

**THE EFFECT OF DIFFERENT BAGGING MATERIALS OF PUMMELO, *CITRUS MAXIMA* LIN. FOR THE CONTROL OF CITRUS RIND BORER, *PRAYS ENDOLEMMA*, DIAKONOFF AND OTHER INSECT PESTS**

Fe B. Pableo and Judith T. Simpao  
Bureau of Plant Industry, Davao National Crop Research and Development Center  
Bago-Oshiro, Davao City, Philippines

**ABSTRACT**

The Effect of Different Bagging Materials on Pummelo, *Citrus maxima* L. for the Control of Citrus Rind Borer (CRB), *Prays endolemma* Diakonoff and Other Insect Pests was conducted at Davao National Crop Research and Development Center, Bureau of Plant Industry, Bago-Oshiro, Davao City.

The experiment was laid out in a randomized complete block design with four replications. Nine treatments were evaluated with six different bagging materials namely: news paper bag, brown paper bag, bag made of katsa, straw sack bag, plastic net bag and plastic bag and compared to insecticide and no spray and no bagging as Control. There were two trials conducted. The three bagging materials which exhibited zero infestation were selected for the second trial.

Results showed that bagging can control the CRB, the most destructive insect pest of pummelo which causes galling using different bagging materials. The use of old news paper, plastic bag and modified net bag as bagging materials showed comparable advantage over the other materials used. Fruit bagging resulted to clean, pesticide free fruits that can command premium price. Based on economic analysis, the use of plastic bag gave the highest economic benefit of P23.20 per fruit among other treatments. However using the net bag is more advantageous in the long run for it is recyclable compared to plastic bag.

**KEYWORDS:** Citrus Rind Borer (CRB) Control, Pummelo fruits, Fruit stage, Time of bagging, Bagging materials

## INTRODUCTION

Pummelo (*Citrus maxima* L.) is one of the favorite fruits of the many Filipinos because of its delicious taste and high nutritional value. It has good market potential and of low perishability allowing for distant transport to overseas consumers. To increase export competitiveness however, researches should be aimed for its cultural improvement especially on pests and disease management.

Pummelo is grown best in Mindanao . The area devoted to production of pummelo in the country increased from 3,600 hectares in 1994 to 4,468 hectares in 1997 with an annual increase of 5.5 percent. Production during the said period increased from 22,707 mt. to 48,886 or an annual growth rate of 29 percent . (The Philippine Fruit Network- DA, 2000)

The country's production is not enough to satisfy big domestic demand . The volume of pummelo export was 62 mt. in 1993 , 40 mt. in 1994 , 16 mt in 1995 and 10 mt. in 1997. It has also a big potential for export considering that Malaysia and Thailand are actively selling pummelo to Singapore, Hongkong and other countries (DA).

There are many factors which contribute to the production of quality fruits. One of those factors is the crop protection aspect. Pest and disease control is indispensable in pummelo production. Pesticide is still the most commonly used pest and disease control by most growers because of limited technology available for other control methods. The Citrus Rind Borer (CRB), *Prays endolemma* Diakonoff is the most destructive insect pests of pummelo in the Philippines. Damage attributed to this insect pest reached as high as 60-80 percent. The Citrus Rind Borer feed and complete its life cycle on both flowers and fruits. Infestation is made by boring of the larva resulted to the swelling and formation of galls on the rind of the fruits. Severe infestation during the early stages lead to the malformation and hardening of pummelo fruits at maturity, thereby affecting the fruit quality. Feeding by larvae on flowers and newly formed fruits contributed to the premature fall (Gavarra,1988).

Mr. Mauro, a practicing agriculturist and a successful grower of pummelo in Davao stated that in one fruiting cycle, he sprays 18-21 times using insecticides and fungicides. It is done before flowering at weekly interval and seven times after flowering for seven weeks or forty-nine days. After seven weeks, the same insecticide-fungicide combinations was sprayed every two weeks up to the time the fruits are 5 months old and re-applied pesticide for the fruitfly control until harvest (Mauro, 2003).

In other countries, bagging of pummelo fruits has been practiced for the control of fruitfly which infests all stages of fruit development . However, the pest is not a major problem in the Philippines, but under local conditions, the Citrus Rind Borer (CRB), *Prays endolemma* Diakonoff is the major insect pest that causes galling at different

stages of fruit development (Gavarra,1988). Results of a study on the use of selected insecticides conducted at BPI-DNCRDC for the control of citrus rind borer, particularly on the early stage of fruit development showed that insecticide spray is the only recommendation for the control and that no other recommendations so far for the said pest .

This study was conducted to incorporate bagging in the pest management scheme to control CRB and to produce fruits with a less pesticide and to command a better price.

## **OBJECTIVES**

1. To generate information on the biology seasonal prevalence of CRB, its prospective natural enemies and their biology
2. To screen available and promising insecticides against CRB
3. To demonstrate effective and sustainable IPM for CRB
4. To develop IPM guide for the control of CRB

## **MATERIALS AND METHODS**

### **Location and Duration of the Experiment**

The experiment was conducted at Bago-Oshiro, Davao City from April 2006 to December 2008 utilizing the existing eleven-year old pummelo orchard of the Bureau of Plant Industry - Davao National Crop Research and Development Center.

### **Identification and Management of Experimental Trees**

Soil analysis of the experimental site was undertaken before setting-up the experiment. Experimental trees were identified, tagged and equally managed. Fertilizer application was based on the result of the soil analysis. Sanitation was strictly observed in the area.

### **Experimental Procedures**

The experiment was conducted in two trials using the Randomized Complete Block Design (RCBD) as experimental lay-out and replicated four times.

### **Time of Bagging**

Bagging was done during the pre-bloom stage of pummelo. Since the most critical stage of Citrus Rind Borer (CRB) infestation is during the first two to three months from button or pre-bloom stage (Gavarra, 1988). Eggs are laid on the flowers or

fruits then hatched into larvae and immediately bore into the fruits, thereby causing galls. Thus, bagging was done before eggs were laid.

### **First Trial**

During the first trial, nine treatments consisting of seven different bagging materials were tested, as follows:

#### 1. Newspaper

Old newspapers were cut 6 inches long and 5.5 inches wide. The left and right edges of the cut old newspapers were stapled together leaving the both ends open. Pummelo flowers were bagged and enclosed with the prepared newspaper bags by stapling the both ends. Small holes are made in both corners of the bottom end of the newspaper bags.

#### 2. Paper Bag

This is the commercial brown-colored paper bag or “supot” (7.5 x 11 inches in size). Pummelo flowers were bagged or enclosed in the paper bag, the ends were secured by the use of a stapler.

#### 3. Katsa

Clean empty flour bags were sewed and made into bags (8.5 x 12.5 inches in size) with both ends open. Fine strings were tied at both ends of the katsa bags enclosing the pummelo flowers.

#### 4. Straw Sack

Straw sack is the same material as the bag of commercial rice. Bagging materials out of the straw sack were prepared and used in the same way as the katsa. Size of the bags is 15 inches long and 9.0 inches wide.

#### 5. Plastic Bag

This is the ordinary commercial transparent plastic bag, 7.5 x 13 inches in size. Pummelo flowers were bagged or enclosed in the plastic bags by tying together the upper corner tips of the bags. Small opening at the bottom end of the plastic bag was made.

#### 6. Net Bag

This is the white-fine mesh plastic net. Bags (10 x 18 inches in size) were manually prepared by sewing fine string at both ends and strengthen with a wire inside so that the flowers or fruits will not touch the net.

## 7. Newspaper + Plastic Bag.

This is the combination of the newspaper and plastic bag. Prepared newspaper bags covered with plastic bags were used in enclosing or bagging the flower.

## 8. Unbagged ( But Sprayed with Insecticide)

## 9. Unbagged ( No Spray)

Fifty fruit samples per treatment per replication were bagged. Bagging was done on unopened flowers (pre-bloom stage) or before fruit setting because CRB infestation starts at flowering stage.

### **Second Trial**

Based on the result of the first trial, four treatments were selected and further tested in the second trial, namely:

1. Net Bag
2. Plastic Bag
3. Newspaper
4. Unbagged (no spraying with insecticide)

Bagging procedure was the same as of the first trial.

### **Monitoring of Other Insect Pests**

Monitoring was regularly done on weekly basis . Observation on the occurrence of other insect pests was also undertaken. Methyl eugenol, an attractant was used for the control of fruitfly

### **Harvesting and Evaluation of CRB Infestation**

Fruits were harvested at 160-170 days from fruit set. Ten percent of the harvested fruits per treatment per replication were evaluated for the presence of rind borer damage or gall.

The following were recorded and evaluated:

1. Presence and number of rind borer damage per sample fruit
2. Total number of fruits. Infested/no. of fruits bagged
3. Occurrence of other insect pests
4. Economic analysis

## RESULTS AND DISCUSSIONS

### Evaluation of CRB Infestation in Pummelo

#### First Trial

In the first trial, percent CRB infestation was very high on unbagged fruits with no chemical spray at 23.0 percent followed by unbagged fruits with insecticide spray at 22.03 percent. Fruits bagged with paper bag were moderately infested at 4.68%. The rest of the treatments were free from CRB infestation (Figure 1).

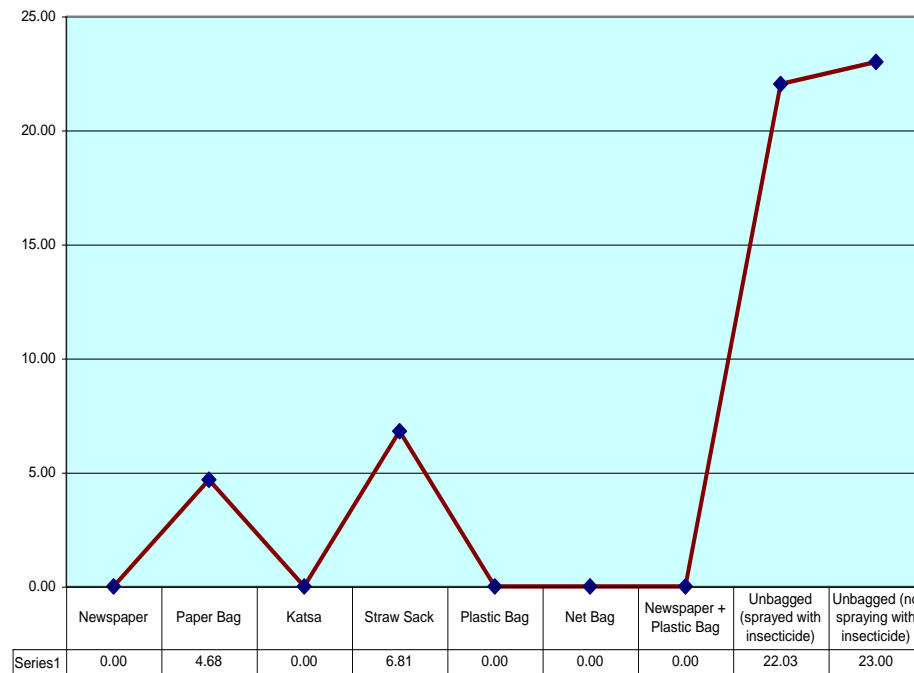


Figure 1. Percent CRB infestation in the first trial, DNCRDC, 2006-2007.

#### Second Trial

Based on the result of the first trial, three bagging materials were selected and further tested in the second trial including the unbagged (with no spraying of insecticide) to serve as control. Bagging was also done during the pre-bloom stage of pummelo. Results showed that the unbagged fruits were highly infested at 6.11 percent. Fruits bagged with plastic bag was slightly infested at 0.23%. Fruits bagged with both the net bag and newspaper were observed free from CRB infestation (Figure 2).

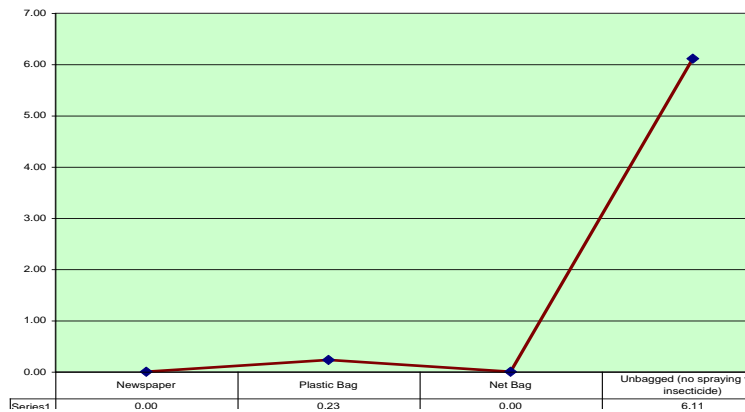


Figure 2. Percent CRB infestation in the second trial, DNCRDC, 2007-2008.

As per evaluation, the use of newspaper and net bag effectively control CRB infestation during the first and the second trials. However, using the plastic bag is much better than without bagging materials and spraying of chemicals (Figure 3).

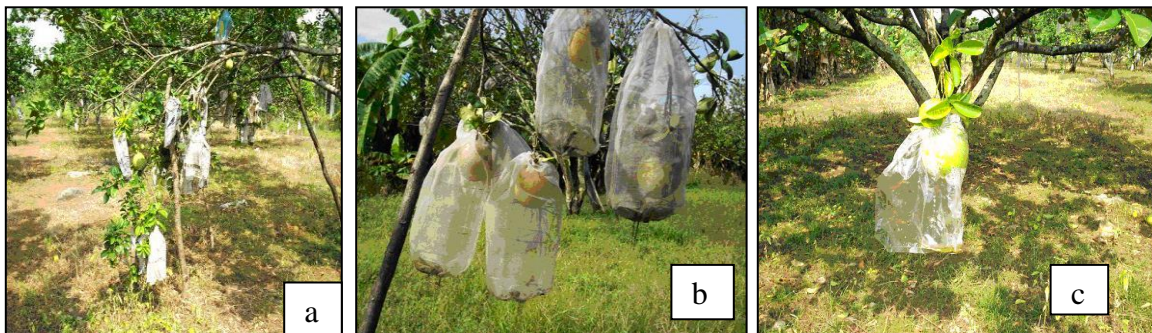


Figure 3. Pummelo fruits bagged with (a) newspaper, (b) net bag and (c) plastic bag.

### Occurrence of Other Insect Pests

Other insect pests were also observed (Figure 4). Scale insect infestation was observed in all bagged treatments. Fruitfly infestation was not observed on fruits bagged with newspaper, paper bag and newspaper + plastic bag. Mealybug infested the fruits bagged with paper bag and net bag. Presence of black ants or “hantik” was also noticed.

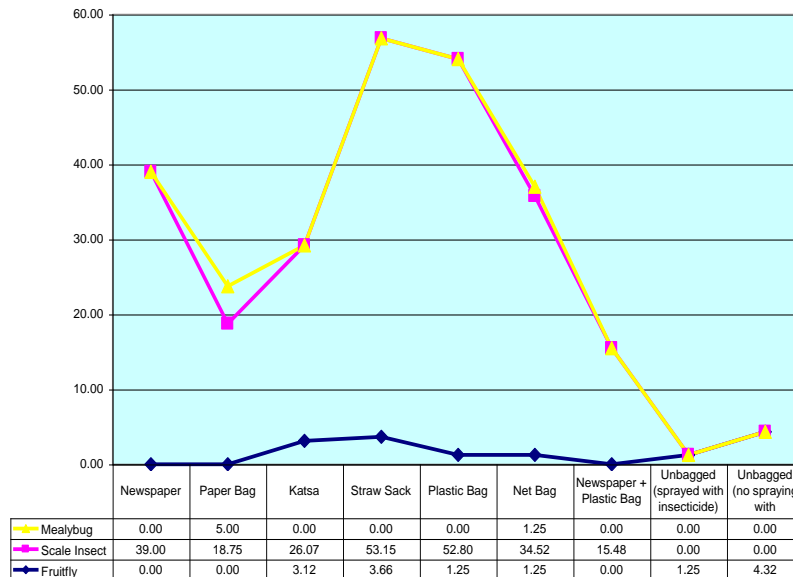


Figure 4. Percent infestation of other insect pests.

## Economic Benefits

Based on economic analysis, fruits bagged with plastic bag gave the highest net benefit per fruit of P23.20, followed by fruits bagged with newspaper at P22.90 and those unbagged fruits sprayed with insecticide at P21.62 (Table 1).

Table 1. Economic analysis of bagging pummelo fruits using the newspaper, net bag and Unbagged (with insecticide spray)

TREATMENTS	Cost of Material/Fruit (P)	Cost of Application/Fruit (P)	Total Cost of Bagging/Fruit (P)	Net Benefit/Fruit (P)
1. Net Bag	6.41	0.50	6.91	17.09
2. Newspaper	0.60	0.50	1.1	22.90
3. Plastic Bag	0.30	0.50	0.80	23.20
4. Unbagged (with insecticide spraying)	0.63	1.75	2.38	21.62



Assumptions: Average weight/fruit = 0.8 kg.  
Farm Gate Price / kg = P30.00

Fruits bagged with net bag gave the lowest net return of P17.09. However, although net bag is more expensive than the other bagging materials, using it is more advantageous in the long run for it can be recycled for more than three times. Thus, cost of bagging materials using the net bag becomes free for the succeeding fruiting seasons.

## CONCLUSIONS

The Citrus Rind Borer *Prays endolemma*, Diakonoff or CRB can be controlled by bagging at pre-bloom stage because it is in this stage that the said pest starts infestation. There are options of selecting bagging material to be used like paper bag, plastic bag or net bag. Bagging pummelo fruits with newspaper or net bag is the most effective method against CRB infestation based on two (2) trials. On the economics of using the different bagging materials, the use of plastic bag is the most economical, but using the net bag although expensive is also beneficial for it can be recycled. Thus, cost of bagging materials using the net bag becomes free for the succeeding fruiting seasons. Also, the preparation of the net bag can be modified to reduce bagging costs.

## RECOMMENDATIONS

It is recommended to bag pummelo fruits to prevent or minimize the use of pesticides for the control of CRB infestation thereby enhances production of good quality and pesticide-free pummelo fruits at reduced cost. Pesticide free fruits also can command premium price. However, the use of bagging material is limited to a smaller scale of pummelo plantings.

## BIBLIOGRAPHY

Ann, P.J.et Al.,1998. Effect of Bagging in the control of anthracnose disease of mango.Taiwan. Chinese Hort.Soc.

Cacao IPM Project of BPI-DNCRDC,Bago-Oshiro, Davao City. 1983

Current Fruit Crop Industry Situation. 2000. The Philippine Fruit Network-DA-Philippines

Gavarra, M. R. 1988. Biology , Ecology and Control of Citrus Rind Borer, *Prays endolemma*, Diakonoff. Terminal Report .BPI- DNCRDC.1988.

Hwang,A.S.1993.Effect of bagging on fruit growth and quality of'Wenton' Pummelo (*Citrus grandis* ( L). Osbeck ) and the temperature inside the bag. J. Chinese Soc. Hort. Sci. 39(4): 199-208.

Mauro, Virgilio.2003 . Agriculture Magazine of Manila Bulletin. February 2003.

[www.infonet.biovision.org](http://www.infonet.biovision.org) Traps and Bagging.

PCARRD 2004. Research Highlights . PCARRD. Los Banos ,Laguna