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Title

Terminal Report: Efficacy Testing of AICON Against Melon Fruitfly *(Bactrocera cucurbitae),* Aphids *(Aphis gossypii* Glover*)* and Mites *(Tetranychus cinnabarinus)* of Bitter Gourd *(Momordica charantia)*

Introduction

Bitter gourd, *Momordica charantia* L., locally known as ampalaya, belongs to the Family *Cucurbitaceae*. It is also known as *asparia* in Ilocano and Indonesia, *palia* in Bisaya, *peria* in Malaysia, and Balsam pear in English [Department of Agriculture-Bureau of Plant Industry (DA-BPI), 2013]. Bitter gourd is a crawling vine that grows well in tropical countries, particularly in the Philippines, and can grow as high as five meters (DA-BPI, 2013). This is mostly cultivated, although wild forms can be abundantly found in areas where growth is favorable. It is rich in minerals such as calcium, phosphorus, iron, potassium, sodium, and zinc (DA-BPI, 2013). It also has the following vitamins: retinol, beta-carotene, thiamin, riboflavin, niacin, and ascorbic acid (Department of Science and Technology- Food and Nutrition Research Institute [DOST-FNRI], 2009). Bitter gourd is similar in nutritional value to other cucurbits. It is higher in folate and Vitamin C. The vine tips are an excellent source of vitamin A. It is popularly known to treat diabetes. The young leaves and shoots of the "Makiling" variety were reported to have lowered the blood sugar level of people with type 2 diabetes mellitus [DOST-Philippine Council for Agriculture, Aquatic Resources Research and Development (PCAARRD), 2009].

In the Philippines, cucurbits are the hosts of Melon Fruit Fly, *Bactrocera cucurbitae* (Coquillett)(Truong et al., 2004). However, farmers are not certain about actual pest infestation levels in their fields, prompting them to overuse pesticides. *B. cucurbitae* is one of the world's most serious pests, particularly on cucurbits. Truong et al. (2004) found out that the Melon Fruit Fly *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae) and *Diaphania indica* (Saunders) were the major pests observed on bitter gourds (Truong et al., 2004).

Meanwhile, aphids not only damage the bitter gourd crop by sucking the sap but also serve as a vector of Cucurbit aphid-borne yellows virus (Sathiya Priya, et al., 2022). Aphids damaged the plants by sucking the sap which resulted in yellowing, crinkling of leaves, and in severe cases withering of plants (Sathiya Priya, et al., 2022). On the other hand, spider mites are tiny, eight-legged mites that range in color from yellowish to green or red (Hortsense, 2023). They typically feed on the underside of leaves, causing a yellowish to bronze stippling or speckling of leaves (Hortsense, 2023). Severe infestations can cause entire leaves to turn yellow and may reduce yields. Spider mite feeding is usually accompanied by webbing on the underside of leaves (Hortsense, 2023). The mites may be visible as "moving dust" in the webbing. Mite infestations are worse in hot, dry, and dusty conditions (Hortsense, 2023). Heavy infestations result in a thick webbing appearing on the plant (Ingwell et al., 2018). Therefore, scouting should be done often. Crops that are not irrigated tend to be more susceptible because

the nutrients are concentrated in the leaves and the mites can increase more quickly, adding to the already water-stressed damage in the plant (Ingwell et al., 2018). Mite feeding can lead to defoliation in as little as a week or can result in direct damage to the fruit, lowering yield (Ingwell et al., 2018). Mites can feed directly on the fruits themselves, and result in a sandpaper-like texture to the rind (Ingwell et al., 2018).

Adoption of pre-harvest management practices is important in reducing direct losses. Two common mechanical methods of control are wrapping developing fruit with a protective paper covering and the use of baited traps (Allwood & Drew, 1997). The use of protective covering is more effective but time-consuming and more costly compared to the use of traps. Despite its cost, protective paper coverings are still used to a certain extent largely by home gardeners (Truong et al., 2004). Baited traps are also used to kill adults. Some farmers perceive the actual use of Methyl Eugenol (ME) as a control measure but not as a tool for monitoring melon fly abundance. Of most importance is field sanitation particularly the destruction of all unmarketable and infested fruits which is effective in reducing fruit fly population in the field but seldom done (Truong et al., 2004). Net bagging of fruits was a better alternative management strategy against melon fly which resulted in 95% marketable fruit yield, reduced pesticide use, and kept weed vegetation under bitter gourd favorable for habitation of predators and parasitoids of rice and non-rice pests even up to three months after rice harvest (Truong et al., 2004). The use of white net bags to protect bitter gourd fruits was found to be economical, easy, and a better management strategy than regular insecticide application (Truong et al., 2004). Farmers can get more sustainable profit from the rice-bitter gourd cropping system using the environment-friendly net bagging technique, supplemented with minimal insecticide application (Truong et al., 2004). Hence, an intensive campaign for the adoption of net bagging of bitter gourd fruit to reduce production costs, minimize health hazards due to insecticide application, and increase productivity is urgently needed and strongly recommended (Truong et al., 2004).

Pesticides are widely used in agricultural production to prevent or control pests, diseases, weeds, and other plant pathogens to reduce or eliminate yield losses and maintain high product quality (Damalas & Eleftherohorinos, 2011). Although pesticides are developed through very strict regulation processes to function with reasonable certainty and minimal impact on human health and the environment, serious concerns have been raised about health risks resulting from occupational exposure and residues in food and drinking water (Damalas & Eleftherohorinos, 2011). Occupational exposure to pesticides often occurs in the case of agricultural workers in open fields and greenhouses, workers in the pesticide industry, and exterminators of house pests (Damalas & Eleftherohorinos, 2011). Exposure of the general population to pesticides occurs primarily through eating food and drinking water contaminated with pesticide residues, whereas substantial exposure can also occur in or around the home (Damalas & Eleftherohorinos, 2011). Regarding the adverse effects on the environment (water, soil, and air contamination from leaching, runoff, and spray drift, as well as the detrimental effects on

wildlife, fish, plants, and other non-target organisms), many of these effects depend on the toxicity of the pesticide, the measures taken during its application, the dosage applied, the adsorption on soil colloids, the weather conditions prevailing after application, and how long the pesticide persists in the environment (Damalas & Eleftherohorinos, 2011).

Ahcil Insect Control (AICON) is a botanical insecticide developed for crops by Ahcil Laboratories, Inc. With Azadirachtin as an active ingredient, AICON will play an important role in the organic bio-pesticide category for controlling pests. Azadirachtin, the key insecticidal ingredient found in the neem tree, is a naturally occurring substance that belongs to an organic molecule class called tetranortriterpenoids. It is structurally similar to insect hormones called "ecdysones", which control the process of metamorphosis as the insect passes from larva to pupa to adult (ALI, n.d).

It exhibits various behavioral responses such as antifeedant, feeding deterrent, repellent, and oviposition deterrent. It is non-toxic to humans and animals, biodegradable, and is effective against foliage feeders or defoliators (ALI, n.d). In addition, it does not leave any residue on the crop and is environmentally friendly (ALI, n.d).

Information that will be derived from this particular research activity will serve as a basis for recommendations to our ampalaya growers in all regions growing ampalaya.

Objective/s

The general objective of the study was to generate the efficacy data on AICON to support product registration with the Department of Agriculture - Bureau of Agriculture and Fisheries Standards (DA-BAFS). Specifically, the trials aimed to determine the:

1. efficacy of AICON against Melon Fruit Fly, Aphids, and Mites on Bitter Gourd; and
2. effective dose/s of AICON against Melon Fruit Fly, Aphids, and Mites on Bitter Gourd.

Methodology

1. **Efficacy Trial Period and Location**
   The trials were conducted in Kapatagan, Digos City (Location 1) and Purok Narra, Sto. Tomas, Davao del Norte (Location 2) from December 2022 to March 2023.

2. **Test Crop and Insect Pest/s**
   Bitter Gourd (Momordica charantia)
   Bitter Gourd is a crawling vine that grows well in tropical countries, particularly in the Philippines, and can grow as high as five meters (DA-BPI, 2013)

   The target pests are as follows:

   Melon Fruit Fly *(Bactrocera cucurbitae)*
   Melon Fruit Fly is one of the most important pests of cucurbits and bitter gourd *(Momordica charantia* Lin*.).* The female fruit flies prefer

young, soft, and tender fruits for egg laying at 2 to 4 mm depth inside with its sharp ovipositor (Mawtham et al., 2020).

Aphids (*Aphis gossypii* Glover)
Aphids damage the plants by sucking the leaf sap. In the young stage, cotyledonary leaves crinkle, and in severe cases, the plants wither. The leaves of fully grown vines turn yellow and the plant loses its vigor (Bittergourd-NHB).

Mites (*Tetranychus cinnabarinus)*
*S*pider mites are tiny, eight-legged mites that range in color from yellowish to green or red. They typically feed on the underside of leaves, causing a yellowish to bronze stippling or speckling of leaves (Hortense, 2023).

3. Efficacy Trial Design and Treatments

The treatments were laid out randomly with four replications. Each plot for each treatment had an area of 10 sqm (1m x 10m). The treatments included a control and different dosages of AICON as shown in Table 1.

Table 1. Dosages and Frequency of Application

Treatment	Dosages (per L water)	Frequency
1	Untreated	*Weekly application at seven days intervals and applied eight cycles of treatment application*
2	15 ml	
3	10 ml	
4	5 ml	

4. Cultural Management Practices

a. Land Preparation

The area was thoroughly plowed and pulverized. Plots of 1 m x 10 m were prepared. There were four replicates for each treatment with a total of 40 sqm.

b. Seedling/Planting Preparation/Transplanting

Bitter Gourd seedlings were pre-grown in a small bag made of banana leaves and transplanted at a distance of 88 cm between hills, at around 21 to 25 days after seeding (DAS).

c. Fertilizer Management

During land preparation, chicken manure was applied, and a source of nitrogen and given at 12 to 15 days after planting. Complete fertilizer (14-14-14) was applied also after 20 to 25 days and another fertilization followed if necessary.

d. Water Management

The trial did not use any irrigation system. Plants were grown naturally without any additional artificial irrigation. Rainy days were sufficient for Bitter Gourd growth.

e. Pest and Disease Management

Weeds were hand-weeded to reduce competition with the test crop and eliminate the host of other insects. Fungicide or any insecticide was not applied during the growing period of bitter gourd.

f. Harvesting

Harvesting of fruits was classified into two; good (without any damage by insects or bruises, good-shaped) and unmarketable due to Melon Fruit Fly infestation. Fruits were harvested 10 times within the duration of the study.

5. Sampling

There were 10 plants per plot with uniform appearance tagged for sampling. Whole plant observation was done to assess the presence of the target pests, which includes trifoliate leaves and stems as a manifestation of insect pest damage occurring on the whole plant.

6. Analysis of Results

The data gathered were subjected to analysis by comparing the difference of the mean of treatments against the untreated using the Abbots' Formula. The standard percent comparison of ≥50 percent against control is set in the *Philippine National Standards (PNS) Organic Bio-control Agents (OBCA) – Microbials and Botanicals – Minimum requirements (PNS/BAFS 182:2016).*

Data Gathered

1. **Percent of Insect Infestation.** The percent of insect infestation of each target pest was computed using the established procedure and formula as prescribed in the DA-BAFS OBCA Manual, as shown in Table 2. Then, efficacy was expressed in terms of the mean percentage of infected plants.

   a. ***Melon Fruit Fly.*** Initial infestation was done a day before the first application, followed by three and seven days after each application. The larvae (on fruits) were counted and assessed.

   b. ***Aphids.*** There were 10 sample plants per replicate where data collection was done. The percent infestation in each sample plant was recorded. The number of colonies in the three youngest leaves of a stalk of each sample plant. Efficacy will be expressed in terms of the mean number of aphid colonies per plant as well as aphid-infested plants.

c. ***Mites.*** The number will be counted from three selected leaves representing the upper, middle, and lower portion of the plant of each 10-tagged randomly selected plant.

The formula for insect pest percent infestation:

$$\text{Percent Infestation} = \frac{\text{Total No. of Infested Plants/Fruits}}{\text{Total No of Plant Sample/Fruits}} \times 100$$

2. **Percent Control on Aphids Damage.** The percent control to damage of each target pest was computed using the established procedure and formula as prescribed in the DA-BAFS OBCA Manual, as shown in Table 2. The efficacy evaluation of treatments was done three and seven days after application.

Table 2. Rating Scale for Aphids

Scale	Description
1	No visible damage-symptom
3	Slight: 1-20% of leaves curling
5	Moderate: 21-40% of leaves curling
7	Severe: 41-60% of leaves curling
9	Very severe: more than 60% of leaves curling

Results & Discussion

The following results showed the AICON's efficacy against the infestation and damage caused by target pests:

1. **Percent Control on Infestation.** The treatments and their percent infestation control against the target pests, which passed the standard efficacy set by the PNS/BAFS 182:2016, are shown in Tables 3, 4, and 5.

Table 3. Percent Control on Melon Fruit Fly Infestation on Harvest Fruits Against Untreated

Treatment	Location 1	Location 2
AICON at 15 ml/L water	71.57%	74.45%

AICON at 10 ml/L water	70.05%	69.62%
AICON at 5 ml/L water	56.07%	60.22%

Table 4. Percent Control on Aphids' Infestation Against Untreated

Treatment	Location 1	Location 2
AICON at 15 ml/L water	93.70%	64.40%
AICON at 10 ml/L water	91.00%	58.10%
AICON at 5 ml/L water	86.90%	50.00%

Table 5. Percent Control on Mites' Infestation Against Untreated

Treatment	Location 1	Location 2
AICON at 15 ml/L water	71.40%	73.80%
AICON at 10 ml/L water	67.10%	61.50%
AICON at 5 ml/L water	60.10	59.30%

2. **Percent Control on Damage.** The treatments and their percent infestation control against the aphids' damage, which passed the standard efficacy set by the PNS/BAFS 182:2016, are shown in Table 6.

Table 6. Percent Control on Aphids' Damage Against Untreated

Treatment	Location 1	Location 2
AICON at 15 ml/L water	72.20%	77.30%

AICON at 10 ml/L water	64.90%	61.50%
AICON at 5 ml/L water	61.60%	58.10%

Conclusion and Recommendation

Conclusion and Recommendation

The product AICON was able to meet the efficacy standards set by the PNS/BAFS 182:2016 at ≥50 percent, and as required by the Department Circular No. 01, series of 2021. Thus, the product is recommended to apply for product registration with DA-BAFS.

Practical Implication

The efficacy results suggest that the product can be used to control the level of infestation of Melon Fruit Fly in Bitter Gourd fruits. Further, the product can also be used to control the level of infestation caused by aphids and mites, with the following dosage as shown in Table 7.

Table 7. Disease, Dosage and Frequency of Application

Disease	Dosage and Frequency of application
Melon Fruit Fly	5-15 ml/L of water, every seven days during the early fruiting stage and onwards
Aphids	
Mites	

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Ahcil Laboratories Inc. is a duly organized company since 2008, engaged in the manufacture of organic, safe, nontoxic and natural extracts as components for agricultural application. The products are:
1. Antica, Organic Fungal Control
2. Aicon, Organic Insect Control
3. 3SE, Seaweed Sticker

References

Allwood, A.J., and Drew, R. A. J. (1997). Management of fruit flies in the Pacific. *ACIAR Proceedings No. 76,* 267p

Damalas, C. A., & Eleftherohorinos, I. G. (2011). Pesticide exposure, safety issues, and risk assessment indicators. *International Journal of Environmental Research and Public Health*, *8*(5), 1402–1419. https://doi.org/10.3390/ijerph8051402

Department of Agriculture-Bureau of Plant Industry. (2013). Ampalaya Production Guide. *Info. Sect., Bureau of Plant Industry,* 7p

Department of Science and Technology- Food and Nutrition Research Institute (DOST-FNRI). (2009). *FNRI Annual Report*. FNRI Website. https://www.fnri.dost.gov.ph/index.php/publications/fnri-annual-report

Department of Science and Technology (DOST)-Philippine Council for Agriculture, Aquatic Resources Research and Development (PCAARRD), (2009). Information Bulletin No. 156-A/ 2009

Ingwell, L., Foster, R., & Egel, D. (2018). *Spider mites on cucurbit crops*. Purdue University. Vegetable Crops Hotline. https://vegcropshotline.org/article/spider-mites-on-cucurbit-crops/

Mawtham, M. M., Justin, C. G., & Roseleen, S. S. (2020). Field efficacy of bio-inputs and insecticides against Melon Fruit Fly, Zeugodacus Cucurbitae (Coquillett) (Diptera: Tephritidae) in bitter gourd (Mormodica Charantia L.). *ENTOMON*, *45*(3), 201–208. https://doi.org/10.33307/entomon.v45i3.551

National Horticulture Board - Ministry of Agriculture Farmers' Welfare, Government of India. (n.d.). *Bitter Gourd - NHB*. National Horticulture Board. https://www.nhb.gov.in/pdf/vegetable/bittergourd/bit003.pdf

Sathiya Priya, S., Suganthy, M., Murugan, M., & Renukadevi, P. (2022). Influence of weather parameters on seasonal occurrence of aphids and Cucurbit aphid-borne yellows virus (CABYV) on bitter gourd, Momordica charantia L. *Biological Forum – An International Journal*.

Ahcil Laboratories, Inc. (ALI) (n.d.). Supporting Documents for AICON insecticide

Truong G, H. X., Rapusas, H. R., Valdez, E. M., Marquez, L. V., and Casimero, M. C., (2004). Community-based management strategies against major insect pests in the Rice-Based Cropping System with Emphasis on Bitter Gourd. *The Philippine Entomologist, Jour Phil. Assn of Entom. Inc. Vol. 18 #2, 2004,* pp. 100-120

Washington State University. (2023). *Hortsense*. Go to Hortsense. https://hortsense.cahnrs.wsu.edu/fact-sheet/cucumber-pumpkin-squash-spider-mites/

Annex

-Photo Documentation

Figure 1. Curling of leaves caused by aphids

Figure 2. Black aphids

Figure 3. Worm & black aphid

Figure 4. Black Aphids

Figure 5. Bugs infesting Bitter Gourd Gourd

Figure 6. Snail infesting Bitter

Figure 7. Infestation of Melon Fruit Fly (A) "Good"harvest

Figure 8. No infestation or

Figure 9. Infestation by Melon Fruit Fly (B) Fruit Fly on fruits

Figure 10. Infestation of Melon (after dissection)

T1- Untreated

T3- AICON at 10 ml/L water

T2- AICON at 15 ml/L water

T4- AICON at 5 ml/L water

Figure 11. Bitter Gourd sample plants from different treatments after first application at Location 1: Kapatagan, Digos City

T1- Untreated

T3- AICON at 10 ml/L water

T2- AICON at 15 ml/L water

T4- AICON at 5 ml/L water

Figure 12. Bitter Gourd sample plants from different treatments taken last April 20, 2023, at Location 1: Kapatagan, Digos City

T1- Untreated

T3- AICON at 10 ml/L water

T2- AICON at 15 ml/L water

T4- AICON at 5 ml/L water

Figure 13. Bitter Gourd sample plants from different treatments taken on May 03, 2023, at Location 1: Kapatagan, Digos City

T1- Untreated

T3- AICON at 10 ml/L water

T2- AICON at 15 ml/L water

T4- AICON at 5 ml/L water

Figure 14. Bitter Gourd sample plants from different treatments from the first treatment application at Location 2: Purok Narra, Sto. Tomas, Davao del Norte

T1- Untreated

T3- AICON at 10 ml/L water

T2- AICON at 15 ml/L water

T4- AICON at 5 ml/L water

Figure 15. Bitter Gourd sample plants from different treatments taken after the fourth treatment application at Location 2: Purok Narra, Sto. Tomas, Davao del Norte

Figure 16. Good or marketable fruits fruits

Figure 17. Unmarketable

Figure 18. Unmarketable

Figure 19. After dissection

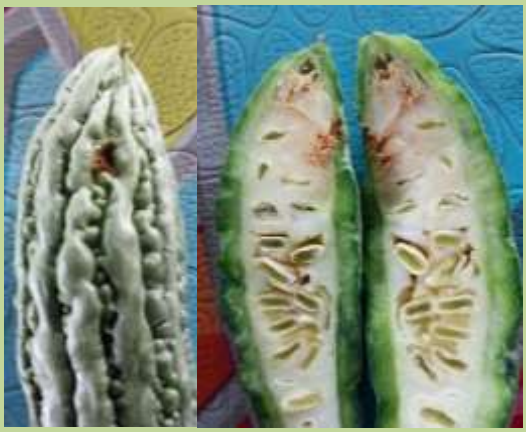

Figure 20. Damaged fruit caused by Melon Fruit Fly

Figure 21. Larvae inside the fruits

Figure 22. Curling caused by mites infestation

T1- Untreated

T3- AICON at 10 ml/L water

T2- AICON at 15 ml/L water

T4- AICON at 5 ml/L water

Figure 23. Mites infestation as shown in the sample plots per treatment

Figure 24. Good fruits (left) and fruit fly-infested fruits