

Management of *Myzus persicae* using *Beauveria bassiana* and Environment-friendly agricultural materials (EFAM) on pepper

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Abstract

This study was carried out to development the environment-friendly control method of *Myzus persicae* using *Beauveria bassiana* and Environment-friendly agricultural materials (EFAM).

Germination rate the dried conidia of *B. bassiana* was 90 percent at 24~27 °C temperature condition. Mortality of *M. persicae* was 56.7% at 1×10^7 cfu/ml conidia concentration. Four EFAM such as Pachungtan, Wangjungwang, Newbiodakill, Muginchon were low toxicity to *B. bassiana* growth. Among them, Muginchon (derris extract) and Wangjungwang (neem extract) could have synergistic effect to aphid mortality when mixing treat with *B. bassiana*, which protection value was 99% in 3 days after treat.

Introduction

Entomopathogenic fungi are ecologically classified as fungi that grow either inside of insect bodies or on the surface of their exoskeleton, which eventually causes the death of the host insect. The species of entomopathogenic fungi was *Beauveria bassiana*, *Meira geulakonigii*, *Nomuraea rileyi*, *Paecilomyces farinosus* and *Paecilomyces fumosoroseus*. Recently, preserve the ecosystem was the most project in the world. This point of view, Entomopathogenic fungi such as *Beauveria bassiana* was major factor for control of agricultural pests. *B. bassiana* such as SFB-205 strain showed 32.7% of insecticidal activity to *M. persicae* at 4 days after application in the greenhouse (Kim *et al.*, 2008). Many *B. bassiana* strains was commercialized in the world to control of mites, diamond back moth, beet armyworm (Mutimura *et al.*, 2009). Only application the *B. bassiana* was not enough to management aphids. For this reason, we selected several commercialized products to improve the control effect of *B. bassiana*. Aim of this study was select the effective organic pest control materials, and bioassay the improvement effect to control aphids (*M. persicae*) when mix spray the *B. bassiana* and organic pest control materials.

Materials and methods

- Mass production the conidia of *B. bassiana* and germination test

In this experiment, entomopathogenic fungi such as *B. bassiana* collected from suwon university. To gain many conidia, *B. bassiana* cultured with wet rice media at 26 °C during 14 days and dried at 35 °C incubator during 2 days. We separate the

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conidia from dried rice by sieve shaker and storage at 4°C. To germination test, conidia dilution (10^7) make with sucrose + pepton solution. Input the hole slide glass which 1ml of dilution (10^7) dropped into plastic scharet (diameter 85mm) and closed cap. This scharet input to incubator controlled at different temperature (15, 18, 21, 24, 27, 30, 33°C), and survey germination rate of conidia using microscope and haematocytometer in each 16, 20, 24, 40 hour after treatment.

- Bioassay

Bioassay the *B. bassiana* and environment-friendly agricultural materials (EFAM) to *Myzus persicae* was tested two methods of leaf disc and field test. *M. persicae* rear in green house condition on pepper plant. Seven species of EFAM such as Muginchon, Wangjungwang, Hongmaengi, Pachungtan, Bakmeru+, Newbiodakil and Meolguseul extract was selected.

The method of leaf disc was as following: 1) input wet cotton wool at bottom of insect rearing scharet. 2) lay pepper leaf with aphids. 3) manufacture conidia dilution (10^5 , 10^6 , 10^7 , 10^8 , 10^9). 4) spray 5 times from 30cm distance. 5) dry during 2 hour and close cover. 6) survey mortality (1, 2, 3 day after treat). Mortality field test was as following: 1) planting young pepper in house. 2) inoculation the *M. persicae* at pepper plant. 3) survey the density of aphids before spray. 4) spray 5 times from 30cm distance each materials. 5) survey aphids density at 1, 2, 3, 5 days after treat.

Results

Germination of *B. bassiana* showed the highest rate at 27°C after 40 hours (F=6.524, df=14, P= 0.002). The rate was as high as increasing temperature but decreased at 33°C. Mortality of *M. persicae* by *B. bassiana* was high at 1×10^7 cfu/ml as 48.4% (F=28.465, df=12, P=<0.001)

Table1. Germination rate of *B. bassiana* in different temperature condition.

Temperature (°C)	Germination rate (%)			
	16 hour	20 hour	24 hour	40 hour
15	0.3±0.6 c	6.4±3.5 b	33.0±5.5 c	85.0±27.6 c
18	31.9±9.5 b	58.9±3.1 a	74.3±11.0 b	88.9±13.0 bc
21	29.7±7.2 b	51.7±27.2 a	60.0±12.0 b	89.0±17.4 bc
24	56.8±27.1 a	58.0±8.2 a	88.8±4.0 a	96.0±15.9 ab
27	56.6±15.5 a	70.1±7.4 a	90.1±18.5 a	98.1±13.6 a
30	60.8±13.8 a	65.0±20.8 a	70.1±13.9 b	92.1±10.2abc
33	32.0±8.0 b	52.0±26.0 a	65.1±11.0 b	86.0±8.5 bc

Values represent means+standard deviation. Same letters at values within a column are not significant different (One-way ANOVA, Post hoc tests by Duncan test 0.05%) Data transformed arc sine to ANOVA

Table2. Mortality of *Myzus persicae* at different conidia concentration of *Beauveria bassiana* (leaf disc)

Conidia concentration (cfu/ml)	Before density	Mortality (%)		
		1 DAT	2 DAT	3 DAT
1×10^5	22.0	1.6±2.7 c	8.3±6.7 b	12.8±4.2 b

1×10 ⁶	25.3	4.1±2.5 bc	6.5±4.1 b	15.5±7.1 b
1×10 ⁷	27.7	28.7±8.0 a	55.7±11.0 a	64.5±10.9 a
1×10 ⁸	28.3	17.6±3.0 ab	44.0±14.0 a	50.0±21.1 a
1×10 ⁹	26.7	13.7±6.6 ab	16.0±0.0 b	8.3±0.0 bc
Control(density)	21.7	21.7 c	22.3 c	29.3 c

Mycelium could grow in low concentration of EFAM(0.1%), but Bakmeru+ could not grow mycelium from 0.5% to 8%(F=128.50, df=14, P=<0.001). Wangjungwang, Pachungtan, and Newbiodakil could grow mycelium till 4%. We recommended these three EFAM to mixing *B. bassiana* to synergist effect of *M. persicae*. In field test, mortality of *M. persicae* was 100% at *B. bassiana* plus Wangjungwang and plus Mujinchon plot after 5 days after application. In table 4, the mortality only Wangjungwang treat and *B. bassiana* (10⁷)+Wangjungwang treat did not different to perfect mortality. Therefore, it needs additional study to the lower concentration treat.

Table3. Mycelium growth at different additive concentration of environment-friendly agricultural material (EFAM).

EFAM	Mycelium growth at different additive concentration						
	0.1%	0.2%	0.5%	1%	2%	4%	8%
Muginchon	○	○	○	○	△	×	×
Wangjungwang	○	○	○	○	○	○	△
Hongmaengi	○	○	○	○	△	×	×
Pachungtan	○	○	○	○	○	○	○
Bakmeru+	○	△	×	×	×	×	×
Newbiodakil	○	○	○	○	○	○	△
Meolguseul	○	○	○	○	○	△	×

※ Mycelium growth: ○; Good, △; Bed, ×; No growing

Table4. Mortality the *Myzus peareia* spray by *B. bassiana* and environment-friendly agricultural material(EFAM) (field test)

Treat	Before treat (No. of adult)	Mortality (%)			
		1 DAT	2 DAT	3 DAT	5DAT
<i>B. bassiana</i> (10 ⁷)	74.0	14.5±4.2 d	21.9±7.0 e	39.0±13.6 e	37.8±4.3 d
<i>B. bassiana</i> (10 ⁷)+Wangjungwang	64.7	51.7±6.2 c	89.5±5.6 d	98.5±1.4 d	99.0±1.7 c
Wangjungwang	145.0	40.3±17.3 ab	87.5±3.5 ab	99.1±1.0 ab	100±0.0 a
<i>B. bassiana</i> (10 ⁷)+Hongmaengi	91.7	25.8±7.5 abc	65.3±18.4 abc	79.2±16.3 a	65.0±15.5 a
<i>B. bassiana</i> (10 ⁷)+Mujinchon	79.3	63.1±5.1 bc	96.0±2.7 bc	98.9±2.0 c	99.4±1. b
Mujinchon	159.7	23.0±19.4 a	58.3±20.0 a	85.4±0.3 a	81.5±7.3 a
Untreated(density)	117.0	154.0 bc	156.0 c	135.0 bc	161.0 b

※ EFAM spray concentration: 1,000 times

Discussion

For biological control of many agricultural insect pests, such as lepidopterous, mites, aphids, planthopper, pathogenicity of *Beauveria bassiana* was tested the bio-control agents in the world (Yun *et al.*, 2004; Vu *et al.*, 2007). Most of precedent study performed in laboratory condition, and it's control effect was good. But, the control effect was decrease remarkably when trial in field. Maybe it induced bad circumstance condition such as temperature and aerial humidity. In this study, the aphid control effect was perfect in trail field test, when spray *B. bassiana* with environment-friendly agricultural material (EFAM). We expect to development the good agent for bio-control aphid.

Conclusions

Our results show that only *B. bassiana* treat was low control effect to *Myzus persicae* but when mix spray with environment-friendly agricultural material (EFAM), the mortality of *M. persicae* was 99% in 3 days after treat. Therefore, *B. bassiana* could be considered as one of the environment-friendly control agent to control aphids.

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