Original Version

# PROJECT PROPOSAL
2021 DOST-GIA FUNDING

## I. PROJECT PROFILE

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|---|
| **(1) Project Title:** Efficacy Trial of Various Levels of Liquid *Metarhizium anisoplae* Against Army Worm in Onion in Selected Barangays of San Jose, Occidental Mindoro |
| **(2) Project Leader/Sex:** Garry L. Calitang / Male<br>**Agency:** Occidental Mindoro State College<br>**Address/Telephone/Fax/Email:** OMSC- Murtha, San Jose, Occidental Mindoro |
| **(3) Cooperating Agency/ies:**<br>LGU San Jose, DOST PSTC Occidental Mindoro |
| **(4) Site/s of Implementation**<br>**Base Station:** San Jose, Occidental Mindoro, MIMAROPA<br>**Other Implementation Site(s) none** |
| **(5) Project Duration**: 14 months |
| **(6) Total Project Cost:** (indicate Counterpart Funds; use Form A for the Line-Item Budget) |

| Source of Fund / Site(s) of Implementation | PS | MOOE | EO | Total |
|---|---|---|---|---|
| A. LGU San Jose | 20,000 | 210,000.00 | | 230,000.00 |
| B. OMSC | | 50,000.00 | 100,000.00 | 150,000.00 |
| C. DOST | | 176,485.00 | 355,000.00 | 531,485.00 |
| **TOTAL** | **20,000** | **436,485.00** | **455,000.00** | **911,485.00** |

## II. PROJECT SUMMARY

**(7) Rationale**

Onion (bulb) is a priority commercial crop that can generate progressive and viable markets not only in Nueva Ecija, Pangasinan and Tarlac but also in the province of Occidental Mindoro. It is commonly planted in the municipalities of Magsaysay, Paluan and San Jose during the second cropping season after rice. Although Occidental Mindoro has the smallest share of production it brought income among onion farmers of the province.

It is used as seasoning in many food preparations and the most indispensable culinary ingredient in the world. Depending on the variety, an onion can be sharp and pungent or mild and sweet. Onions are rich in vitamins and minerals that are essential to our body to fight against common cold, heart disease, diabetes, osteoporosis, and other diseases. (CRS Onion Report, 2013)

However, maintaining a stable production trend of onion in the country had been a struggle for the past few years. Fluctuations in the supply may be attributed to a number of factors such as occurrence of natural calamities, lack of farming motivation, less systematic commodity flow and production to post-production lapses and incidence of pest and diseases like army worm *(Spodoptera exigua*) locally known as 'Harabas'.

Harabas are nocturnal pests attacking and feeding on the tender parts of onion leaves, reaching down to the bulbs, eventually killing the plant. Suppressing the armyworm larvae seems impossible as they are too many to handle. The average egg the Harabas lays is around 500 and it only takes one (1) to three (3) days incubation period before the hatched egg could infest.

Armyworm, *Spodoptera exigua* (Hübner) (Lepidoptera: Noctuidae), had an outbreak in onion

growing provinces in the Philippines particularly in Nueva Ecija, Pangasinan, and Tarlac in 2016 (Navasero et al. 2017). None of the control measures tried were able to control the pest. This alarmed farmers, local government units, and DA-RCPC III. Some LGUs declared State of Calamity due to the pest.

Likewise, Occidental Mindoro, an onion producing province in MIMAROPA region, particularly in the municipality of San Jose, experienced the onslaught of army worms in onion. Just the same, farmers in the province resorted to the use of several methods of chemical controls but none of which had solved the problem.

Meanwhile, the Municipal Agriculture Office in coordination with Occidental Mindoro State College and DOST-PSTC Occidental Mindoro joined forces to conduct an experiment project on the effectiveness of *Metarhizium anisoplae* against Harabas in onion.

*Metarhizium anisoplae,* an entomopathogenic fungus is a fungal species that can act as parasite of insect and kill or seriously disables them. These fungi usually attach to the external body surface of insects in the form of microscopic bodies such as asexual, mitosporic spores also called conidia. These characteristics are possessed by *Metarhizium anisopliae.* The spore of *Metarhizium anisopliae* can be formulated as dust and sprayable formulation. It is used to control termites, mosquitoes, leaf hopper and rice bugs (Solunke, 2014).

This is a facultative parasite which can affect a group of insects and is a well-studied species for microbial control of insect pests. This fungus produces some cyclic peptides, destruxins which may play a role in its pathogenicity (Ghayedi and Abdollahi, 2013).

*Metarhizium anisopliae* is a fungus that infects insects, primarily adult rice bugs. It has been approved as a microbial pesticide active ingredient for non-food use in greenhouses and nurseries, and at limited outdoor sites not near bodies of water. Many strains of *Metarhizium anisopliae* have been isolated worldwide from insects, nematodes, soil, river sediments, and decomposing organic material. No harm is expected to humans or the environment when pesticide products containing *Metarhizium anisopliae* are used according to label instructions. No harm is expected to humans from exposure to *Metarhizium anisopliae* by ingesting, inhaling, or touching products containing this active ingredient. No toxicity or adverse effects were seen when the active ingredient was tested in laboratory animals. The Agency has performed an environmental risk assessment and determined that the proposed uses of *Metarhizium anisopliae* as an insecticide will have no adverse effects on birds, mammals, or terrestrial and aquatic plant species (Environmental Protection Agency, 2003).

Based on the result of the study conducted by Occidental Mindoro State College Research and Development Unit, 300 mL to 400 mL diluted in one (1) liter water of fermented *Metarhizium* successfully killed 12 spotted beetles in eggplant comparable with the chemical (Batiles, 2018). Similar study reveals that fermented *Metarhizium* for seven (7) months successfully killed black bug when sprayed (Batiles, 2018).

In this context, the effectiveness of fermented *Metarhizium* as a biological control agent should not be limited in the control of black bug and 12 spotted beetles. It should also be tested to other insects like Army Worm that infest onions.

If this is effective, this can be another technology that would help farmers control insects without the use of chemical pesticides. In this premise, the study on the effectiveness of fermented *Metarhizium anisoplae* shall be conducted.

**(8) Project Description** (Not to exceed 15 pages)

Attempts to control onion pests like army worm currently entail excessive use of pesticides. Intensive pesticides use in onion increases the cost production, making this vegetable expensive for

poor consumers. Pesticide misuse and residues post serious risk to the health of growers, consumers, and the environment (Srinivansan, 2009). Since it was proven that chemical pesticide residues are harmful to human health, these practices can be avoided by using biological pesticides which cannot harm human health.

Thus, this study conceptualized that the M*etarhizium anisopliae* could be the source of biological pesticides for controlling army worm infestation in onion. Various amounts and duration of fermentation of liquid *Metarhizium anisopliae* is assumed to have an effect on the mortality of army worm.

This project involves the conduct of efficacy trial of fermented Metarhizium against army worm 'Harabas' infestation in onion, in selected barangays of San Jose, Occidental Mindoro. Onion producers - cooperators will be selected to implement the efficacy trial. This will be done by OMSC Research and Extension Unit in coordination with DOST PSTC Occidental Mindoro and LGU MAO San Jose.

*Metarhizium* will be produced by Occidental Mindoro State College and be used in the efficacy trial. On the other hand, DOST will provide financial assistance for the procurement of equipment that will be used in the production of liquid *Metarhizium,* while LGU San Jose will answer the supplies and metarials as well as the labor and honorarium for the researchers and staff. On the other hand, OMSC will do the conduct of the field trial and the technology patent application with IPOPhil.

**OBJECTIVES** (General and Specific)

Generally, as a Research and Development project is expected to evaluate and determine the efficacy of liquid *Metarhizium anisopliae* as a biological pesticide against army worm in terms of mortality rate.

Specifically, the project aims to:

1. Provide equipment for the improvement of liquid *Metarhizium* production
2. Protect the technology Patent application, and
3. Present and publish the result of the study

**METHODOLOGY**

**A. Production of liquid Metharhizium**

Pure culture of *Metarhizium* will be obtained from BPI Murtha Seed Farm Production Laboratory. It will be mass produced at OMSC Production Laboratory using aseptic procedure. The harvested *Metarhizium* will be processed into liquid form as biological pesticide using OMSC Murtha Campus production technology. Metarhizium will be fermented in the fermentation tanks for at least eight (8) months. After eight (8) months of fermentation, this will be dispensed to 1.5 L capacity plastic bottle and be closed tightly. This is now ready for the efficacy trial.

**B. Production Cost of liquid *Metarhizium* per liter**

| Items | Quantity/Unit | Price (PhP) |
|---|---|---|
| Rice | 100 g | 5.00 |
| Molasses | 4 tbsp. | 5.00 |
| Bottle/Label | 1.5 L | 30.00 |
| Labor | 1.5 L | 15.00 |
| Miscellaneous | | 15.00 |
| **Total** | | **70.00** |

## C. Efficacy Trial

### Selection of farmer co-operators

Onion growers - cooperators from the municipalities of San Jose will be selected. They will be oriented on the research protocol on the use of the biological pesticide. They are also task to prepare the planting materials (seedlings) and the experimental site.

### Conduct of efficacy trial

Efficacy trial will be conducted during the production season for onion. It shall be conducted for two (2) consecutive cropping seasons. Initial samples of liquid Metarhizium will be provided by OMSC which were prepared eight (8) months before the start of the experiment.

There will be 18 plants damaged by army worm that will randomly be selected. Proper labels will be assigned to identify the treatments and replications. Application of the experimental pesticide will be done based on the treatments cited below. This will be done on different field sites in the municipality of San Jose. Incidence of army worm during the last cropping season will be the basis for the site selection.

### Research Design

This study will use the experimental method of research using the layout in Complete Randomized Design (CRD). There will be 18 plots measuring 1 m x 1 m planted with onion and randomly arranged in the experimental layout as shown below. T= Trial, R= Replication

| | | |
|---|---|---|
| $T_5R_2$ | $T_1R_3$ | $T_3R_2$ |
| $T_2R_1$ | $T_5R_3$ | $T_1R_1$ |
| $T_3R_3$ | $T_0R_1$ | $T_4R_3$ |
| $T_4R_2$ | $T_4R_1$ | $T_2R_2$ |
| $T_0R_2$ | $T_2R_3$ | $T_5R_1$ |
| $T_1R_2$ | $T_3R_1$ | $T_0R_3$ |

Fig. 2. Experimental layout in Complete Randomized Design (CRD).

### Application of liquid Metharhizium

Application of liquid *Metarhizium anisopliae* will be done on plants with pest infestations. Each plant will receive 20 mL of diluted liquid *Metarhizium anisopliae* of various concentrations. Application will be done once, in all treatments. One teaspoon of detergent powder per liter will be added to various concentrations of liquid *Metarhizium anisopliae* to provide stickiness to larvae cuticle. The following treatments will be as follows:

Treatments
$T_0$ – Control (RR of commercial insecticide)
$T_1$ – 100 mL M. *anisopliae* + 1L water + 1 tsp detergent
$T_2$ – 200 mL M. *anisopliae* + 1L water + 1 tsp detergent
$T_3$ – 300 mL *M. anisopliae* + 1L water + 1 tsp detergent
$T_4$ – 400 mL *M. anisopliae* + 1L water + 1 tsp detergent
$T_5$ – Check control (Chemical pesticide)

**Data gathering**

Efficacy of the treatments will be determined in terms of data on percentage mortality and killing duration upon application of the experimental pesticide. Descriptive statistics will be used in presenting the data.

**Statistical Analysis**

Data gathered in this study will be analyzed using Analysis of Variance in Randomized Complete Block Design. Difference of treatments will be determine using the least significant difference at 5% level.

## EXPECTED OUTPUTS

**Publication**

Efficacy Trial of Various Levels of Liquid *Metharhizium anisoplae* Against Army Worm in Onion in Selected Barangays at San Jose, Occidental Mindoro

**Patent/Intellectual Property**

Patent/UM on biological pesticide.

**Product**

Metha-bio (Biological Pesticide for Army Worm). The quality of the product in terms of effectiveness, sustainability is carried over during the efficacy trial to be conducted by the Accredited External Researcher of Fertilizer and Pesticide Authority.

**People Service**

Onion farmers in Occidental Mindoro will benefit from the project

**Place and Partnership**

Collaboration in the conduct of the research between LGU San Jose, Occidental Mindoro and Occidental Mindoro State College

**Policy**

Adherence to RA 10068 or the Organic Agriculture Act of 2012
Adopt the policy stipulated in RA 10055, or the Technology Transfer Act

## EXPECTED OUTCOMES

- Insect and disease-free onion
- Chemical free pesticide onion and other crops
- Provide equipment for the improvement of liquid *Metarhizium* production
- Protect the technology Patent application, and
- Present and publish the result of the study

## PERCEIVED IMPACT

Increased income of onion growers and safer food for the consumers.

## SOCIAL IMPACT

- Healthy consumers since vegetables sold in the market are guaranteed chemical-free
- Awareness on the benefits of biological pesticide. Through the use of biological pesticide from *Metarhizium anisopliae,* farmers including consumers are expected to become fully aware of its benefits such as it is not harmful to human and animal health and being environment-friendly pesticide.
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**ECONOMIC IMPACT**

- Increased profit. Farmers through the use of the liquid *Metarhizium anisopliae* will reduce cost in production and will eventually gain additional income.
- Comparatively, farmers spend PhP 20,000.00 per hectare for chemical pesticides. Meta Bio as proposed is a biological pesticide which is less expensive (Php 150.00 per liter or PhP 600.00 – 1000.00 per hectare application). The liquid fertilizer is safe and is environment-friendly

**SUSTAINABILITY PLAN**

For the sustainability of Metharhizium production, the following shall be undertaken:

1. The developer of the technology on Liquid Metarhizium after obtaining its patent or utility model shall transfer the technology to any interested individual, group or organization who is willing to commercialize the product.
2. A licensing agreement shall be forged between and among OMSC, DOST and the licensee (possibly a farmer cooperative engage in onion production) for the purpose.
3. A production laboratory shall be established as part of the commercialization plan. Initial training in the production of liquid Metarhizium shall be conducted by the developer/maker to start the commercialization.
4. During this stage, monthly monitoring in the production and distribution of the product shall be done in order to ensure the quality and efficacy of the product.
5. The licensee together with the licensor shall also conduct seminars on the use and benefits of the product. The product shall also be promoted in social media and in local and national trade fairs and exhibits.
6. The specified building shall be intended for the laboratory activities like production of the metarhizium while the land will be for the experimental trials.

**(9) Workplan** (See Form B)

**(10) Project Management**

In order to effectively implement the project, the OMSC will designate a staff to help supervise and manage the conduct and monitoring of the efficacy trial. All activities shall be properly coordinated with the onion producer - cooperator recommended by LGU San Jose through its Municipal Agricultural Officer. Production of liquid Metarhizium will also be done by OMSC at least eight months (8) months before each cropping season. Project staff from PTSC-Occidental Mindoro will oversee and ensure the successful implementation of the project. Specifically, PSTC-Occidental Mindoro shall see to it that OMSC complies with the roles and responsibilities as indicated in the MOA including strict adherence set forth in the Line Item Budget and the accomplishment of activities specified in the Work Plan. PSTC-Occidental Mindoro shall request progress reports of the efficacy trial including results of actual application of farmers of the liquid insecticide on other crops aside from onions.

**IPR Ownership**

The Occidental Mindoro State College claims the right in the ownership of the Intellectual Property of liquid *Metharhizium.* This will be filed with IPOPhil to protect the ownership of the technology. Transfer of technology will be initiated by OMSC, LGU San Jose and OMSC to any individual, Cooperative, and business organization who signify its intention in the production and distribution of the product following the protocols stipulated in the Technology Transfer Act under R.A.10055 and IP Code of the Philippines. The product shall also be registered with Bureau of Agriculture and Fishery Standards following as organic pesticide.

There is a plan to have the product registered with the Bureau of Agriculture and Fisheries Standards (BAFS) or Fertilizer and Pesticides Authority (FPA) for consumer protection just after the efficacy trial.

Product label shall follow the standard requirements. OMSC will seek DOST-MIMAROPA's assistance on packaging of the product. Trademark of the product shall be applied with IPOPhil.

**III. ATTACHMENTS** (Please refer to the DOST-GIA Guidelines for the necessary documents.)

Form A – Line-Item Budget

Form B – Work Plan

**Prepared by:**

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Proponent

**Noted by:**

**MARIA ETHELWILDA G. CORONACION**
Provincial S&T Director

**Approved by:**

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