The Journal of Plant Protection Sciences, **3**(1) : 44 - 47, June, 2011

Control strategies of papaya mealybug, *Paracoccus marginatus* Williams & Willink infesting vegetable crops in Bangladesh

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A B S T R A C T

The papaya mealybug, *Paracoccus marginatus* (Williams & Willink) colonize the ventral surface of the papaya leaves along the veins and later disperse to the unripe fruits rendering them unmarketable and inedible. The damage appeared to be in the range between 70 and 95 per cent. Generally young plants die due to heavy infestation and colony formation of the mealybug. *P. marginatus* is a polyphagous pest attacking several agricultural, horticultural crops, ornamental plants and weeds of economic value. The papaya mealybug feeds on the sap of the plants by inserting its stylets into the epidermis of the leaf as well as into the fruit and stem. In doing so, it injects a toxic substance into the leaves. The result is chlorosis, plant stunting, leaf deformation, early dropping of the leaves and fruits, a heavy accumulation of honeydew and death of the host plants. Heavy infestation is capable of making fruits inedible due to the deposition of thick white waxy material by this mealybug. Five biopesticides i.e., tobacco medicine (100 %), tobacco leaf extract (20 %), mehgoni seed oil (5 %), castor seed oil (5 %) and neem seed oil (5 %) were used to assess their effects on the mortality of *P. marginatus* . It is evident that tobacco medicine exerted the best result in terms of control followed by neem seed oil, mehgoni seed oil, castor seed oil and tobacco leaf extract (20 %).

Keywords:Papaya mealybug*, Paracoccus marginatus,* control measures, bio-pesticide use, vegetable crops,Bangladesh.

Introduction

The papaya mealybug colonize the lower side of the papaya leaves along the veins and later move to the unripe fruits rendering them unmarketable and unfit for human consumption. *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae), a pest in Central America and the Caribbean was noted to have established in Palau during March, 2003 and was causing serious damage to papaya and other plants. Chemical control is only partially effective and requires repeated applications. The chemical insecticides such as profenophos 50EC (2 ml/litre), chlorpyriphos 20EC (2ml/litre), buprofezin 25EC (2ml/litre), dimethoate 30EC (2ml/litre), thiamethoxam 25WG (0.6 g/litre), imidacloprid 17.8 SL (0.6 ml/litre) are recommended as the last weapon in the suppression of this mealybug (Anonymous 1999, 2003).

Active ingredients in registered pesticide formulation include acephate, carbaryl, chlorpyrifos , diazinon , dimethoate , malathion and white mineral oils. Typically, twice the normal dose is applied when treating for mealybugs because mealybugs are protected by thick waxy material, and often are concealed inside damaged leaves and buds. Thus, chemical controls are only partially effective and require multiple applications.

Furthermore, problems of insecticide resistance and effects on the natural enemies make chemical control a less desirable option to combat the papaya mealybug. Natural enemies of the papaya mealybug include the commercially available coleopteran predator namely *Cryptolaemus montrouzieri*, lady bird beetles, lacewings and hover-flies, which are all generalist predators but have potential impacts in the suppression of mealybug population. In addition to predators, several hymenopteran parasitoids may attack papaya mealybug. The present paper deals with the different control measures of papaya mealybug, *P. marginatus*

causing heavy damage to the unripe papaya fruits and vegetable crops of economic importance in Bangladesh.

Materials and Methods

P. marginatus was collected from papaya leaves and unripe papaya fruits and other host plants in the Vegetables Research Field of Bangladesh Council of Scientific & Industrial Research (BCSIR) from April to September 2011 with the help of fine and soft camel hair brush and forceps for the experimental purposes. During survey of this mealybug, the parameters considered were: temperature, relative humidity, photoperiod, rainfall etc.

Different nymphal stages, male and female adults of *P. marginatus* were collected randomly from papaya plants at fortnightly intervals. The collected specimens were kept in different glass vials and small petri dishes (6 cm diameter). Some beneficial hymenopteran insect parasitoids associated with *P. marginatus* belonging to Encyrtidae and Braconidae and other insects found in association with this mealybug were preserved in 80% alcohol with a drop of glycerine. The insects were mounted temporarily on slides in lactophenol and permanent mounts were also made for study purposes.

During study period, five different kinds of indigenous plant materials or bio-pesticides were sprayed to the crop fields to find out their effects in the suppression of *P. marginatus*. The biopesticides applied were: 1) Tobacco medicine (100%); 2), Tobacco leaf extract (20%); 3), Mehgoni seed oil (5%) ; 4), Castor seed oil (5%) 5), Neem seed oil (5%) and an untreated control was maintained for comparison.

For preparation of tobacco medicine, 200 gm of dried tobacco leaf were immersed into 1 litre of water for 24 hours. Then this water extract of tobacco was mixed with 2% calcium carbonate. Now, this extract is termed as Tobacco Medicine (100%). Mehgoni, Neem and castor seed oils were purchased from market and applied to papaya and other vegetable plants after making desired percentage/doses with plain water and soap. Many insects including small and big black ants were found along with *P. marginatus*.

Results and Discussion

The control measures of papaya mealybug were evaluated into two main categories which are in the headings; a) Bio-pesticide Control Approach of *P. marginatus* and b) suppression of papaya mealybug through hymenopteran natural enemies

A. Biopesticide control approach of P. marginatus

In this part, effects of some bio-pesticides on the mortality of nymphal and adult stages of *P. marginatus* have been estimated. The potential bio-pesticides which were selected for study were: tobacco medicine, tobacco leaf (with stalk) extract, neem seed oil, mehgoni seed oil and castor seed oil. Regular monitoring of papaya and other crops for incidence of papaya mealybug and its natural enemies were conducted. Bio-pesticide application was started immediately after noticing mealybugs on some papaya plants in the field conditions.

Biopesticides or botanicals such as neem seed oil (5%), mehgoni seed oil (5%), castor seed oil (5%), tobacco Medicine (100%), tobacco leaf extract (20 %) were sprayed at fortnightly intervals to the affected leaves, ripe and unripe fruits of different vegetable crops and papaya plants containing *P. marginatus* infestation . Four immature fruits were plucked that were earlier sprayed with MO (5%) at the end of April, 2011. The fruits were not palatable because of severe attack of mealybug. Observations were made after 24 hours to determine the effect of

these bio-pesticides on the mortality of the mealybugs.

The mortality of mealybugs in different treatments were counted and recorded carefully on papaya leaves and fruits at an interval of 3 days. The effects of different bio-pesticides on the mortality of *P. marginatus* are presented in Table 1.

The highest mortality of *P. marginatus* (93.43%) was observed in Tobacco Medicine (100%) concentration followed by 90.11% , 80% , 78.92% and 68.37% in Neem seed oil, Mehgoni seed oil and castor seed oil and 20% dried tobacco leaf extract respectively. All papaya leaves under observation period were fresh and greenish in appearance. Mealybug control often involves control of attendant ants which are important for proper development of mealybugs. Without the ants, mealybug population is small and slow to invade new areas and the field would be free from severe mealybug attack. Therefore, management of mealybugs often includes the control of different ant species**.**

For management of mealybugs, it is important to know the species present as management programmes for various mealybugs may differ. Plant protection products are of limited effectiveness against mealybugs because of the presence of waxy covering of its body. Management strategies of *P. marginatus* usually involves the following approaches. The

Table 1
Effects of some bio-pesticides on the mortality of nymph and adults of *P. marginatus* attacking papaya fruits

Bio-pesticides applied	Stage	Pre-treatment count	Post-treatment count		Mortality % over pre-treatment count
			Living	Dead	
Dried tobacco medicine 100%	Adult	7	1	6	93.43%
	Nymph	267	17	250	
	Total	274	18	256	
Dried tobacco leaf extract 20%	Adult	44	26	18	68.37%
	Nymph	275	75	200	
	Total	319	101	218	
Mehgoni seed oil 5%	Adult	1000		1000	80%
	Nymph	4000	1000	3000	
	Total	5000		4000	
Castor seed oil 5%	Adult	15	9	6	78.92%
	Nymph	208	38	170	
	Total	223	47	176	
Neem seed oil 5%	Adult	42	5	37	90.11%
	Nymph	49	4	45	
	Total	91	9	82	
Control plant	Adult	150	150	150	0%
	Nymph	600	600	600	
	Total	750	750	750	

strategies given below are based on previous findings and own observations.

- Monitoring and scouting are needed to detect early presence of the mealybug
- Pruning of infested branches and burning them.
- Removal and burning of crop residues
- Removal of weeds/alternative host plants like papaya, hibiscus, parthenium etc. in and nearby crops
- Avoiding the dispersal of planting material from infested area to other locations
- Avoiding irrigation up to the top levels of the lands
- Prevention of the dispersal of ants and destruction of already existing ant colonies
- After pruning, the cuttings of infested shrubs or trees lying around should be immediately burnt
- Shaking of the infested material is prohibited
- Proper phyto-sanitation of planting material, harvested produce etc, before moving to other states is necessary
- Intensive regular survey should be made to find out efficient parasitoids/predators/ pathogens of *P. marginatus*, if occurs any
- Chemical insecticides spraying restriction unless mealybug infestation is confirmed. Unnecessary spraying may destroy natural enemies which keep mealybug population under control
- Sterilization of farm equipments to be performed before using them to the uninfected crops.

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