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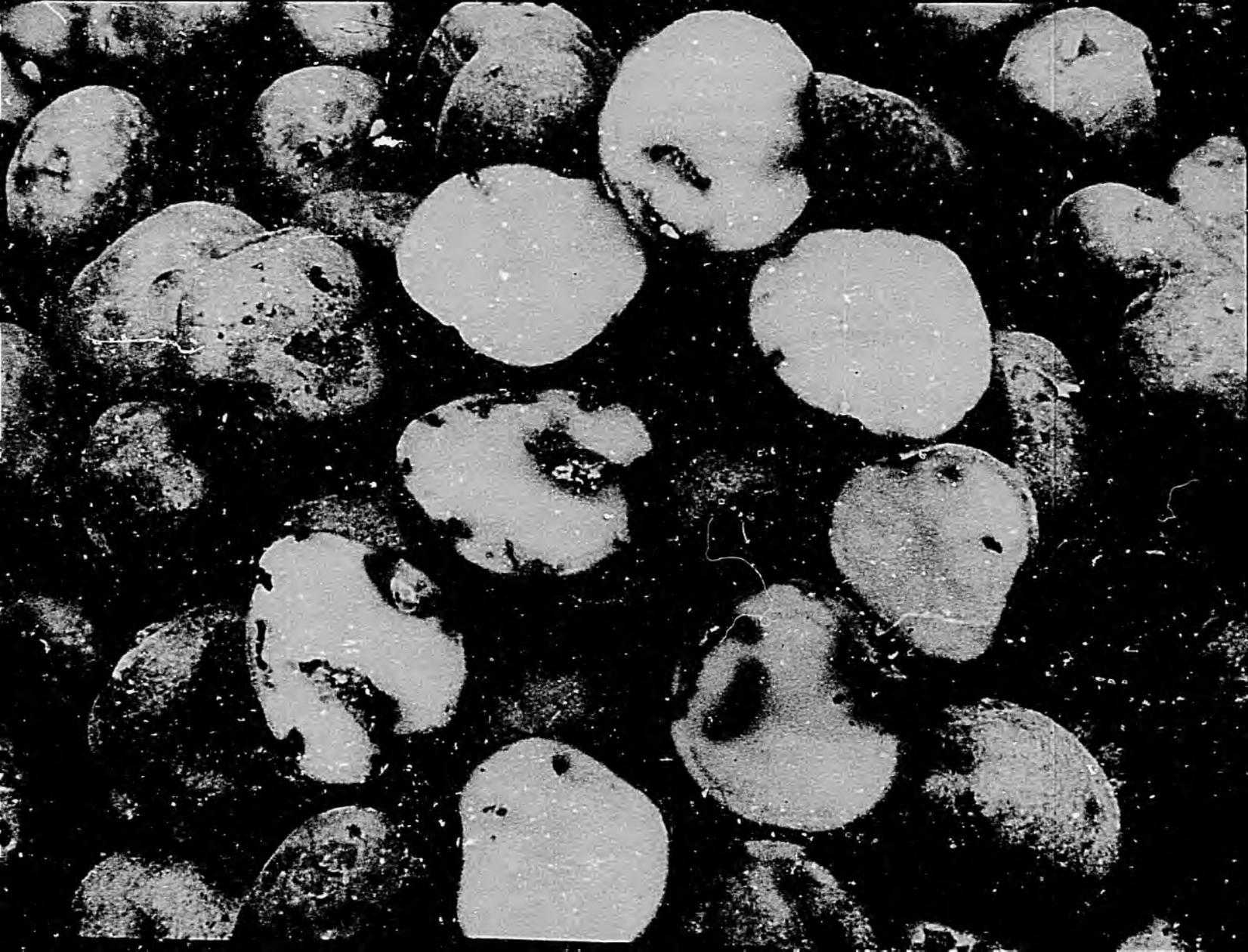
# Biological Control of Potato Tuber Moth Using *Phthorimaea* *Baculovirus*



INTERNATIONAL POTATO CENTER (CIP)

LIMA - PERU

1992



## **INTRODUCTION**

The potato tuber moth or potato tuber worm, *Phthorimaea operculella* (Zeller), is a lepidopterous pest of the Gelechiidae family, and is one of the most important potato pests. Its larvae damage the plant shoots, bore into the stem, mine leaves and attack tubers in the field and in the storehouse. The pest originated in South America and has spread over many potato areas throughout the world. It can be found from the south of Europe through Australia and New Zealand to the United States of America and Japan. The pest also attacks tomatoes, tobacco, eggplants, and other members of the Solanaceae family.

### **OBJECTIVES**

**This brochure should help farm extensionists to:**

- 1. Demonstrate farmers the effectiveness of biological control of the potato moth.**
- 2. Multiply and use baculovirus as a low cost and practical pest control method.**
- 3. Demonstrate the method and disseminate the advantages of using the baculovirus for potato moth control.**

# Integrated Control Components

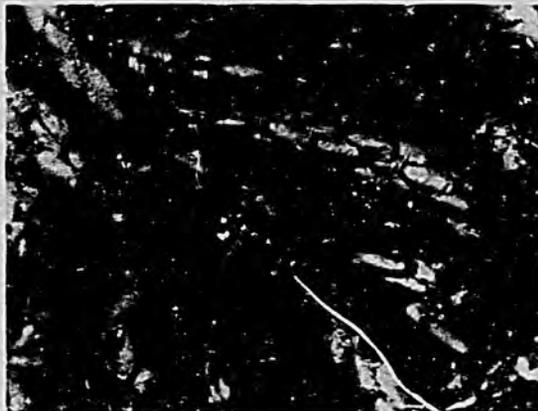


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LT-8



Resistance



Biological  
Control



Pheromones

Cultural  
Control



Repellent  
Plants

Chemical  
Control



Potato tuber moth control is almost exclusively carried out using expensive and toxic insecticides which also result in increased pest resistance, destruction of the pest's natural enemies, and emergence of new pests. The need for alternative control methods has led CIP's Integrated Pest Management Program to develop technologies including the identification and use of potato resistant varieties, utilization of repellent plants, biological control techniques, sex pheromones, and cultural practices. The use of these technologies is aimed at reducing insecticide applications and thus diminish production costs.

Biological control comprises the use of parasitoids, predators, and pathogens. Potato tuber moth pathogens include a granulosis-type virus that attacks moth larvae.

Studies of the virus's potential as a microbiological moth-control agent have led to the development of a simple technology for using the powdered virus in the storehouse, or as a solution in the field.

## WHAT IS THE PHTHORIMAEA BACULOVIRUS?

Dead larvae of naturally diseased *P. operculella* were initially found in potato plants in Sri Lanka and later in South Africa, India, Australia, Tunisia, Peru, Kenya, and Bolivia. Laboratory tests showed the infection was caused by the PHTHORIMAEA BACULOVIRUS granulosis-type virus of the Baculoviridae family. The virus presents an elongated, oval or capsular form, and is approximately 486 nanometres long and 233 nanometers wide. It can only be observed under the electronic microscope (one nanometer equals one millionth of one millimeter).

In contrast to chemical insecticides, *P. baculoviruses* are highly specific to insect pests. *P. operculella* and other viruses affecting major crop pests have been recommended by the Food and Agriculture Organization (FAO), the World Health Organization (WHO), and the Oxford Virology Institute for use in integrated pest management programs.



Oval Granules of the Potato Tuber Moth Virus

## **WHAT IS PHTHORIMAEA BACULOVIRUS USED FOR?**

The PHTHORIMAEA BACULOVIRUS is used in controlling potato tuber moth larvae. The virus is a stomachical insecticide, and the larvae must eat the viral particles to get infected. Thus, the virus acts as a biological insecticide.

Infected larvae became creamy white, move slowly, are slightly swollen, and die 12-21 days after eating the virus. Infected larvae do not pupate.



Dead Baculovirus-infected Larvae in Damaged Tuber

## **HOW TO USE THE PHTHORIMAEA BACULOVIRUS?**

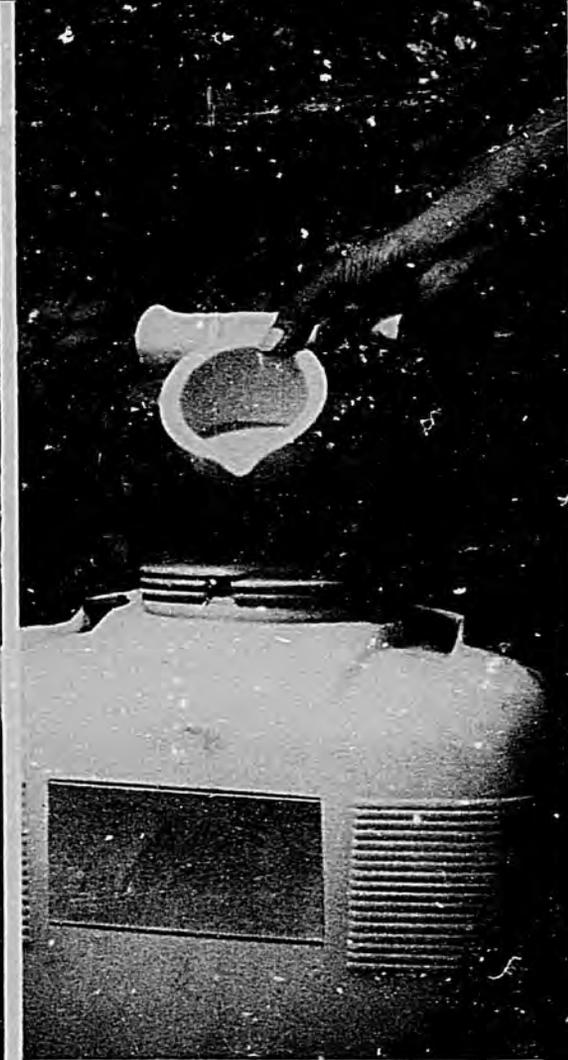
You can use the PHTHORIMAEA BACULOVIRUS as a water suspension for spraying. It can also be used as a dry powder formulation. Fresh or frozen dead, infected larvae are crushed to obtain the white powder inoculum. If the infected larvae are lyophilized, they should be rehydrated before crushing.

To prepare the water suspension for field applications, crush 20 infected larvae in a mortar. Then, add one liter water and a dispersing agent (Triton at 0.2 %). For one hectare you will need 2 000 larvae or about 36.5 g. The death rate after virus application is approximately 70-100 % and the virus persists for up to 60 days after application.

You can apply the solution with a hand or power sprayer. Depending on the level of infestation, you may need to apply the insecticide one or two times during crop development. The baculovirus formulation should be used as soon as eggs or galleries are observed, paying special attention during the tuberization stage to protect the tubers.



Crush larvae



Dilute in water for spraying

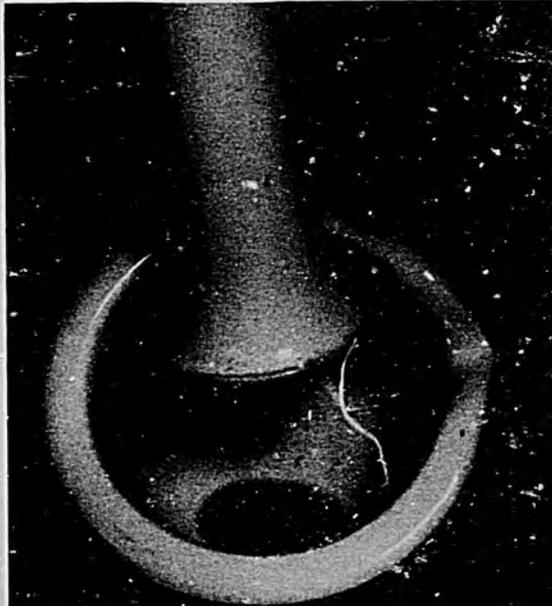


Spray BCP suspension on potato foliage

Materials for dry powder Baculovirus formulation



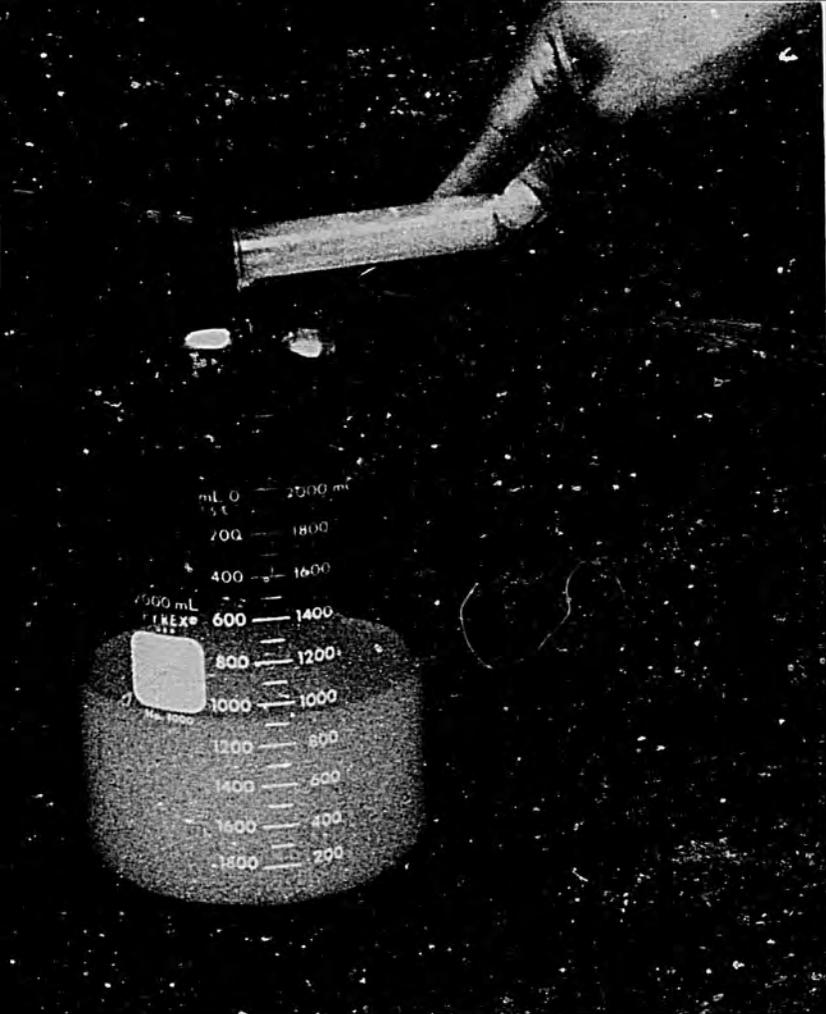
Crush 20  
infected  
larvae



Dilute in one liter water

You can prepare the dry powder Baculovirus formulation by crushing 20 infected larvae and diluting the crushed larvae in one liter water. Add the dispersing agent (Triton at 0.2 %) Next, add one kilogram of talc (magnesium silicate) as inert matter and mix thoroughly to form a paste. Spread the paste on a tray or plastic sheet in the shade to prevent direct virus exposure to sunlight. After one or two weeks, crush the paste with a roller until obtaining a fine powder. Put the powder in bags.

Use 5 kg of powder formulation per ton of potatoes. For best results, place approximately 25 kg of potatoes in a plastic bag, add 125 g of powder and shake until the powder completely covers the tubers. Apply only once at storing.



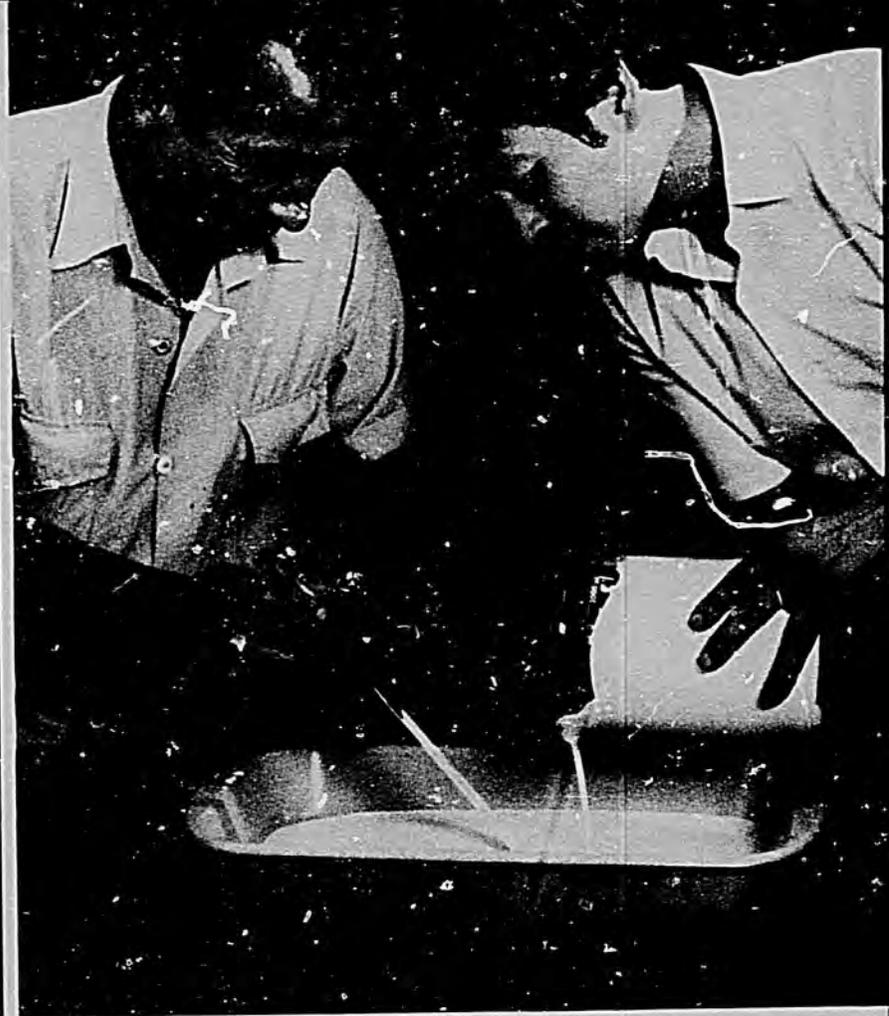
Add dispersing agent (Triton)



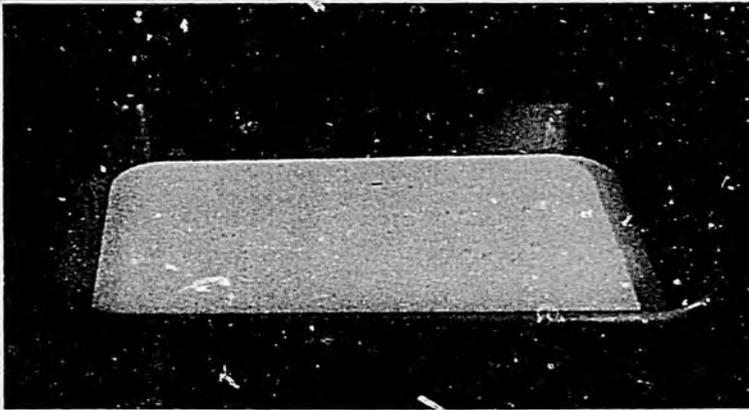
Add talc



Mix and shake the materials to form a paste

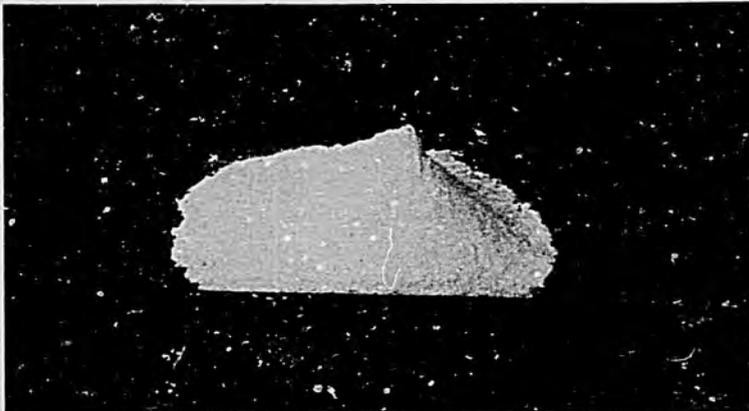


Spread the Baculovirus paste



Dry the Baculovirus paste

Finished product ready for use



Tuber treatment with Baculovirus

## **WHERE TO GET PHTHORIMAEA BACULOVIRUS?**

The PHTHORIMAEA BACULOVIRUS is found naturally in potato moth larvae in the field and in the storehouse. It is more likely to be found where there are large potato moth populations. You will find dead or live infected larvae on the tubers, at the bottom of plant shoots, and inside the galleries or the silk cocoons. Infected larvae can also be found on plant leaves, and in potato tuber moth mass rearing laboratories.

To confirm the presence of virus in a potato tuber moth population, send a sample to CIP's Pest and Nematode Management Program for electronic microscope examination. Alternatively, you may request PHTHORIMAEA BACULOVIRUS inoculum from CIP to start your own multiplication program.

## HOW TO MULTIPLY PHTHORIMAEA BACULOVIRUS

The *P. operculella* granulosis virus can be multiplied using mass-reared potato moth larvae as hosts. Mass rearing provides sufficiently large larvae and adult populations which can then be infected. The viral agent in a liquid suspension is applied to the feeding substrate obtained from tubers or foliage.

In the laboratory, larvae or adults may be multiplied on tubers. Alternatively, adults may be multiplied on foliage. You can use either method depending on the development stage of the moth at infestation and on the type of feeding substrate.

Multiplication can also be carried out in the field by applying a liquid suspension of the granulosis virus to a highly infested potato crop. After 2-3 weeks, you can collect the infected larvae and use them to prepare the bioinsecticide either in powder form for the storehouse, or as a suspension for the field.



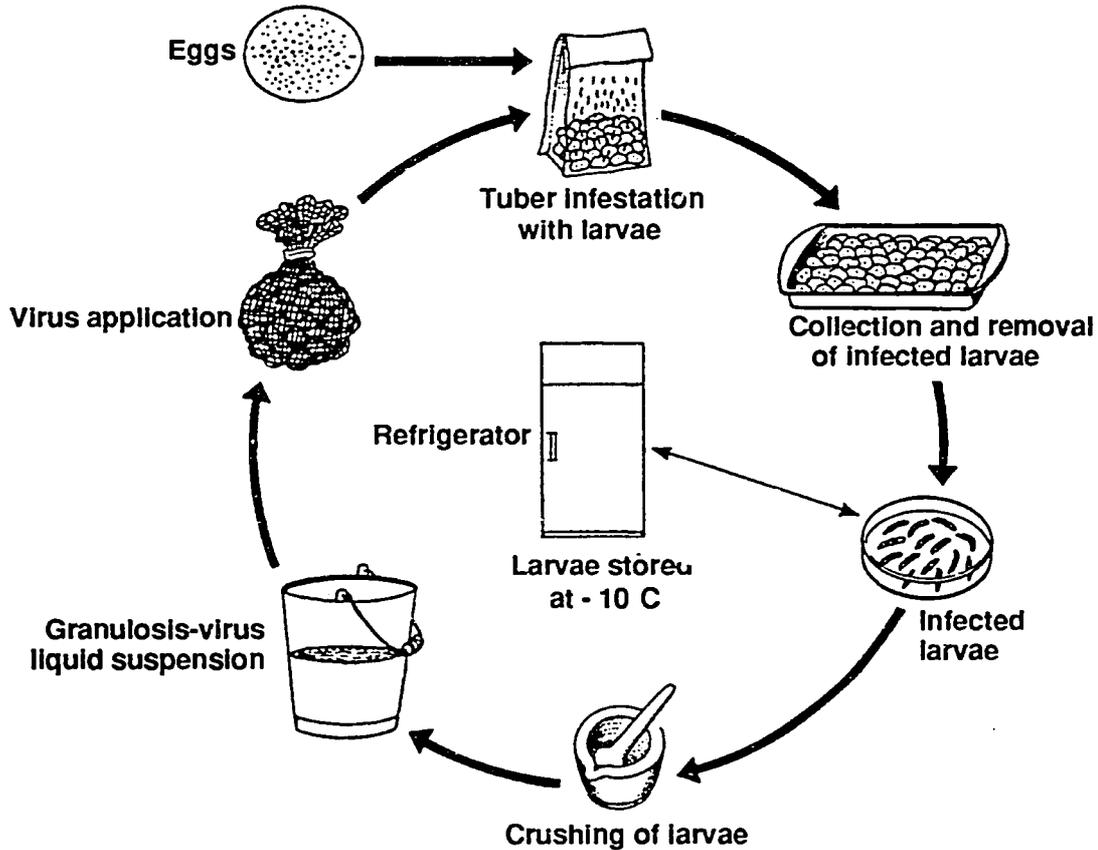
Moth larvae killed by Baculovirus

## **1. Virus multiplication with larvae on tubers**

Prepare a liquid suspension by crushing 10 larvae and mixing with one liter of water. Put 1-2 kg of tubers in a mesh bag and soak for one minute. Soak as many bags as possible. Then, take the tubers out of the mesh bags, dry them in the shade, and put them in paper bags with 300-500 mass-reared potato tuber moth larvae.

After 2-3 weeks, remove the virus-infected larvae from inside and outside the tubers, and use them to prepare the powder or liquid formulations. Alternatively, they can be used for multiplication or stored at -10 C (Figure 1).

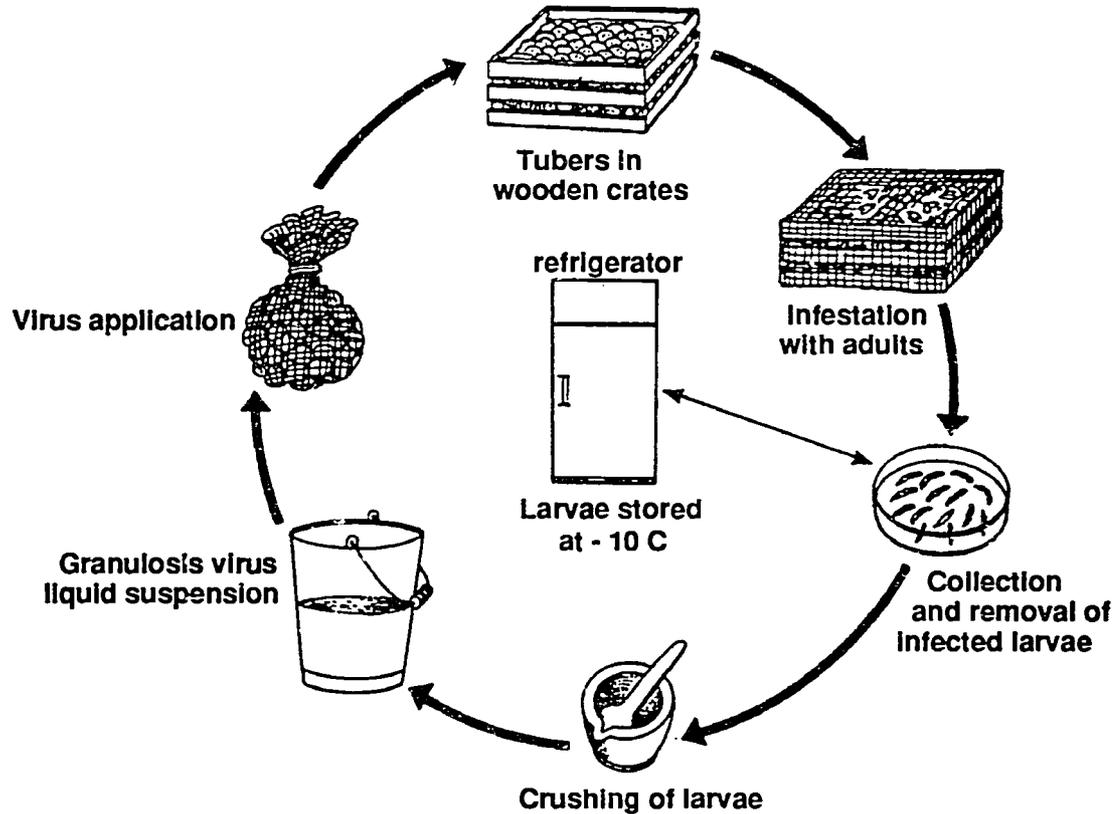
**Figure 1. Multiplication methodology for *Phthorimaea operculella* (Zeller) granulosus virus of potato moth.**



## **2. Virus multiplication with adult moths on tubers**

Follow the same steps as before. However, you should use wooden crates or boxes covered with a thin plastic net to dry 3-5 kg lots of tubers at a time. Next, proceed to infestation by placing 50-100 adult moths per box. You can collect the sick larvae 4-6 weeks later, and use them as described previously (Figure 2).

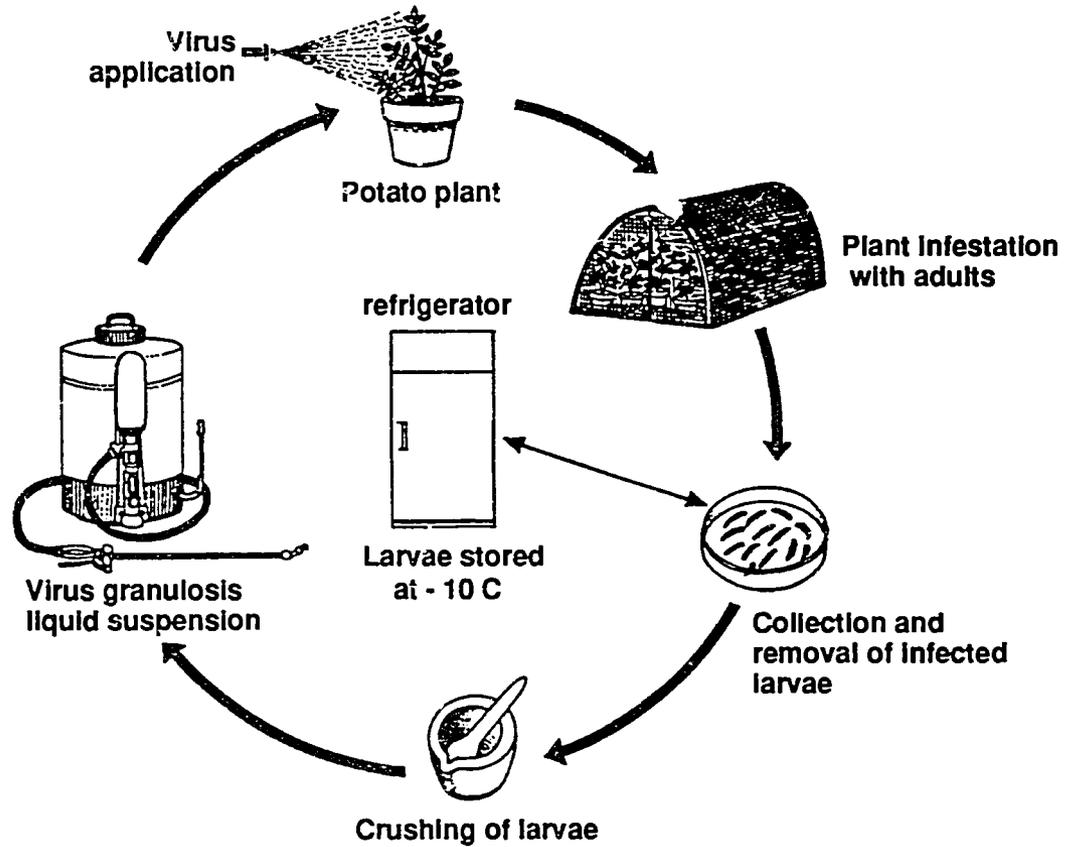
**Figure 2. Multiplication methodology for *Phthorimaea operculella* (Zeller) granulosis virus of potato tuber moth.**

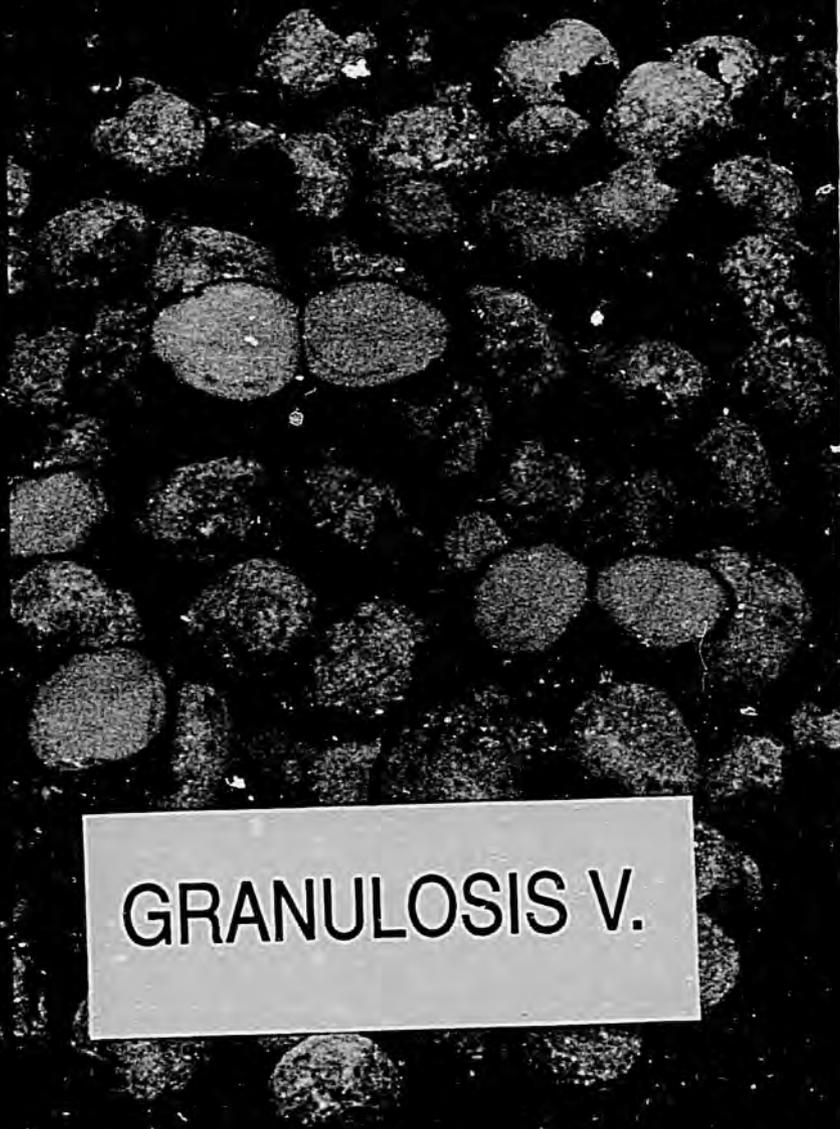


### **3. Virus multiplication with adult moths on foliage**

Follow the same steps as in the first case. However, pour the liquid suspension into a sprayer and apply it to the foliage of potted potato plants or in the field. Cover the plants with a thin plastic net and then infest with 50-100 adults for every 50 plants on average. Wait from 3 to 4 weeks before collecting the infected larvae. You can now use the infected larvae as described above (Figure 3).

**Figure 3. Multiplication methodology for *Phthorimaea operculella* (Zeller) granulosis virus of potato moth.**





GRANULOSIS V.



TESTIGO

# POTATO TUBER MOTH BACULOVIRUS

## POWDERED BIOLOGICAL INSECTICIDE FOR DUSTING

CROP	PEST	COMMON NAME	DOSAGE
Stored potato	<i>Phthorimaea operculella</i>	-Potato tuber moth	5 kg / t of potato tubers

**NON TOXIC**

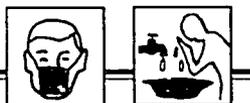
**Fórmula:**

*Phthorimaea operculella granulosis virus* ..... 0.03 %  
 Inert matter ..... 99.97 %  
 100.00 %

**How to use it:** Put 125 g of the formulation in a plastic bag with 25 kg of potato tubers. Shake until tubers are completely covered with powder.

EXPERIMENTAL INSECTICIDE WITH NO COMMERCIAL VALUE

Manufactured by



INTERNATIONAL POTATO CENTER (CIP)

For the: SEINPA PROJECT

FOR ADDITIONAL INFORMATION, PLEASE CONTACT THE  
 Department of Nematology and Entomology, CIP, Apartado 5969, Lima, Peru.

### CIP Training Bulletins

Contain information on Technologies that have been widely tested, and are useful for extension agents and potato producers.

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