



# Implementation of Banana Plant and Diseases Management Technology as An Effort to Improve Banana Producing Center Businesses in Lumajang District

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**Abstract.** Banana is one of the leading commodities in Lumajang District. Partners in this service are farmer groups in Burno Village, Senduro District, Lumajang. The problem faced is the attack fungal plant pathogen caused by *Fusarium* sp. and banana leaf-rolling caterpillar *Erionota thrax*. Methods in community service activities are focused on initiating groups of banana farmers, as well as providing knowledge and training on basic techniques and controlling banana pests. The steps taken include initiating the introduction of banana pests, conducting socialization and training on pest management techniques. The training conducted for partners includes a number of things, namely provision of the diversity of natural enemies, training on basic techniques for controlling pests and diseases, and training on the propagation of natural enemies, especially the fungus *Trichoderma* sp. and the parasitoid *Trichogramma* sp and their release in the field. This service is expected to be able to prevent and control banana pests and increase the amount of banana production so that it can improve welfare. Furthermore, it can improve social quality and community income.

**Keyword:** *Fusarium wilt, Erionota thrax, Trichoderma* sp., *Trichogramma* sp., Banana

**Abstrak.** Pisang merupakan salah satu komoditas unggulan di Kabupaten Lumajang. Mitra dalam pengabdian ini yaitu kelompok tani di Desa Burno Kecamatan Senduro, Lumajang. Permasalahan yang dihadapi yaitu serangan penyakit layu *Fusarium* sp. dan hama ulat penggulung daun pisang *Erionota thrax*. Metode dalam kegiatan pengabdian difokuskan pada inisiasi kelompok masyarakat petani pisang, serta memberikan pengetahuan dan pelatihan teknik-teknik dasar dan pengendalian hama penyakit pisang. Langkah-langkah yang dilakukan antara lain inisiasi pengenalan hama penyakit pisang, melakukan sosialisasi dan pelatihan tentang teknik pengelolaan hama penyakit. Pelatihan yang dilakukan terhadap mitra meliputi beberapa hal yaitu pembekalan tentang keragaman musuh alami, pelatihan tentang teknik dasar pengendalian hama penyakit, dan pelatihan perbanyakan musuh alami khususnya jamur *Trichoderma* sp. dan parasitoid *Trichogramma* sp serta pelepasannya di lahan. Pengabdian ini diharapkan mampu mencegah dan mengendalikan hama penyakit pisang serta meningkatkan jumlah produksi pisang sehingga mampu meningkatkan kesejahteraan. Selanjutnya, dapat meningkatkan kualitas sosial dan pendapatan masyarakat.

**Kata Kunci:** *Layu Fusarium, Erionota thrax, Trichoderma* sp., *Trichogramma* sp., Pisang

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## 1. Introduction

Lumajang is a horseshoe area in East Java where the area contains the Bromo-Tengger-Semeru mountain range [1]. People in Burno Village, Senduro District, Lumajang Regency practice forest agriculture as the main source of local income. In addition, the geographical condition of this village which is at the foot of Mount Semeru has its own advantages, especially the very beautiful scenery. This village is also one of the partner villages of the University of Jember and has developed the concepts of Edu wisata as a form of sustainable and environmentally friendly village development [2].

One of the main brands of edutourism in Burno Village is the banana plant and its processed products. The banana production in Burno Village is the second largest in Lumajang Regency with superior products in the form of mas bananas [3]. The area of banana plantations in Burno Village is quite large, around 67 hectares and has been well-systemized in the form of strategic areas to be used as edutourism areas. The point of banana planting area has been segmented according to the growth phase and productive age. However, along with its development, there are many obstacles faced in the cultivation of banana plants in Burno Village. One of the most important is the presence of plant pest organisms (OPT) that attack banana plants so that it affects banana production in terms of quality and quantity.

This pest attack causes plants to become no longer optimal in producing bananas. There are even some pests that cause banana plants to die and can infect other banana plants that are still healthy. Based on observations, it was found that several pest attacks were quite severe on banana plantations in Burno Village, including the attack of leaf-rolling caterpillars, which caused banana leaves to curl which could affect the process of photosynthesis of banana plants, gradually affecting production which continued to decline. Population density of banana leaf rolling caterpillars greatly affects the intensity of damage caused by these pests [4]. In addition, other pests that are quite troubling to banana farmers are the symptoms of yellowing and wilting of the leaves and over time they languish and die. The cause of this attack is the fusarium pathogen which belongs to the category of fungal pathogens. This malignant disease is capable of causing up to 91% of crop failure attacks [5]. Fusarium wilt attack can be infected on other banana plants that are still healthy so that if it is not controlled immediately it will spread to other banana plants due to the nature of soil-borne pathogens [6].

So far, the control of *E. thrax* is still using synthetic insecticides, which in its application find it difficult because generally banana plants that are attacked by leaf rollers are on the upper leaves so that it is quite difficult to apply spraying. The application of biological control by utilizing natural enemies can be used as an alternative control in preventing *E. thrax* attacks [7]. There are natural enemies of banana leaf rolling pests from the parasitoids *Brachymeria* sp., *Xanthopimpla* sp., *Telenomus* sp., *Ooencyrtus* sp. and *Cotesia erionotae*.

As for the attack of several banana plant disease pathogens, farmers generally still cannot distinguish the cause of the attack, whether it is caused by fungi, bacteria or viruses. Ignorance in differentiating the type of pathogen affects decision making in control. Farmers don't have much understanding of the bioecology of banana plant pests so problems related to prevention and transmission have not been given much attention in banana cultivation so far. Due to pathogens such as *Fusarium oxysporum* f. sp. cubense has several races [8].

This problem needs to be immediately followed up with activities that are solution-based and can be directly implemented by farmers. The solution taken must also continue to support the existing banana plant education program with several integrated pest management approaches based on conservation and manipulation of healthy agroecosystems. The form of development strategy that must be taken is socialization, training, and mentoring activities by involving farmer groups in Burno Village and involving village officials, especially the role of young people including youth organizations as managers of banana edutourism in Burno Village.

The application of science and technology referred to in this activity aims to develop knowledge of the bioecological insight of banana plant pests, optimize the role of biological control agents in the form of the parasitoid *Trichogramma* sp. and the antagonist fungus *Trichoderma* sp. based on local wisdom in the Burno Village area, as well as developing the protection of their natural habitat in the form of planting companion plants and refugia plants, and maximizing this knowledge through the form of propagation of biological agents [9]. Therefore, it is very much hoped that through this service activity, village development on the basis of sustainability can continue to be optimal and can avoid environmental disasters due to imbalances in the development process in the future.

## 2. Methods

The implementation of the service was carried out in the Mlambing Sumberjambe farmer group, Burno Village, Senduro District, Lumajang Regency from August to December 2020. The methods used in solving the existing problems include:

### a. Description of Implementation and Approach

This community service activity is focused on initiating and increasing the empowerment of banana farmer community groups, as well as providing knowledge and training in basic techniques and integrated pest and disease management. The steps taken include: (1) briefing on the diversity of natural enemies; (2) Propagation or mass production of natural enemies; and (3) Release of natural enemies.

#### b. Target Group

The target group of the activity is the community group in Burno Village, Senduro District, Lumajang Regency who has a high willingness to take advantage of the biodiversity and ecological conditions in Burno Village which has the potential as a solution to increase banana production in the banana center of East Java. With the socialization and training of integrated pest management techniques and natural enemy propagation, it is hoped that there will be an optimization of both the quantity and quality of banana production in Burno Village, Senduro District, Lumajang.

#### c. Socialization of Banana Farmer Community Group

This activity was carried out with a discussion with the community to provide knowledge about the types of banana pests. This introduction is intended so that there is an understanding so that banana pests can be prevented or controlled

#### d. Dissemination of Integrated Banana Disease Pest Management Techniques

The socialization was given through presentations and discussions in the community of Burno Village, Senduro District, Lumajang Regency with the hope of increasing public knowledge regarding the types of natural enemies as an alternative to controlling banana pests in Burno Village, their habitat, and behavior. In addition, training was also carried out using observation equipment, field identification, habitat introduction, and imparting knowledge.

#### e. Training on Natural Enemy Reproduction

The training was carried out by carrying out practical field activities, which began to isolate parasitoids to control pests and production of biological agents in the form of Trichoderma to control banana plant diseases. The training is also filled with natural enemy propagation techniques with natural materials available in Burno Village.

#### f. Evaluation Plan

Integrated Banana Pest Management as a form of Sustainable Development is carried out after the initiation, socialization, and training process and is carried out in the community of Burno Village, Senduro District, Lumajang. The evaluation was carried out on three criteria as shown in Table 1.

**Table 1.** Evaluation Design

Number	Criteria	Indicator	Benchmarks
1	Human resources capacity	Changes in social conditions	a. Able to receive knowledge on banana pest prevention b. Able to be an initiator in integrated banana pest management c. Have broad insight into the application of mass production of natural enemies in Burno Village
2	Economic results	Total banana production	Optimum production quantity up to 100%
3	Socio - economic	Community conditions	Increase the number of visits so as to improve welfare. Furthermore, it can improve social quality and income

### 3. RESULT AND DISCUSSION

The problems faced by banana farmers in Burno village, Senduro sub-district, Lumajang are skills in integrated pest management and propagation and application of natural enemies by the community are still low. Control management is still carried out very conventionally without the resistance and resurgence of natural enemies. The banana pest attack factor is very high. The limited knowledge of farmers in the use of natural enemies also makes one of the obstacles to the low productivity of bananas in Burno Village. The assisted village service program trains farmers and ranchers in the ability to manage pest management, natural enemy propagation and natural enemy application. The activities carried out in this beginner service program are socialization, training, monitoring and program evaluation. The community service activities for the fostered villages in Burno village, Senduro sub-district have been carried out to the stage of training in natural enemy propagation and its application in the field. There are 10 farmers who are very enthusiastic about participating in the activities carried out in this service.

#### 3.1. Socialization of activities with the introduction of pests and diseases and their management

The initial activity carried out in starting the community service program was the socialization of activities with the introduction of banana pests and their management to the main village apparatus, then continued to the farmers. The hope of this program is that Burno village becomes a village with a superior banana base so that developers/entrepreneurs in the banana processing industry can find quality bananas in this village. The socialization activity began with the search for farming communities who were interested in participating in the training and socialization of the village breeding center. A total of 10 farmers are interested in participating in the socialization and training activities carried out in August-December 2020.

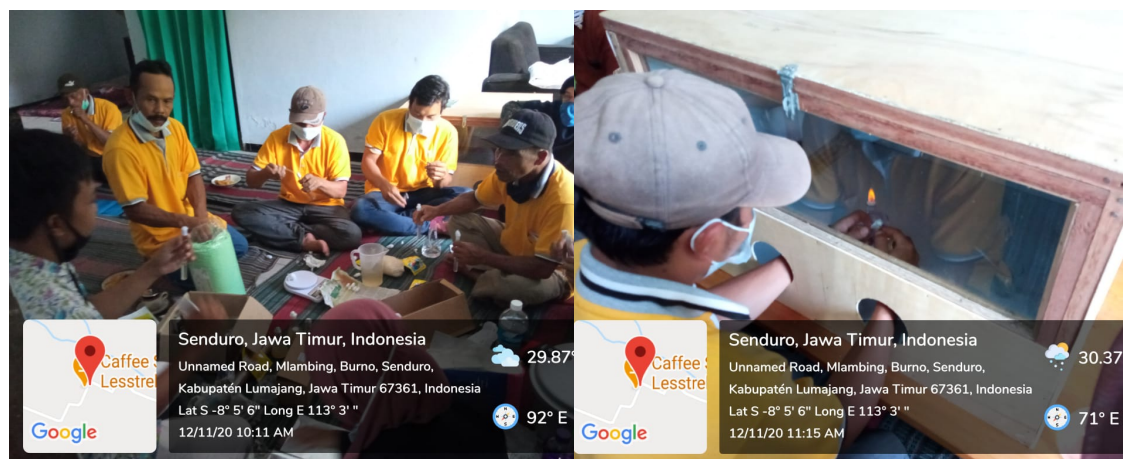


**Figure 1.** Discussion and Field Visit

Based on the results of visits and socialization as well as discussions with Burno village stakeholders, farmer groups, and visits to banana fields, it was found that there were pests, namely banana leaf rolling caterpillars and wilt disease caused by the pathogenic fungus *Fusarium* sp. Therefore, it is necessary to control it appropriately and quickly so as not to cause crop failure. In this activity, we also transferred knowledge related to biological agents as natural enemies of banana pests.

### 3.2. Training on Natural Enemy Reproduction

Propagation of natural enemies begins with training to make solid media to produce the antagonist fungus *Trichoderma* sp. Making media begins with preparing tools and materials. Farmers in Burno village grow a lot of bananas. Almost every family head has 1-3 banana plots. Most of the farmers grow bananas based on experience without special knowledge and skills. So they are not familiar with the basic factors in integrated pest management, namely the cultivation of healthy plants, the use of natural enemies, periodic monitoring, and farmers as managers of their land. In achieving a good productivity target, these factors must be understood and implemented properly.



**Figure 2.** Training on Solid Media Maker and Solid Culture Propagation of *Trichoderma* sp.



The process of making the media begins with weighing the ingredients, then washing and peeling the potatoes and cutting them into cubes. Then boiled with water and given sugar, agar and chloramphenicol antibiotics. Furthermore, it is inserted into a test tube and an erlenmeyer flask and sterilized. After in the cold medium, the *Trichoderma* fungus inoculation process with the agar media has been made. The solid media propagation process is carried out in engkas in order to avoid contamination from contaminant microbes. The participants were very enthusiastic in the training on solid media and mushroom propagation in solid media.

The second training was the propagation of antagonist fungi in liquid media. This stage is a continuation of the previous training. First, farmers prepare potato extract media and sugar without agar. The liquid culture medium is called the PDA solution (potato dextrose agar). Then placed in a gallon as much as 1/3 of the volume that has been provided and added by dissolving the fungus in a test tube with 5 ml of sterile distilled water and 2 drops of tween 80 oil. After that, it is connected to a fermenter (containing a solution of KMNO<sub>4</sub> and rock wool) for air sterilization and an aerator to circulate air into the equipment circuit. The indicator of the tool is working properly when there are air bubbles blown in the water.



**Figure 3.** *Trichoderma* sp. Liquid Culture Propagation Training.

### **3.3. *Trichogramma* sp. parasitoid propagation training.**

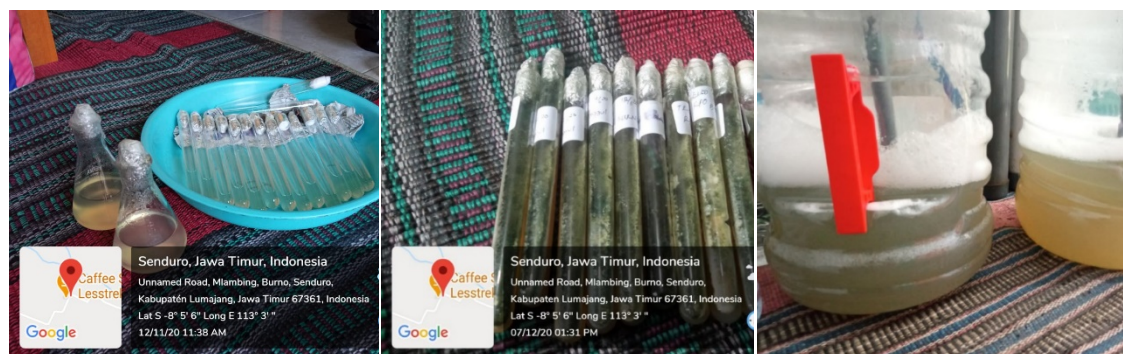
This training provides education to farmers about the importance of utilizing natural enemies of pests in the form of parasitoids. Farmers just saw the technology because the size of the insect is classified as very small. The method of propagation is by maintaining the eggs of *Corcyra* sp. as an alternative host during propagation. The medium used is corn rice. Host eggs that have been parasitized by *Trichogramma* sp. used for application in banana fields.



**Figure 4.** *Trichogramma* sp. Parasitoid Propagation Training.

### 3.4. Monitoring and evaluation of natural enemy propagation training

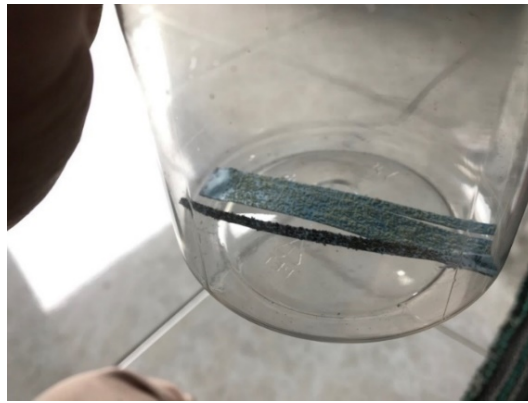
Based on the results of training on making solid media for microbial culture, it can be said to be successful because there is no contamination. In addition, the results of training in solid culture propagation of *Trichoderma* sp. successful so that later it can be directly applied in the field with mixed manure or can be a starter for propagation of liquid culture. While the results of liquid culture propagation are also fairly successful. This was proven morphologically, there was a change in the color of the sugar potato extract media from clear to turbid green after adding *Trichoderma* culture.



**Figure 5.** The results of the training on making solid media and propagation of *Trichoderma* sp.

The results of training on the propagation of the parasitoid *Trichogramma* sp. successful with several indicators including many *Corcyra cephalonica* eggs that can be harvested. It can then be used as an alternative host for *Trichogramma*. So initially the eggs were white when parasitized turned black.





**Figure 6.** The results of the propagation of the parasitoid *Trichogramma* sp.

### 3.5. Release of *Trichogramma* sp.

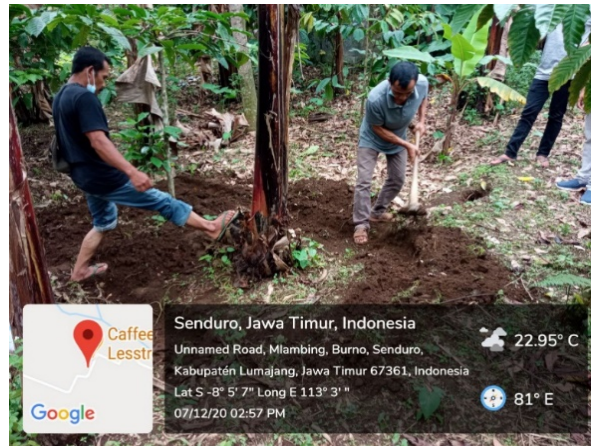
Release of the parasitoid *Trichogramma* sp. which has been propagated is done by preparing a wooden stick to put parchment paper containing parasitized eggs. Then the parchment paper that has been placed is covered with a glass so as not to be affected by the rain. Furthermore, the base of the stick is given oil to avoid ant interference.



**Figure 7.** *Trichogramma* sp. application. in the banana field

### 3.6. Application of *Trichoderma* sp.

The application of antagonistic fungi is done by sprinkling manure that has been mixed with *Trichoderma* sp. The first way is to dig a hole around the banana tree root area as deep as 15 cm with a distance of 1 meter from the base of the banana stem. Then sprinkle a fertilizer rich in antagonistic fungi. Applications are carried out every 3 months. After sowing then buried again with soil.



**Figure 8.** Application of *Trichoderma* sp. in the banana field

#### 4. Conclusion

Based on the results of the village service program activities, farmers were very enthusiastic in participating in counseling and training as well as releasing natural enemies. Breeders have been able to make solid media for microbial culture. Suggestions from this assisted village service program are the need for continuity and commitment from Burno village farmers in processing abundant agricultural waste so that processed products have higher nutrients and have a longer shelf life and can be sold sustainably to other farmers who need. There is also a need for structured organization such as the involvement of various parties such as a combination of farmer groups providing waste, PPL, and farmers who optimize waste, because the key to the success of waste utilization is the continuity of providers, producers and users of processed waste products which can be in the form of organic fertilizers and organic biopesticides.

#### 5. Acknowledgments

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