Integrated Management of Fruit Fly and its Impact on Yield of Crops with Effective Microorganisms (A Case Study)

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***Abstract** : Fruit fly is a serious problem all over the world and research is carried out to develop methods for the insect pest. Most methods currently in use attract the male flies. However development of a technology using Effective Microorganisms indicated the possibilities of attracting female flies, which cause the most significant damage by laying eggs. This cost effective technique and results of this project are discussed.*

Introduction

Melon Fly *(Bacterocera cucubitae)* was introduced to Hawaii from Japan in 1985. It has been recorded from more than 80 different host plants, including tomato, peppers, watermelons, cantaloupe, pumpkin, beans, eggplant, cucumber, squashes and passion fruit (Culliney, 2002). Eggs are inserted into fruit in bunches of 1 to 37 and hatches in 26 hours or more. Larvae feed in fruits. Fruit develop water-soaked appearance and saprophytic organisms rot fruit. Adults feed on nectar, plant sap and juices from damage or decaying fruit. Adults have bright yellow stripes on the dorsum, and the secutellum is yellow. Wings have a dark brown stripe up the tip of the wing and other patterned areas on the wing (Marsden, 1979). Oriental fruit fly *(Bacterocera dorsalis)*, a major fruit fly pest in Southeast Asia, was found on Oahu in 1946 and quickly spread throughout the islands. Over 90 plants have been recorded as hosts. In Hawaii, citrus, mango, papaya, guava, banana, and avocado are among the most important commercial crops attacked.

A case study to determine effectiveness of different bait lures was held at the Hamamoto farm on November 2000 to January 2001. The farm is located in Mountain View, on the island of Hawaii at an elevation of 800 feet and located near Kilauea volcano. Mr. Kert Hamamoto has over 30 years of farming experience. He has worked with the United States Department of Agriculture (U.S.D.A.) in the past and recently accepted a part-time position with the U.S.D.A.

Mr. Hamamoto grows various diversified crops such as peppers, eggplants, green onions, cabbages, cucumbers and Italian squash commonly called zucchinis. Over the past 20 years of farming at this location, Mr. Hamamoto has been changing his approach to low sustainable input of chemical fertilizers and pesticides. One and a half years ago, EM was introduced by a representative for United Horticultural Supply an authorized EM dealer in Hawaii.

United Horticultural Supply is a division of United Agri Products - A Conagra Company that is part of a diversified, international corporation operating across the entire food chain of products and services. To reduce the concerns from some farmers in Hawaii, United Horticultural Supply and Dow Agrosciences approached Mr. Hamamoto to see if he could test their product GF-120. This product, jointly developed by the United

States Department of Agriculture ARS and Dow Agrosciences, is intended for use by government agencies or in production agriculture in eradication and prevention programs. Mr. Hamamoto set up an experimental design to test this product among other fruit fly baits for its effectiveness in the field at no cost for his time and labour.

Materials and Methods

Melon fly *(Bactrocera cucurbitae)* and Oriental fly *(Bactercera dorsalis)* were raised from discarded Italian squash (zucchini) and papayas in an augmentorium tent supplied by the University of Hawaii. Different bait traps were set in the tent to check for its effectiveness before testing them in the field. GF-120 was also sprayed and tested. Six experimental treatments were designed, spaced 1,000 feet apart. 8 rows of the Italian squash variety -"spineless beauty" were planted in each treatment. Ti leaf plants and sugarcane bordered each treatment. Cuelure (male attractant) was placed at each corner of the border and three Nulure bottle traps (female attractant) were placed in strategic places in the middle of the treatment.

Treatment 1 — Control - No spray applications

Treatment 2 — Nulure combined with Malathion was sprayed on top and underside of sugarcane and Ti leaves starting the second week of harvest on a weekly basis.
* Normal procedure as recommended by U.S.D.A. and University of Hawaii

Treatment 3 — GF-120 was sprayed on top and underside of sugar cane and Ti leaves starting at 2nd week of harvest on a weekly basis.
* Normal procedure as recommended by U.S.D.A. and University of Hawaii

Treatment 4 — In addition to the 4 Cuelure bottle traps at the borders, 4 different bottle traps were placed 20 feet apart in the field

Nulure bottle trap	1,3,5,7
EM-1 bottle trap	2,4,6,8
226 (fruit extract) bottle trap	9,11,13,15
227 (vegetable extract) bottle trap	10,12,14,16

Bottle traps were made from recycled plastic soda bottles with holes cut on two sides and filled with respective baits. Bottle traps were hung at a height of 3 feet on poles with recycled wire.
* No spraying was conducted

Treatment 5 — Nulure combined with Malathion was sprayed on the outside edge of Italian squash plant leaves.
* Application method developed by Mr. Hamamoto.

Treatment 6 — GF-120 was sprayed on the outside edge of Italian squash plant leaves.
* Application method developed by Mr. Hamamoto

Italian squash was harvested every 2 days, from 26 November 2000 to 14 January 2001. Mature Italian squash were harvested then separated by non-infested and infested, and weighed.

Results

Figure 1 shows the total weight of non-infested yield of 6 different treatments. Yield of the control plot was mostly infested. Figure. 2 shows the percentage of yield infested by fruit flies. Treatment 4 with various bottle traps including EM-1 indicated the first percentage decrease in the infested yields. Figure. 3 shows the cost comparison on 3 treatments (bottle traps, GF-120 spray and Nulure with Malathion spray). The cost of 5 types of bottle trapsincluding EM-1 traps added up to $110 for 50-day-period. This amount is only one fourth of the other two treatments. Figure. 4 shows the comparison of the total count of fruit flies within the 5 types of bottle traps. EM-1 traps were as effective as the others in trapping both male and female flies.

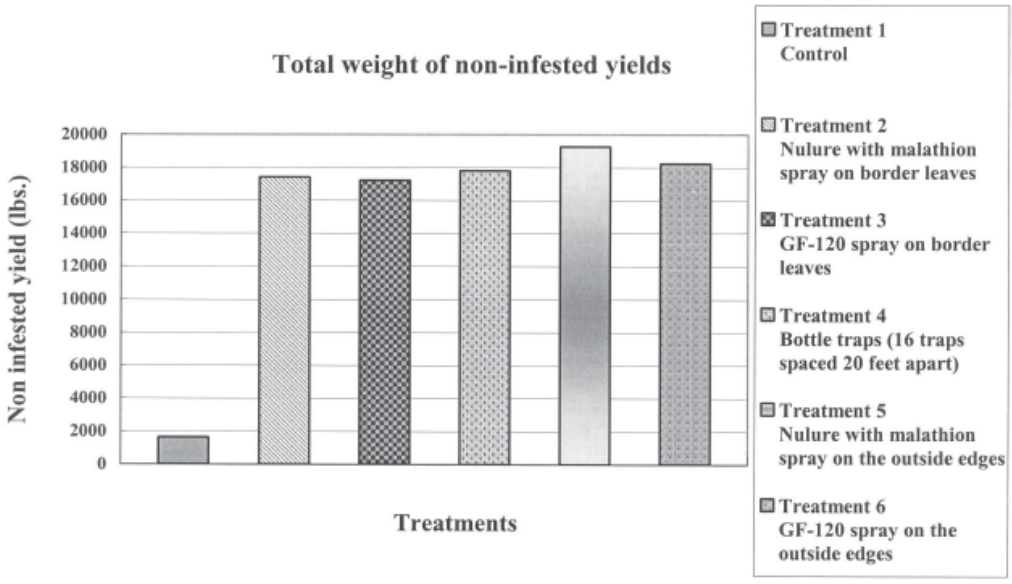

Figure 1. Measurement of Total Weight of Non Infested Yield of Italian Squash

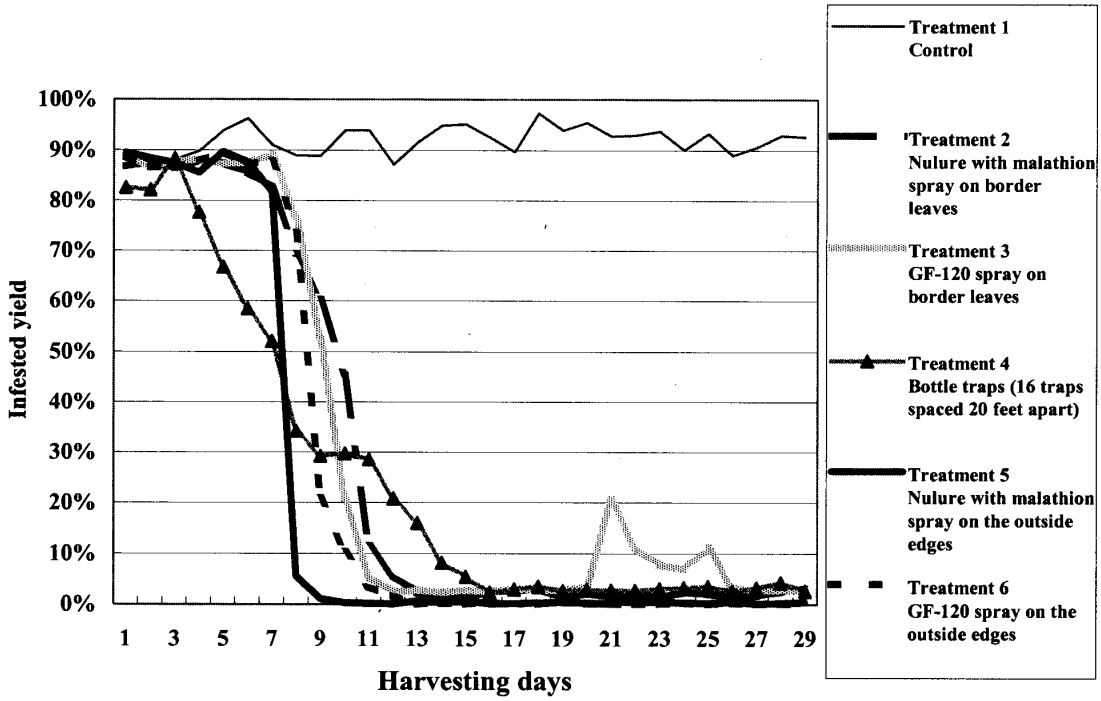

Figure 2. Percentage of Italian Squash Yield Infested by Fruit Flies (data taken from 11/26/00 to 1/14/01)

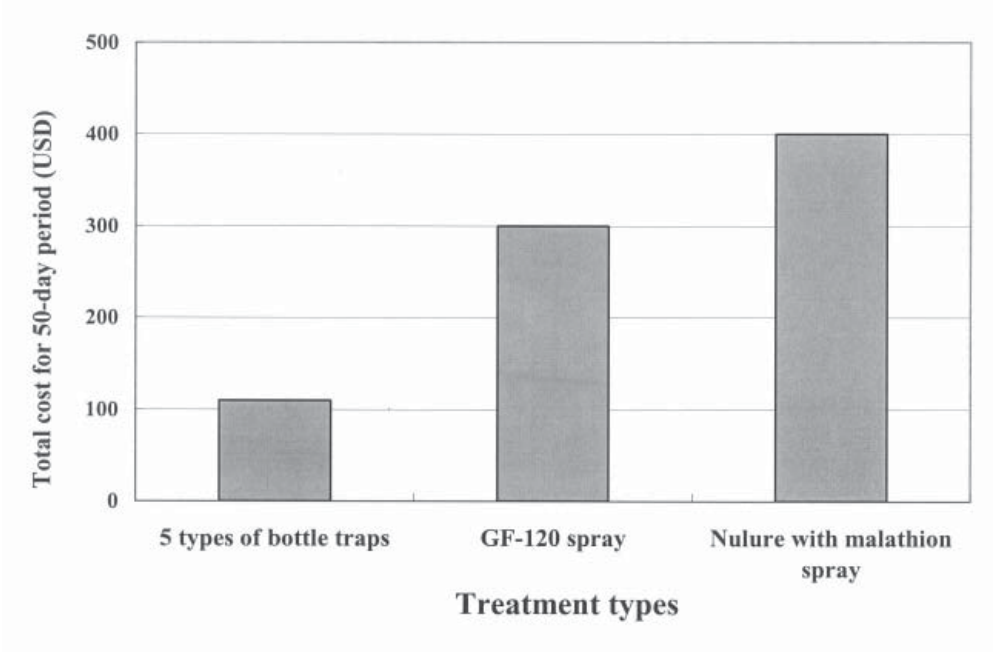

Figure 3. Cost Comparison in three Separate Treatments

Cost of 5 types of bottles traps: Approximately $110 total

Cuelure	**$ 30**
Nulure	**$ 50**
EM-1	**$10 or less using extended EM-1 at (10%)**
Fruit extract	**$10**
Vege extract	**$10**

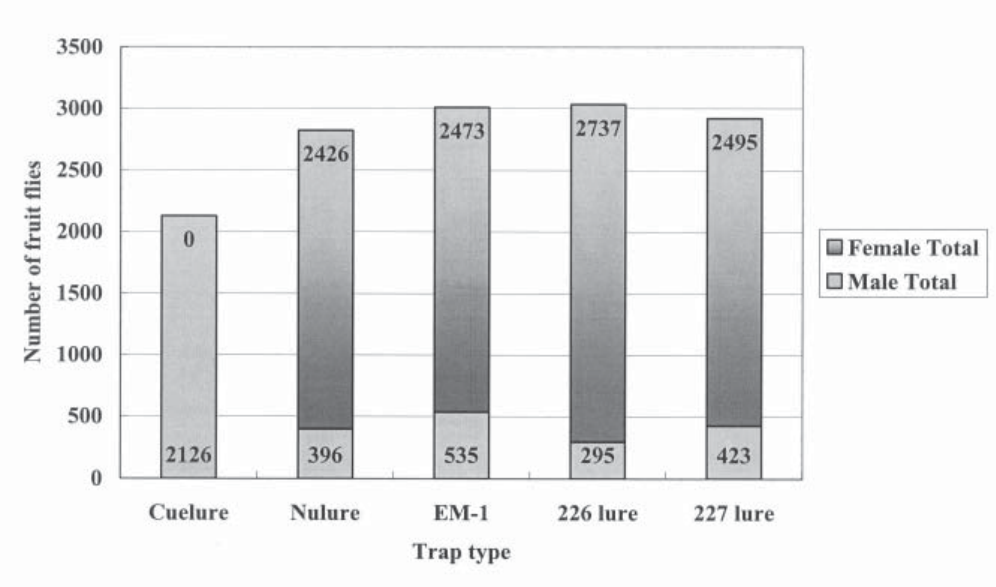

Figure 4. Comparing the Total Count of Fruit Flies with Five Types of Bottle Traps (Treatment 4)

Discussion and Conclusion

Melon Fly *(Bacterocera cucubitae)* and Oriental fly *(Bactercera dorsalis)* specie and others in this family are considered major agricultural pests. In this case study, it was found that using bottle traps alone was sufficient to maintain higher yields of non-infested Italian squash, when compared to standard spray practices using conventional pesticides combined with fruit fly baits.

A cost comparison also shows that the Nulure combined with Malathion spray was the most expensive. GF-120 was the next expensive spray. The bottle trap method was the least expensive. The results show the bottle traps were also successful with no weekly spray treatments needed requiring less man hours and labour costs.

Another phenomenon found in this case study is that in comparison to fruit fly baits that are commercially available, EM-1 proved very effective in attracting melon flies, the majority of which were female. This is very significant, considering it is the female fruit fly by depositing its eggs leads to fungal and bacterial rot as well as larvae damage. Therefore, the advantages of using EM-1 as part of an integrated management program include its use as fruit fly bait, which is both cost effective and environmentally safe. This case study indicates that applying EM Technology for pest control in plant production systems can yield successful results. To further the study in this area, we encourage further research in other countries and on other crops.

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