submitted to analysis of variance using F test and the means were compared by Tukey test ($P \leq 0.05$) using the Sanest (version 3.0) software package.

Lethal Concentration Estimation

The 645 *B. bassiana* and CG 321 *M. anisopliae* isolates, identified as the most pathogenic in the previous stage based on mortality and smaller LT_{50} observed against the cassava green mite, were used at the concentrations of 1×10^4, 10^5, 10^6, 10^7, and 10^8 conidia mL^{-1} for LC_{50} determination. The experiments were conducted as a completely randomized experimental design, consisting of six treatments and five replicates containing 20 *M. tanajoa* females each, totaling 100 mites per treatment. The same methodology employed in the isolate selection experiment was used for disc and suspension preparation, as well as for suspension application, conidial viability determination, mite transfers, and evaluations.

RESULTS AND DISCUSSION

Selection of the most pathogenic isolates

Conidia viability for the *M. anisopliae* and *B. bassiana* isolates was higher than 95%. The total mortality percentage caused by *B. bassiana* isolates varied from 13.0 to 97.0%; confirmed mortality varied from 9.0 to 91.0%, and LT_{50} values ranged from 4.2 to 17.0 days. Isolate 645 caused the highest total mortality (97.0 %) and confirmed mortality percentages (91.0 %), and the

shortest LT_{50} (4.2 days) (Table 2). These values are similar to those obtained by Tamai (1997) for the mite *Tetranychus urticae* Koch, with a variation from 5.5 to 100% in total mortality and from 4.2 to 73.3% in confirmed mortality, using *Beauveria* spp. isolates at a concentration of 5×10^8 conidia mL^{-1}. Also, Oliveira et al. (2002), working with *B. bassiana* isolates at 10^8 conidia mL^{-1} and the red mite *Oligonychus yothersi* (McGregor), verified a variation in total mortality from 77 to 98% and a confirmed mortality from 19 to 75%.

With regard to *M. anisopliae*, the total mortality percentage obtained for isolates of this fungus ranged from 12.0 to 45.0%, confirmed mortality ranged from 8.0 to 45.0%, and LT_{50} ranged from 8.6 to 18.4 days (Table 3). When these values are compared to those obtained for *B. bassiana*, *M. anisopliae* was less pathogenic to *Mononychellus tanajoa*; the *M. anisopliae* isolate CG 321 was the most efficient, providing a 45.0% confirmed mite mortality with an LT_{50} of 8.6 days. These results are better than those obtained by Tamai (1997), who evaluated *M. anisopliae* against *T. urticae*; the author obtained low pathogenicity against the mite, achieving only 4.2 % confirmed mortality.

Even though using a concentration of 2.27×10^6 conidia mL^{-1}, Albuquerque et al. (2000), during an evaluation of *M. anisopliae* pathogenicity over *Brevipalpus*

Table 2 - Total mortality and confirmed mortality percentages (Mean ± SE) of *Mononychellus tanajoa* females by *Beauveria bassiana* isolates at a concentration of 1×10^8 conidia mL^{-1} and Lethal Time (LT_{50}), in the laboratory. 26.5 ± 0.6°C, 78.4 ± 4.2% RH, and 12-hour photophase.

Isolate	Mortality[1] total	Mortality[1] confirmed	LT50 e CI (days)[2]	Regression equation	Calculated χ^2
645	97.0 ± 1.2 a	91.0 ± 3.3 a	4.2 (3.8 - 4.7)	Y = -0.7 + 8.9 logx	27.6*
447	86.0 ± 4.8 ab	80.0 ± 6.3 ab	4.7 (4.2 - 5.3)	Y = 0.7 + 6.4 logx	26.6*
CG 001	83.0 ± 5.2 ab	77.0 ± 4.1 ab	5.3 (4.8 - 5.8)	Y = -0.6 + 7.8 logx	27.4*
IPA 198	83.0 ± 7.0 ab	71.0 ± 6.0 ab	5.2 (4.6 - 5.8)	Y = -0.2 + 7.2 logx	35.2*
561	61.0 ± 10.7 bc	56.0 ± 10.7 bc	6.3 (5.5 - 7.1)	Y = 1.5 + 4.3 logx	16.2*
IPA 205	50.0 ± 5.5 c	43.0 ± 6.0 c	7.12 (5.9 - 8.4)	Y = 2.0 + 3.4 logx	14.5*
604	48.0 ± 5.1 c	40.0 ± 4.7 c	7.7 (6.9 - 8.6)	Y = 0.1 + 5.6 logx	8.6 ns
512	38.0 ± 4.0 cd	35.0 ± 4.4 cd	8.7 (7.6 - 10.0)	Y = -0.7 + 6.1 logx	8.3 ns
634	36.0 ± 7.3 cd	29.0 ± 6.2 cd	8.9 (7.5 - 10.4)	Y = -0.5 + 5.8 logx	10.6 ns
635	13.0 ± 1.2 de	9.0 ± 1.00 d	17.0 (11.3 - 25.4)	Y = 0.13 + 3.9 logx	2.4 ns
Control	6.00 ± 2.9 e		-	-	-
CV	23.1%	24.4%			

[1]Means (± SE) followed by the same letter in the columns do not differ by Tukey test at 5%.
[2]LT_{50} Lethal Time; CI, Confidence Interval at 5%; CV, Coefficient of Variation.

Table 3 - Total mortality and confirmed mortality percentages (Mean ± SE) of *Mononychellus tanajoa* females by *Metarhizium anisopliae* isolates at a concentration of 1×10^8 conidia mL^{-1} and Lethal Time (LT_{50}), in the laboratory. 26.1 ± 0.7°C, 79.5±5.9% RH, and 12-hour photophase.

Isolate	Mortality[1] total	Mortality[1] confirmed	LT50 e CI (days)[2]	Regression equation	Calculated χ^2
CG 321	45.0 ± 2.7 a	45.0 ± 2.7 a	8.6 (7.9 – 9.4)	Y = 0.7 + 4.7 logx	2.7 ns
1022	37.0 ± 5.3 ab	32.0 ± 4.8 ab	9.4 (8.5 – 10.4)	Y = -0.7 + 5.8 logx	3.1 ns
3027	35.0 ± 4.4 abc	28.0 ± 4.8 bc	9.9 (8.6 – 11.3)	Y = 0.6 + 4.3 logx	3.3 ns
1189	25.0 ± 4.4 bcd	20.0 ± 4.4 bcd	12.1 (8.7 – 16.7)	Y = 0.9 + 3.7 logx	8.0 *
E9	21.0 ± 1.0 bcde	19.0 ± 1.8 bcd	12.0 (9.4 – 15.2)	Y = -0.4 + 5.0 logx	3.8 ns
CG 423	19.0 ± 4.5 cde	15.0 ± 4.1 cd	13.6 (9.8 – 18.9)	Y = 0.2 + 4.2 logx	4.3 ns
IPA 204	13.0 ± 2.5 de	10.0 ± 2.2 d	16.4 (11.9 – 22.6)	Y = -0.4 + 4.4 logx	1.4 ns
PL 47	13.0 ± 1.2 de	10.0 ± 1.5 d	19.8 (13.0 – 30.1)	Y = 0.12 + 3.7 logx	1.4 ns
866	12.0 ± 2.5 de	10.0 ± 2.7 d	21.2 (12.0– 37.3)	Y = 0.4 + 3.4 logx	2.3 ns
860	12.0 ± 3.7 de	8.00 ± 2.0 d	18.4 (14.0 – 24.2)	Y = -0.3 + 4.2 logx	0.6 ns
Control	7.00 ± 1.2 e		-	-	-
CV	35.1%	38.5%			

[1]Means (± SE) followed by the same letter in the columns do not differ by Tukey test at 5%.
[2]LT_{50} Lethal Time; CI, Confidence Interval at 5%; CV, Coefficient of Variation.

phoenicis Geijskes, also did not verify efficiency of the fungus over this mite; during their study, only 2.25% mortality occurred, and no conidiogenesis was observed.

Lethal Concentration Estimation

A relationship was verified between the increase in conidial suspension concentration and the increase in total mortality and confirmed mortality caused by the *B. bassiana* 645 and *M. anisopliae* CG 321 isolates, as well as with the LC_{50} values (Table 4). The total mortality caused by the *B. bassiana* isolate 645 at the concentration of 10^4 conidia/mL was not different from the control; however, the other concentrations caused higher mortalities than the control, with a total mortality of 93.0% and a confirmed mortality of 83.0%, at the concentration of 10^8 conidia mL^{-1}.

The LC_{50} for the 645 *B. bassiana* isolate was 3.93×10^6 conidia mL^{-1}, ranging from 2.67×10^4 to 7.36×10^7 conidia mL-1 (Table 4). The 645 *B. bassiana* isolate showed a lower LC_{50} than the CG321 *M. anisopliae* isolate, thus demonstrating that the first was more pathogenic than the second. Tamai et al. (1999), using the 447 *B. bassiana* isolate on females of the mite *T. urticae*, concluded that only at the concentration of 1×10^9 conidia mL^{-1} there was a total mortality higher than 50%. Alves et al. (2002), evaluating the effect of *B. bassiana* isolate 447 on *T. urticae* at different concentrations, verified an LC_{50} of 1.26×10^7 conidia mL^{-1}, therefore higher than the value obtained in this work with *B. bassiana* isolate 645.

The *M. anisopliae* isolate CG 321 showed an LC_{50} of 7.44×10^8 conidia mL^{-1}, varying from 1.97×10^8 to 6.51×10^9 conidia mL^{-1}; At a concentration of 1×10^8 conidia mL^{-1}, a total mortality of only 41.0 % and a confirmed mortality of only 31.0 % were obtained. Correia et al. (1998), studying *M. anisopliae* isolate E_9 at concentrations of 7.5×10^5 to 7.5×10^8 conidia mL^{-1} on the cattle tick *Boophilus microplus* Canestrini, verified mortalities from 10.9 to 40.0%, respectively; these values are also not very expressive for the highest concentration used. Hanchinal & Manjunatha (2000), however, working with *M. anisopliae* at concentrations of 1.5×10^4, 1.5×10^6, and 1.5×10^8 conidia mL^{-1} on *Tetranychus neocaledonicos* Andre adults, verified that the fungus at the highest concentration caused a mite mortality of 92.9%.

With regard to the performance variability of different isolates, Sosa Gómez & Alves (1983) verified a high enzymatic activity in more virulent isolates of *M. anisopliae* from several Brazilian regions, and mentioned that they are probably associated with the presence of enzymes that influence the penetration process of the fungus (St Leger et al., 1988; De La Rosa et al., 1997), as well as with toxins such as destruxins and beauvericin present, respectively, in *M. anisopliae* and *B. bassiana*, which vary in different isolates (Roberts & Krasnoff, 1998). Considering that the use of entomopathogenic fungi should be viewed as a component of integrated pest management, the results here obtained suggest that *B. bassiana* isolate 645 should be used in control programs against the cassava green mite *M. tanajoa*.

Table 4 - Total mortality and confirmed mortality percentages (Mean ± SE) of *Mononychellus tanajoa* females by the *Beauveria bassiana* 645 and *Metarhizium anisopliae* CG 321 isolates, at the concentrations of 1×10^4, 10^5, 10^6, 10^7, and 10^8 conidia mL^{-1}, and Lethal Concentration (LC_{50}). Temperature of 25.4 ± 0.7ºC, 64.7 ± 2.2% RH, and 12-hour photophase.

Isolates	Concentration (conidia/mL)	Mortality[1] total	Mortality[1] confirmed	LC_{50} (conidia mL^{-1}) IC[2]	b[3]	$\chi^{2,4}$
645	10^8	93.0 ± 3.7 a	83.0 ± 2.0 a	3.9 x 10^6	0.7	5.5 ns
	10^7	4.0 ± 2.4 b	38.0 ± 2.0 b	(2.6 x 10^4 - 7.3 x 10^7)		
	10^6	32.0 ± 3.0 c	26.0 ± 2.4 c			
	10^5	26.0 ± 1.8 cd	19.0 ± 2.4 c			
	10^4	19.0 ± 3.6 de	8.00 ± 1.2 d			
Control		7.00 ± 2.0 e				
CV	17.36		13,24	-		-
CG 321	10^8	41.0 ± 3.3 a	31.0 ± 2.4 a	7.4 x 10^8	0.4	4.7 ns
	10^7	26.0 ± 6.5 ab	19.0 ± 5.3 ab	(1.9 x 10^8 - 6.5 x 10^9)		
	10^6	21.0 ± 5.5 bc	13.0 ± 3.9 bc			
	10^5	12.0 ± 2.5 bc	7.00 ± 1.2 bc			
	10^4	9.00 ± 1.8 bc	3.00 ± 1.2 c			
Control		7.00 ± 2.0 c		-		-
CV		47.0%	47.9%			

[1]Means (± SE) followed by the same letter in the columns do not differ by Tukey test at 5%.
[2]LC_{50}, Lethal Concentration; CI, Confidence Interval at 5%; CV, Coefficient of Variation.
[3]b Regression line slope coefficient
[4]$\chi^2 = \chi^2$ Test

CONCLUSION

B. bassiana isolates tested are more efficient than the *M. anisopliae* isolates for utilization in integrated management of the cassava green mite *M. tanajoa*.

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