Research of *Beauveria bassiana* the field control of *Locusta migratoria manilensis* Meyen

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**Abstract.** In this experiment, through testing the *B. bassiana* colony space persistent change on the lawn by isolate medium, explore the application time of field climate and other factors on the inoculum effect. Results: The control effect of lawn locust, Suspension emulsion mortality rate was 74.2%, Bt bacterium mortality rate was72.2%, *B. bassiana* bacteria mortality rate was70.1%. Test the population dynamics of *B. bassiana* surviving in lawn during 30 days by PPDA medium, we found that different strains of time has a great influence to the spore viability. Each cell showed obvious changes, the overall downward trend evident. After application the lawn every part of colony persistent distribution for soil> leaf > air; the best application time is 6:00 p.m.

**Keywords:** *Beauveria bassiana*, *Locusta migratoria manilensis*, field control.

1. **Introduction**

*Locusta migratoria manilensis* (Meyen) is one of lawn pests, feeding a variety of grasses. Locusts lawn leaf eating does great harm to the lawn, leading to deterioration of the ecological environment, affecting people's appreciation entertainment. *Beauveria bassiana*, as an entomogenous fungi, had been widely used for pests control, which could be a potential control way efficient control and non-toxic to human and livestock, keep lawn ecological balance, excellent control and so on. However, very few research was reported for locust control on garden lawn by using *B. Bassiana*.

With the continuous improvement of people's quality of life, landscaping has become a new subject of urban development. Lawn is an important part of urban landscaping and an important place for people to play and relax, and is closely related to people's lives. The lawn has many functions, such as green environmental protection, for people to rest and entertain, etc.

In recent years, the planting area of lawns has greatly increased, and the occurrence of lawn pests has become more and more serious. As one of the lawn pests, the East Asian migratory locust prefers to eat ryegrass, bermudagrass, bluegrass and other grasses and cyperaceae plants, It is extremely harmful to the lawn, leading to the deterioration of the lawn ecological environment, and affecting people's viewing and entertainment. Therefore, the prevention and control of migratory locusts is very important for lawn ecological protection.

The control of locust damage in our country is a combination of chemical control and biological control, but there are very few relevant research reports[1-2]. Traditional chemical pesticides have the advantages of fast, efficient, and flexible use, but they have strong toxicity, serious pesticide residues,
and great harm to natural enemies. They often cause irreversible damage and pollution to soil, insect natural enemies, surrounding environment, air, etc.

*Beauveria bassiana* is a very widespread microbial fungus. Microbial pesticides with *Beauveria bassiana* spores as the main component have developed and put into use a variety of *Beauveria bassiana* formulations. The common *Beauveria bassiana* preparations include powders and granules, EC, microcapsules, and water emulsions, etc. [3-4]. However, as a fungal insecticide with live microorganisms-*Beauveria bassiana* as the active ingredient, its application to control lawn locusts can maintain species diversity, maintain ecological balance, have a long duration of efficacy, and have relatively strong pathogenicity and control good effect and other advantages [5], but the current research on the application of *Beauveria bassiana* to control locusts in garden lawns is relatively rare [6].

2. Materials and Methods

2.1. Experiment material

2.1.1. Strain material. From the Agricultural Microbiology Platform Biological Pesticide Project of the Institute of Plant Protection, Jilin Academy of Agricultural Sciences

Table 1. The tested strains

| Number | Strain  |
|--------|---------|
| 1      | D4-2-1  |

2.1.2. Tested insects. Eastern Asian migratory locust: 3rd instar larvae provided by the locust breeding base in Cangzhou, Hebei, hatched in our laboratory.

2.1.3. Test medium. Potato culture medium (PPDA): Peel the potatoes and cut them into small cubes with a kitchen knife, weigh 100g, add 400mL deionized water and boil for 30min, add 7.5g glucose, 6.5g agar powder, and 1g peptone to a four-layer sterile gauze filter. To 500mL, autoclave sterilization, 121℃, 20min, invert the plate for later use.

2.2. Test method

2.2.1. Field control of East Asian migratory locusts. The experiment was conducted at the experimental site of Jilin Academy of Agricultural Sciences. The sprayer was a Xinxing double-tube sprayer. The experiment was set up with four treatments, with 4 replicates in each treatment plot (50 heads × 4). The area of each plot is 667m² (25m×26.7m). Set a 100m isolation zone in the small section. Set up *Beauveria bassiana* suspension emulsion, *Beauveria bassiana* bacterial liquid and Bt bacterial liquid, ck as sterile water.

2.2.2. Field sampling survey. Dilute 20g of *Beauveria bassiana* powder with clean water 200 times before spraying. Spray the pesticide in the morning, midnight, and evening, and investigate the samples in the soil, air, and leaves at each test site. Set three spray areas and one control area as shown in Table 2-3. The spray time is early July, and the sampling time is 1d, 4d, 8d, 16d, 30d after spraying.

Table 2. Different treatments in field

| Test site | Number of sprays | Spray time | Investigation time          |
|-----------|------------------|------------|----------------------------|
| 1         | 1                | 6: 00      | After medicine 1d, 4d, 8d, 16d, 30d |
| 2         | 1                | 12: 00     | After medicine 1d, 4d, 8d, 16d, 30d |
| 3         | 1                | 18: 00     | After medicine 1d, 4d, 8d, 16d, 30d |
| 4         | 0                | ck         | 1d, 4d, 8d, 16d, 30d         |
Sampling method: This test adopts the five-point sampling method, that is, five points are taken from each experimental plot, and the range of each sampling point is within 25cm×25cm. Within a set time after application, the amount of *Beauveria bassiana* in the soil, leaves, and air was determined, with three replicates for each sample.

Soil: Take a 3-5cm layer of soil under the surface at each point in the plot and put it into a ziplock bag, and take about 20g of soil.

Leaves: Pick up lawn leaves around each sampling point, about 10 pieces.

Air: Use the prepared culture medium to detect the *Beauveria bassiana* in the air. Open the petri dish at each sampling point. After 30 minutes, seal it on the spot with a sealing film and bring it back to the laboratory.

### 3. Result analysis

#### 3.1. *Beauveria bassiana* in field control of East Asian migratory locust

Using *Beauveria bassiana* D4-2-1, in the laboratory-developed *Beauveria bassiana* suspension emulsion, *Beauveria bassiana* bacteria liquid, and Bt (Bacillus thuringiensis) inoculum, the locusts are covered in the field for control, according to the cumulative mortality Calculate the regression equation and the number of half-lethal days LT50.

| Concentration (pcs/ml) | Number of test insects | Cumulative adjusted mortality (%) |
|------------------------|------------------------|-----------------------------------|
|                        |                        | 3d  | 4d  | 5d  | 6d  | 7d  | 8d  | 9d  | 10d |
| ck                     | 200                    | 0   | 0   | 1   | 2   | 3   | 3   | 4   |
| Bt                     | 10⁷                    | 200 | 15  | 38  | 46.5| 50.1| 67.3| 68.1| 70.1| 72.2|
| Bacteria               | 10⁷                    | 200 | 13  | 41  | 52.5| 55.1| 64.3| 67.1| 68.1| 70.1|
| Supoemulsion           | 10⁷                    | 200 | 16  | 42  | 56.6| 58.2| 66.3| 71.1| 72.2| 74.2|

#### 3.2. Investigation on the population density of *Beauveria bassiana* on the lawn

3.2.1. Screening medium to detect the persistence of *Beauveria bassiana*. Through the detection of the persistence status of *Beauveria bassiana* in different parts of the lawn (air, soil, leaves), it shows that the screening medium can effectively screen the persistence of lawn colonies (Figure 1). The screening medium can well control the growth of the bacteria in the tested samples, and can meet the growth needs of *Beauveria bassiana*, and can sensitively detect the persistence of *Beauveria bassiana* at different times in the lawn, and provide guidance for control in accordance with.
3.2.2. Changes in the persistence of bacterial colonies in different layers of the lawn after application. Through different application times, it can be detected that *Beauveria bassiana* is in different layers (air, leaves, soil), and the persistence of *Beauveria bassiana* changes over time.

![Figure 1](image1.png)

*Figure 1.* Colonies of *B. bassiana* sieved from different part of lawn by selective medium

![Figure 2](image2.png)

*Figure 2.* Change variation of *B. bassiana* CFU in different part of the morning at the different time

![Figure 3](image3.png)

*Figure 3.* Change variation of *B. bassiana* CFU in different part of the noon at the different time

![Figure 4](image4.png)

*Figure 4.* Change variation of *B. bassiana* CFU in different part of the night at the different time
It can be seen from Figures 2, 3, and 4 that no matter when the pesticide is applied, the storage of leaves and soil is better than that of air. Applying the bacteria in the morning or evening can quickly increase the persistence of *Beauveria bassiana* within a certain period of time. From the perspective of the downward trend, although the application time is different, the decline rate of the colony inventory in each layer of the lawn is basically the same.

In summary, applying *Beauveria bassiana* in the morning or evening can better maintain the colony number of *Beauveria bassiana* at a higher growth level. With the increase or extension of time, the rate of decrease in the number of *Beauveria bassiana* colonies has increased significantly, but application in the morning or evening will increase the number of *Beauveria bassiana* colonies, so it is beneficial to the prevention and control of lawn pests. Therefore, it is appropriate to choose the morning or evening for lawn Pesticide treatment to enhance its long-term environmental protection ability to prevent and control lawn ecology.

4. Conclusions

In this experiment, the screening medium was used to detect the changes in the colony stock of *Beauveria bassiana* in the field, and to explore the influence of the application time on the field climate and other factors on the use of the fungus to provide new technical support for the exploration of biological control of garden lawn greening.

According to the test results, the following conclusions are drawn:

The field control of lawn locusts obtained: the death rate of suspension emulsion was 74.2%, the death rate of Bt bacteria was 72.2%, and the death rate of *Beauveria bassiana* was 70.1%. The PPDA medium was used to detect the changes in the colony persistence within 30 days after the turf field application. It was found that different application times had a greater impact on the vigor of *Beauveria bassiana*. The colony inventory in each plot showed a significant downward trend. The distribution of colony persistence is: soil>leaf>air; the best application time is 6:00 in the evening.

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