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The Kill Power Test of Microbial Insecticide to Copra Pest Insects in Minahasa Regency

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Abstract: Copra is one of the processed coconut flesh products as raw material for making cooking oil and butter and other processed products. Efforts to increase the quantity and quality of copra are strongly influenced by pests and diseases. The aim of the study was to determine the killing power of microbial insecticides against copra pests. The study used a completely randomized design (CRD) with 5 treatments and 3 replications. As treatment A: concentration of pathogen Metarhizium anisoplie 5%, B: concentration of pathogen M. anisoplie 10%, C concentration of pathogen M. anisoplie 15%, D: concentration of pathogen M. anisoplie 20% : concentration of pathogen M. anisoplie 25%, F: Beauveria bassiana pathogen concentration 5%, G: B. bassiana pathogen concentration 10%, H: B. bassiana pathogen concentration 15, I: 20% B. bassiana pathogen concentration, J: 25% B. bassiana pathogen concentration, and K = Control. The insect population of each treatment was 25 imago individuals.
The results showed that the killing power of pathogens M. anisopliae and B. bassiana against important pests on copra varied according to the type of pest. The highest Necrobia rufipes mortality was at 20% and 25% concentrations of M. anisopliae, ie 98.68% and 100%, the highest Carpophilus dimidiatus mortality was B. bassiana and M. anisopliae at 25% concentration, respectively, and T. castaneum was highest at concentrations of B. bassiana 20% and 25%, namely 89.32% and 100%, respectively. M. anisopliae had more potential to control N. rufipes larvae, M. aniasopliae and B. bassiana had the same potential to control C. dimidiatus larvae, and B. bassiana had more potential to control T. castaneum larvae.

Keywords: Metarhizium anisoplie, Beauveria bassiana, Necrobia rufipes, Carpophilus dimidiatus, Tribolium castaneum.

1. Introduction

1.1. Background

Coconut (Cocos nucifera) is a type of plant from the aren-arenan tribe or Arecaceae and the sole member of the Cocos clan. This plant is used almost all of its parts by humans so that it is considered a versatile plant, especially for coastal communities. Coconut fruit is known as the main source of vegetable oil production, it can also be used as a source of protein, vitamins, minerals and carbohydrates. Coconut flesh can be processed and used into a variety of useful processed products, one of which is copra. Copra is one of the processed coconut meat which is widely cultivated by the community because the process is very simple. The production cost is relatively low when compared to processing coconut meat into dry coconut milk or cooking oil (Manueke and Moningka, 1998; Amin, 2009).

The exploitation of copra is still encountered various obstacles, one of the obstacles is the loss caused by attacks of pests including insects. These insects not only attack in the field but also attack agricultural products stored in warehouses. The important copra pests are insects, fungi, and bacteria (Manueke and Moningka, 19984; Shambangun, 1998; Gonibala, 2006; Gabriel, et al. 2020).

There are several types of important insect pests in copra commodities. These pests were found to attack copra of poor quality and generally attack copra with high water content, which is above 15%. Important insect pests on copra include Necrobia rufipes De Geer, Carpophilus dimidiatus F., Tribolium castaneum Herbst., Ahasverus Advena Walt., Oryzaephilus surinamensis L. and Sitophilus oryzae L. (Hinton and Corbet, 1975; Kalshoven, 1981; Halstead, 1986; Hill, 1990; Haines, 1991; Syarief and Halid, 1993; Gonibala, 2006; Astuti, 2019; Gabriel, et al. 2020).

Control efforts carried out against copra pests are still limited to physical/mechanical control and have not given satisfactory results. The results of research by Manueke and Moningka (1998) and Dewi, et al. (2015) against pest attacks on copra in North Sulawesi showed significant damage and loss of defecation economically. Within 3 months pest attacks can cause heavy losses in copra commodities 5-10%. The report from the Center for Plantation Research and Development of the Agricultural Research and Development Agency stated that the damage caused by copra pests, especially N. rufipes, was very worrying. At the time of improper storage of copra will be attacked by warehouse pests which can result in damage and loss of weight due to pest activity which will directly affect the quantity and quality of the product. The amount of damage and loss depends on how the pests attack or damage (Mudjiono, et al. 2015).

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2 Research purposes

The aim of the study was to determine the killing power of pathogens M. anisopliae and B. bassiana against larvae of N. rufipes, C. dimidiatus, and T. casataneun on copra.

Materials and Methods

This research was carried out at the Laboratory of Pests and Plant Diseases, Faculty of Agriculture, Sam Ratulangi University, Manado. Samples of copra that have shown symptoms of attack or are attacked by pests are collected from copra warehouses in Minahasa Regency and then taken to the Pest and Plant Diseases laboratory for propagation. The research will be carried out for 6 months from February to September 2022. The materials and tools used in this research are rice that is attacked by pests or has shown symptoms of insect pests, cultured pathogens Metarhizium anisopliae and Beauveria bassiana, test insects Necrobia castsaneum, Topl. , collection bottles, filters, label paper, petridis, loops, tongs, tapes, cameras, and writing utensils.

The study used a Completely Randomized Design (CRD) with 10 treatments and three replications. As treatment, the concentrations of pathogens M. anisopliae and B. bassiana were 5 levels of concentration as follows: A = concentration of pathogenic M. anisopliae 5 gr/100 cc of distilled water, B = concentration of pathogenic M. anisopliae 10 gr/100 cc of distilled water, C = concentration of pathogen M. anisopliae 15 gr pathogen/100 cc aquadest, D = concentration of pathogen M. anisopliae 20 gr/100cc aquades, = concentration of pathogen M. anisopliae 25 gr/100cc aquadest, F = concentration of pathogen B. bassiana 5 gr /100cc aquades, G = concentration of pathogens M. anisopliae 10 gr/100cc aquades, H = concentration of pathogens M. anisopliae 15 gr/100cc aquades, I = concentration of pathogens B. bassiana 20 gr/100cc aquades, J = concentration of pathogens B. bassiana 25 gr/100cc aquadest, and K = Control (pathogenic concentration 0 gr/100cc aquadest). The insect population of each treatment was 25 imago individuals. The layout of the research on the use of pathogens M. anisopliae and B. bassiana can be seen in Figure 1 (attached).

1. Preparation

a. Test Insect Maintenance

- The tested pest insects that are kept are obtained by taking copra from copra warehouses that have been attacked or showing symptoms of pest attack and then taking them to the pest and plant disease laboratory for rearing.
- Copra that has been attacked or shows symptoms of insect pests is put in 1 kg jars each and covered with white azahi cloth.
- Jars containing copra that are attacked by these pests are left for 1.5 - 2 months until the insect pests in the rice multiply.
- The test insect culture on the copra is ready for research applications.
- Prepare the imago of N. rufipes, C. dimidiatus, and T. castaneum each for each treatment, 25 g each.

b. Preparation of Pathogen Culture of M. asopliae and B. bassiana on Rice Media

- Steamed rice until half cooked
- Half-cooked rice packed in a transparent plastic bag per 20 gr.
- Pure cultures of M. anisopliae and B. bassiana were inoculated in each of the 20 gr rice packages.
- Packages of rice that have been inoculated with pathogens of M. anisopliae and B. bassiana are incubated for a week and are ready to be applied.

2. Implementation

- Microbial insecticide treatment is only carried out on the main types of insect pests found in the propagation of insect pests on copra in the laboratory.
- Each type of main insect pests, namely N. rufipes, C. dimidiatus, and T. castaneum, was prepared 25 imago for each treatment.
- Apply the pathogens M. anisopliae and B. bassiana to the test insects in a jar that already contains new copra along with 25 imago.
- After the application of the potogen, each jar was covered with a white azahi cloth.
- Observations will be made one day after the application of the pathogen M. anisopliae, and carried out for one week with an observation time interval of 2 days.

3. Observation

Observations were made 5 times with an observation interval of 2 days. What was observed was the mortality of copra pests. Calculation of pest mortality using the formula:

$$\text{rtality} = \frac{\text{nber of dead test insect}}{} \times 100\ \%$$

number of test insects observed

4. Data Analysis

Data from the mortality study of N. rufipes, C. dimidiatus, and T. castaneum pests due to the treatment of pathogens M. anisopliae and B. bassiana were analyzed using the SPSS 21.0 program.

3. Results and Discussion

The results of the research on the types of pests on copra collected from the warehouses of copra collectors in Kombi District found 3 types of pests, namely Necrobia rufipes, Carpophilus dimidiatus, and Tribolium castaneum. These three types of pests are important pests that are found attacking copra in the copra storage warehouses of copra collectors traders in Kombi sub-district. The results of observations on the development of imago mortality of N. rufipes due to the application of pathogenic cultures of M. anisopliae and B. bassiana can be followed in Table 1 (attached).

The results of observations on mortality of N. rufipes imago in table 1 show that the development of mortality of N. rufipes imago is directly proportional to the concentration of pathogenic cultures of M. anisopliae and B. bassiana. The greater the concentration of pathogenic cultures of M. anisopliase and B. bassiana, the greater the mortality of N. rufipes imago. The mortality of N. rufipes was also directly proportional to the concentration of pathogenic cultures of M. anisopliae and B. bassiana. The longer the observation time, the greater the mortality, and the mortality of imago N. rufipes reached 100% in the fifth observation.

The results of observations on the development of mortality of C. dimiatus pests due to the application of pathogens M. anisopliae and B. bassiana can be followed in Table 2 (attached).

The data in table 2 shows that the greater the concentration of pathogenic cultures of M. anisopliae and B. bassiana, the greater the mortality of imago pests of C. dimidiatus. The increase in mortality of C. dimidiatus was in line with the length of time of observation, namely the mortality of C. dimidiatus increased from the first observation to the fifth observation, and reached 100% in the treatment with 25% concentration of the pathogen M. anisopiae in the fifth observation.

The results of observations on the development of mortality of T. castaneum pests due to the application of pathogens M. anisopliae and B. bassiana can be followed in Table 3 (attached).

The data in table 3 shows that the greater the concentration of pathogenic cultures of M. anisopliae and B. bassiana, the greater the mortality of imago pests of T. castaneum. The increase in mortality of T.castaneum was in line with the length of observation time, namely the mortality of T.castaneum increased from the first observation to the fifth observation, and reached 100% in the fifth observation treatment with 25% concentration of the pathogen M. anisopiae.

The observed mortality data in tables 1, 2, and 3 show that an increase in the concentration of pathogenic cultures was always followed by an increase in the larvae mortality of N. rufipes, C. dimidiatus and T. castaneum. The increase in mortality can be caused by an increase in the levels of toxins contained in each treatment. The greater the concentration of pathogenic culture, the greater the toxic content contained therein.

Novizan (2002) and Elawati, et al. (2018) stated that the virulence of entomopathogenic fungal spores is largely determined by the number, age of spores, and after successfully penetrating, entering the insect's body, the fungus will release toxins, at the stage of destruction and colonization, infecting the digestive tract and respiratory system which results in damage. insect tissue. Eventually the insect will die. The content of the taxin affects the fast and slow death of the test organism or the host of the entomopathogenic fungus.

The results of research Angrgawati, et al. (2017) and Manueke, et al. (2018) and showed that each treatment caused a significant difference in the mortality of Paraeucosmetus sp. on lowland rice in Papontolen Village, Amurang District, South Minahasa Regency. Paraeucosmetus sp. mortality. directly proportional to the increase in the concentration of the entomopathogenic fungus .B bassiana. The higher the concentration of B. bassiana, the higher the mortality of Paraeucosmetus sp. In paddy fields. The high mortality of Paraeucosmetus sp. caused by the content of spores and fungal toxins which are greater in the concentration of B. Bassiana fungus.

The results of statistical analysis of the killing power of pathogens M. anisopliae and B. bassiana against copra varied according to the type of pest. The average number of imago N. rufipes, C. dimidiatus, and T. castaneum that died from pathogens M. anisopliae and B. bassiana can be followed in Table 4 (attached).

The data in table 4 shows that the pathogen M. anisopliae has more potential to control N. rufipes than the pathogen B. bassiana. This is evidenced by the presence of the highest mortality of N. rufipes in the treatment concentration of M. anisopliae culture, namely in the 15% treatment causing 80% mortality, 20% treatment causing 98.68% mortality, and 25% treatment caused 100% mortality. Both types of pathogens B. bassiana and M. anisopliae have the potential to control C. dimidiatus pests. This is evidenced by the presence of the highest mortality of *N. rufipes* in the treatment concentration of M. anisopliae and B. bassiana cultures, namely in the 25% treatment which causes mortality causing 100% mortality. The *B. bassiana* pathogen has more potential to control *T. castaneum* than the *M. anisopliae* pathogen. This is evidenced by the highest mortality of *T. castaneum* in the treatment of *B. bassiana* culture concentrations in the 10%, 15%, 20%, and 25% treatments, which caused mortality of 70.0%, 81.32% 89.32% and 100 %. In general, these two types of pathogens have the potential to control the main pests of copra because both *M. anisopliae* and *B. bassiana* have been able to cause the death of the test insects above 50%.

According to Harini et al. (2004) the fungus *Beauveria* sp. and *Metarrhizium* sp. known as insect pathogenic fungi, or entomopathogenic fungi, namely fungi that can cause disease in insects. This is because the fungus can be used to control pests by making the target pest sick first, then dying. The formulation of the fungus *Beauveria* sp. and *Metarrhizium* sp. able to control caterpillars, aphids, and leaf beetles in food crops, horticulture, and biopharmaceuticals. In addition, it can be used to control brown planthoppers, green leafhoppers, rice stem borers, walang sangit, white pests, and soil bedbugs on rice plants. Melani, et al. (2020) and Elawati, et al. (2020) the fungus Beauveria sp. and *Metarrhizium* sp. controlling pests by means of spores that enter the body of insects. Inoculum or fungal spores attached to the body of the host insect will germinate and develop to form a sprout tube. After that, the spores enter by penetrating the skin of the insect's body (integument). Spores enter through the digestive tract, respiratory tract, and integument of insect pests. The successful use of this fungus as a pest control in the field is strongly influenced by environmental factors (temperature, humidity, and sunlight). Insects attacked by *Beauveria* sp. will die with a hardened body like a mummy, while those who are attacked by Metarrhizium sp. will die with a fragile body.

Dinata (2004) said that the way the fungus Beauvaria bassiana infects the insect body begins with host contact, enters the host's body, reproduces in one or more host tissues, then contacts and infects new hosts. *B. bassiana* enters the host insect's body through the skin, digestive tract, spiracles and other openings. The fungal inoculum attached to the host insect's body will germinate and develop to form a sprout tube, then enter through the body's skin. Penetration is done mechanically and/or chemically by removing enzymes or toxins. In the next process, the fungus will reproduce in the host's body. The fungus will develop in the host's body and attack all body tissues, so the insect dies. Fungal mycelia penetrate outside the host's body, grow over the host's body and produce conidia. In a matter of days, the insects will die. Insects that are attacked by the fungus B. bassiana will die with a hardened body like a mummy and the fungus covers the host's body with a white color.

The results of the study by Manueke, et al (2018) and Rachmawati, et al. (2018) showed that the death of Paraeucosmetus sp. due to infection with the fungus *B. bassiana* is thought to be caused by the toxin it produces. Beauveria produces a toxin called beauvericin and secondary metabolites such as bassianin, bassiacridin, bassianolide, beauverolides, tenellin and ceosporein (Dacust and Perriera, 1986).

According to Tampubolon, et al. (2013) that the fungus *M. anisopliae* produces a toxin Cyclic peptide called destruxin, this compound is composed of five amino acids, namely proline, isoleucine, methyl-valine, methyl-alanine, and beta-alanine. Destruxin has an effect that causes abnormalities in the function of the middle stomach, hemocyt, malpighian tubules and muscle tissue in the host. Destruxin has been used as a new generation insecticide.

Saenong and Alfons (2009) and Manurung, et al. (2012) stated that *M. anisopliae* spores enter the insect's body through the skin. Spores that have entered the insect's body begin to form hyphae starting from the epidermal tissue until the entire insect body tissue is filled with hyphae. After the host is killed, the hyphae will form primary and secondary spores, depending on weather conditions, when the weather supports the appearance of spores on the insect cuticle. Dead larvae that are attacked by the fungus *Metarhizium anisopliae* will later harden and stiffen. The larvae's skin will be covered by white flour which will turn dark green in color.

According to Mulyono (2007) and Yunizar, et al. (2018) that the optimum temperature for the development of fungal pathogenicity and survival ranges between 20^0C – 300^0C and above 300^0C will have a detrimental effect on entomopathogenic fungi. infection and spread of spores are influenced by several factors, namely wind, humidity, and host solids. Strong winds and high humidity can help spread spores and spread the infection evenly across individuals in the population.

4. Conclusions and Recommendation

Conclusion

Based on the results of research and discussion, it can be concluded as follows:

1. Mortality of *N. rufipes, C. dimidiatus*, and *T. castanmeum* was directly proportional to the concentration of pathogenic cultures of *M. anisopliae* and *B. bassiana*.
2. The greater the concentration of pathogens, the greater the mortality caused by copra imago.
3. The *M. anisopliae* pathogen has more potential to control *N. rufipes* than the *B. bassiana* pathogen.
4. Pathogens *M. anisopliae* and *B. bassiana* have the same potential in controlling C. dimidiatus pests.
5. The pathogen *B. bassiana* has more potential to control *T. castaneum* than the pathogen *M. anisopliae*.
6. In general, the pathogens *M. anisopliae* and *B. bassiana* have the potential to control *N. rufipes*, *C. dimidiatus*, and T. castaneum on copra.

Suggestion

This research needs a field application to determine the real ability of the pathogens *M. anisopliae* and *B. bassiana* in controlling N. rufipes, C. dimidiatus, and T. castanem pests on copra.

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APPENDICES

Appendix 1. Layout diagram for the test of the killing power of M. anisopliae and B. bassiana pathogens against copra pests.

Figure 1. Layout of the research on the killing power of M. anisopliae and B. bassiana against copra pests

C3	E2	D1	F3	A2	B2
E1	B3	A3	D2	E3	F2
C2	F1	B1	C1	A1	D3
J3	H3	G3	I1	K3	E3

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K1	I1	H2	J2	H1	G2
G1	G1	I3	K2	E2	J1

Where : A = Concentration of pathogenic M. anisopliae 5 gr/100cc aquades; B = Concentration of pathogenic M. anisopliae 10 gr/100cc aquades; C = Concentration of pathogenic M. anisopliae 15 gr/100cc aquades; D = Concentration of pathogenic M. anisopliae 20 gr/100cc aquades; E = Concentration of pathogenic M. anisopliae 25 gr/100cc aquades; F = Concentration of pathogenic B. bassiana 5 gr/100cc aquades; G = Concentration of pathogenic B. bassiana10 gr/100cc aquades; H = Concentration of pathogenic B. bassiana 15 gr/100cc aquades; I = Concentration of pathogenic B. bassiana 20 gr/100cc aquades; J = Concentration of pathogenic B. bassiana 25 gr/100cc aquades; K = Concentration of pathogenic M. anisopliae and B. bassiana 0 gr/100 cc aquades; 1,2,3 = Replication.
;

Appendix 2. Table of development of N. rufipes mortality due to application of pathogens M. anisopliae and B. bassiana

Table 1. Mortality development of N. rufipes due to application of pathogens M. anisopliae and B. bassiana

No.	Treatment	Average observational mortality I-V				
		I	II	III	IV	V
1.	A = 5%M	3,33	5,33	7,0	10,33	12,67
2.	B = 10%M	4,67	7,67	9,67	14,33	16,33
3.	C = 15%M	5,67	9,67	13,33	18,0	20,0
4.	D = 20%M	7,33	13,33	17,0	21,0	24,67
5.	E = 25%M	9,67	17,0	20,0	22,67	25,0
6.	F = 5%B	0,33	3,0	4,67	6,33	7,67
7.	G = 10%B	1,33	4,67	8,0	10,33	11,0
8.	H = 15%B	2,67	6,67	10,67	13,0	14,33
9.	I = 20%B	4,33	8,67	14,0	14,67	16,33
10.	J = 25%B	5,67	11,66	17,33	16,33	16,67
11.	K = 0%MB	0	0	0	0	0

Where : O%K = control: 0% M. anisopliae and 0% B. bassiana; 5%M = 5% treatment of M. anisopliae: 10%M = 10% treatment of M. anisopliae; 15% M = 15% treatment of M anisopliae; 20% M = 20% treatment of M. anisopliae; 25% M = 25% treatment of M. anisopliae; 5%B = 5% cultivation of B. bassiana; 10% B = 10% treatment of B. bassana; 15% B = 15% treatment of B. bassiana; 20% B = 20% treatment of B. bassiana; 25% B = 25% treatment of B. bassiana. I –V = observation time.

Appendix 3. Table of development of C. dimidiatus mortality due to the application of pathogens M. anisopliae and B. bassiana

Table 2. Mortality development of C. dimidiatus due to application of pathogens M. anisopliae and B. bassiana

No.	Treatment	Average observational mortality I-V				
		I	II	III	IV	V
1.	A = 5%M	0,67	7,67	7,67	10,67	14,0
2.	B = 10%M	4,67	10,0	10,0	11,33	15,67
3.	C = 15%M	8,67	14,67	14,67	14,67	17,67
4.	D = 20%M	11,33	18,67	18,67	18,67	22,0
5.	E = 25%M	14,67	21,67	21,67	23,67	25,0
6.	F = 5%B	1,0	7,0	7,0	11,33	11,33
7.	G = 10%B	4,67	10,0	10,0	15,0	15,0
8.	H = 15%B	7,67	15,0	15,0	18,0	18,0
9.	I = 20%B	10,67	18,33	18,33	30,33	20,33
10.	J = 25%B	15,67	21,33	21,33	24,33	25,0
11.	K = 0%MB	0	0	0	0	0

Where : O%K = control: 0% M. anisopliae and 0% B. bassiana; 5%M = 5% treatment of M. anisopliae: 10%M = 10% treatment of M. anisopliae; 15% M = 15% treatment of M anisopliae; 20% M = 20% treatment of M. anisopliae; 25% M = 25% treatment of M. anisopliae; 5%B = 5% cultivation of B. bassiana; 10% B = 10% treatment of B. bassana; 15% B = 15% treatment of B.

bassiana; 20% B = 20% treatment of B. bassiana; 25% B = 25% treatment of B. bassiana. I –V = observation time

Appendix 4. Table of T. castaneum mortality due to application of pathogens M. anisopliae and B. bassiana

Table 3. Mortality development of T. castaneum due to application of pathogens M. anisopliae and B. bassiana

No.	Treatment	Average observational mortality I-V				
		I	II	III	IV	V
1.	A = 5%M	0,33	2,67	4,0	6,0	8,67
2.	B = 10%M	2,67	4,67	6,67	8,67	11,0
3.	C = 15%M	4,67	6,33	8,67	11,0	13,0
4.	D = 20%M	6,33	8,33	10,67	13,67	15,67
5.	E = 25%M	8,0	1,67	14,0	14,67	16,33
6.	F = 5%B	0,67	3,0	7,67	10,67	14,67
7.	G = 10%B	6,33	10,0	12,67	16,0	17,67
8.	H = 15%B	8,67	12,67	15,0	18,0	20,33
9.	I = 20%B	11,33	14,67	16,67	21,67	22,33
10.	J = 25%B	13,67	17,0	19,0	23,0	25,0
11.	K = 0%MB	0	0	0	0	0

Where : O%K = control: 0% M. anisopliae and 0% B. bassiana; 5%M = 5% treatment of M. anisopliae: 10%M = 10% treatment of M. anisopliae; 15% M = 15% treatment of M anisopliae; 20% M = 20% treatment of M. anisopliae; 25% M = 25% treatment of M. anisopliae; 5%B = 5% cultivation of B. bassiana; 10% B = 10% treatment of B. bassana; 15% B = 15% treatment of B. bassiana; 20% B = 20% treatment of B. bassiana; 25% B = 25% treatment of B. bassiana. I –V = observation time

Appendix 5. Table of average mortality of pests N. rufipes, C. dimidiatus and T. castaneum due to application of pathogens M. anisopliae and B. bassiana

Table 4. Statistical test results on average mortality of imago N. rufipes, C. dimidiatus and T. castaneum due to the application of pathogens M. anisopliae and B. bassiana

No.	**Types of pests**								
	N. rufipes			***C. dimidiatus***			***T. castaneum***		
No.	Teat-ment	Mortali-ty (%)	Nota-tion	Teat-ment	Mortali-ty (%)	Nota-tion	Teat-.ment	Mortali-ty (%)	Nota-tion
1.	0%K	0.0	a	0%K	0.0	a	0%K	0.0	a
2.	5%B	30,68	b	5%B	45.32	b	5%M	34.68	b
3.	10%B	44.0	c	5%M	56.0	c	10%M	44.0	c
4.	5%M	50.68	d	10%B	60.0	cd	15%M	52.0	d
5.	15%B	57.32	e	10%M	62.68	d	5%B	58.68	e
6.	10%M	65.32	f	15%M	70.68	e	20%M	62.68	ef
7.	20%**B**	65.32	f	15%B	72.0	e	25%M	65.28	fg
8.	25%B	66.68	f	205B	81.32	f	10%B	70.68	g
9.	15%M	80.0	g	20%M	88.0	g	15%B	81.32	h
10.	20%M	98.68	h	25%M	100.0	h	20%B	89.32	i
11.	25%M	100.0	h	25%B	100.0	h	25%B	100.0	j

Where: Numbers followed by the same letter in the same column show that they are not significantly different.; O%K = control; 5%M = 5% treatment of M. anisopliae; 10%M = 10% treatment of M. anisopliae; 15% M = 15% treatment of M anisopliae; 20% M = 20% treatment of M. anisopliae; 25% M = 25% treatment of M. anisopliae; 5%B = 5% cultivation of B. bassiana; 10% B = 10% treatment of B. bassana; 15% B = 15% treatment of B. bassiana; 20% B = 20% treatment of B. bassiana; 25% B = 25% treatment of B. bassiana

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