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Cost and Benefit Analysis of Different Integrated Pest Management Strategies for Mango Production

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Abstract

Eight integrated pest management strategies (including farmer's practice) against major pests of mango were evaluated and compared based on cost and return analysis from January to June 1996 at the Central Mindanao University Mango Orchard in Bukidnon. Based on protection provided against pests, yield, net income and return of investment (ROI) obtained, IPM 7 (spraying based on economic threshold level, ETL + bagging), IPM 4 (pruning one month before flower induction + spraying based on ETL + bagging), [PM 1 (pruning one month before flower induction + fungicide + spraying based on ETL + bagging) and IPM 6 (fungicide + spraying based on ETL+ bagging) are recommended since these IPM strategies gave similar marketable yields ranging from 59.3 to 66.9 kg net incomes ranging from P774.69 to P872.86 and ROT's ranging from 658.33% to 739.59%. Data were obtained from 100 sample panicles per tree. Without sanitary pruning and bagging of fruits, mango yield, net benefit and ROI considerably decreased even if recommended pesticides were applied. Calendar spraying with recommended fungicide and insecticide may provide better protection of mango flowers and fruits from fruit flies, leafhoppers and anthracnose but this strategy was more expensive resulting in very low to negative net returns.

Keywords: economic threshold level, anthracnose, mango leafhopper, return of investment, fruit fly

Introduction

Mango, *Mangifera indica* Linn. is one of the most delicious, important and sought-after fruits in the world. It is widely distributed among Asian and European countries and this is largely due to commerce which started in the 16th century. It was introduced in the Philippines during the 17th century (Valmayor, 1962). According to Valmayor (1962), the taste of the best variety of mango is rich, savory and spicy with perfect blending of sweetness and acidity while fruits of inferior varieties are often fibrous and unpleasantly acidic that sometimes prejudice the consumer against all mangoes. In the Philippines, the Carabao mango, better known as "Manila Super"

is one of the world's finest varieties produced in the country for export to Japan, Hongkong, Singapore, Middle East (Cabahug, 1994), British Pacific Islands and Canada (PCARRD, 1978). Most Filipinos love to eat mango and in terms of consumption, this fruit ranks second to banana because the latter is cheaper and more abundant. In terms of production, mango ranks third among Philippine fruit crops (Greenfields, 1984). A major problem besetting the mango industry is insect pest and diseases that considerably reduces fruit production. Yield reduction is tremendous during the last decade due to insects and diseases (Golez and Bignayan, 1993). Insect population buildup and the development of insect strain resistant to insecticides are particular problems besetting mango growers as well the excessive use of chemicals leading to excessive dosage and cocktail mixtures aggravate the problem. The production of quality mangoes for export or for domestic use does not only require the use of suitable flower inducer to induce flowering at the right time, but also the adequate protection of the plant, particularly its flowers and fruits from destructive insect pests and diseases that considerably reduce fruit production. The tree is susceptible to pest infestation from seedling to the fruit bearing stage. However, the damage inflicted by some insects are not as serious as the others. Presently, pest control is still oriented towards the use of chemicals, although exporting countries require strict pesticide residue regulations. The use of a single control method in combating pests is not enough to effectively manage pests. The introduction of the integrated pest management is an ecologically sound approach but its adoption by farmers is not without difficulty due to lack of available technology and education on its utilization in the farm level. Integrated pest management involves the application of all suitable measures and techniques in as compatible a manner as possible to maintain the pest population at a level below that which causes economically unacceptable damage or loss. It is an integrated approach that combines where appropriate, physical, mechanical, biological, modified cultural methods, planting of resistant plants and judicious use of chemical pesticides with the goal of attaining the long-term control and minimum risks to humans, natural enemies, non-target organisms, and the environment. It aims to increase yield and maximize profit while reducing the total cost of production. Satisfactory control of pests has been obtained with a number of synthetic pesticides- Several insecticides were found superior in controlling mango leafhoppers (MLH) (Palo, 1932; Bato, 1978; Nachiappan, 1982; Corey, 1986). Likewise, fungicide is extensively utilized against fungal diseases of mango (Bergonia and Diloy, 1974; Pordesimo, 1979; Jacobs et al., 1973; Sangchote, 1987). Pruning, light trapping, thinning and early flower induction are also recommended against insects which are immune to insecticides (Bato et al., 1983). Pruning results in an increase in yield by 20 to 35% (Covacha, 1982). Bagging, in which young fruits are enclosed in bags made of water-resistant paper, (Bondad, 1985) prevents pest problems after fruit set. Aside from reducing the cost of pesticide sprays, it provides protection when the fruits are packed after harvest (Bondad, 1980). Bagging is also effective for cacao, banana and other important fruit crops against pests. Wrappers or bags serve as physical barrier that prevents pests from coming in contact with the fruit (Ortega, 1979). Unfortunately, only few studies had been conducted about integrating different pest management strategies to determine the best

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mix of pest control tactics for mango production in line with cost effectiveness and efficiency.

Materials and Methods

The materials used in this study were: a knapsack sprayer, a pair of pruning shears, newsprints, baskets, foliar fertilizer (Crop Giant liquid with boron + calcium), ftngicide (Dithane M-45), and insecticides (Trebon, Confidor).

The randomized complete block design with three replications was used with a total of 24 mango trees as sample frees. Treatment combinations were as follows:

IPM 1 Pruning + fungicide + spraying insecticide at economic treshold level (ETL) using sequential sampling + bagging
IPM 2 Pruning + calendar spraying with insecticide + fungicide
IPM 3 Pruning + fungicide + bagging
IPM4 Pruning + spraying with insecticide at ETL using sequential sampling + bagging
IPM 5 Fungicide + calendar spraying with insecticides, no foliar fertilizer (farmer's practice)
IPM 6 Fungicide + spraying insecticide at ETL using sequential sampling plan + bagging
IPM 7 Spraying insecticide at ETL using sequential sampling + bagging
IPM 8 No foliar fertilizer, no pruning and no spraying of fungicide and insecticide (Untreated control)

Twelve- to fifteen-year-old mango trees were used in this study. These were weeded and labeled properly based on the treatments. Sanitary pruning was done before the start of the rainy season (April). All branches that cannot be reached by sunlight were removed and those that were aggregated or overcrowded were likewise pruned. The trees were induced to flower when the leaves were brittle when crumpled by hand and when no sign of active bud growth of dormant bud was exhibited.

Where called for, trees were sprayed with foliar fertilizer at recommended timing and intervals. Calendar spraying with insecticides was done at 7 days interval from a day after floral bud formation until 35 days and at 14 days interval thereafter until 2 weeks before harvest.

Spraying with insecticides based on economic threshold level (ETL) of 3 leafhoppers per panicle was done using sequential sampling plan (Corey, 1989). Specified fungicide was mixed every time insecticide was sprayed.

Harvesting was done 125 days after flower budbreak (DAFBB). Yield data was obtained from 100 random sample panicles per tree (3 mango trees/treatment) to maximize the discrepancy that different mango trees do not produce the same number of fruits per tree even if induced with the same flower inducer and foliar fertilized with

the same material.

The collecting baskets were lined with old newspaper to avoid and prevent contact with the rough side of the containers. Harvesting was done between 9:00 a.m. to 3:00 p.m. to avoid excessive latex exudation.

Cost and return analysis were computed using the formula below:

Net income/treatment = Gross income/treatment — total cost of production/ treatment

Gross Income = Total yield (kg)/treatment x market price/kg.

$$\text{Return of Investment (ROI)} = \frac{\text{Net Income}}{\text{Cost of production}} \times 100$$

The cost of production included expenses in pruning, flower induction, chemical control, fertilizer application, bagging of fruits and harvesting. Miscellaneous expenses included cost of crates and newspaper.

Results and Discussion

Mean weight of marketable fruits was obtained by weighing the sound fruits with no appreciable quality defects. Fruit trees treated with [PM l, significantly gave the most marketable fruits while trees given [PM 3 and IPM 8 treatments did not yield any fruit due to insect pest attack.

Based on cost and return analysis, some of the integrated pest management strategies evaluated exhibited negative net incomes (Table I). It was only in trees treated using IPM 1, IPM 4, IPM 6, and IPM 7 that provided profitable net incomes. IPM 3, IPM 5 and IPM 8 resulted in negative net incomes.

IPM 1 gave the highest net income of P 872.86 followed by IPM 6 with P 847.34, IPM 7 with P 831.52, IPM 4 with P 774.69 and IPM 2 with 93.20. However, trees treated based on IPM 7 had the highest return on investment (ROY) of 739.59% followed by IPM4 with 679.88%, IPM 1 with 665.85% and [PM 6 with 658.33%.

Based on the results, high population of mango leafhoppers caused tremendous losses in mango production. Calendar spraying with recommended insecticide reduced population density of mango leafhoppers. However, such control method is quite expensive, not to mention the environmental pollution it creates and hazardous effects to the applicators and non-target organisms.

Low cost of production with high net income is an important consideration in crop production business. Integration of some cultural practices such as pruning,

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bagging and spraying insecticide based on economic threshold level of three leafhoppers per panicle reduced the frequency of insecticidal application, which eventually reduced production costs.

Table 1. Cost and return analysis of different integrated pest management strategies against major insect pests and disease of mango, January to June 1996

Treatment	Weight of Fruits[1] (kg)	Gross Income[2] (P)	Expenses[3] (Pesos)				Net Income (P)	ROI (%)
			Labor	Chemical	Misc.	Total		
IPM 1	66.93[A]	1,003.95	24.28	96.48	10.33	131.09	872.86	665.85
IPM 2	19.33[E]	298.95	37.98	159.44	8.33	205.75	93.20	45.30
IPM 3	0[G]	0	35.43	48.13	2.00	85.56	(-85.56)	---
IPM 4	59.30[D]	889.50	24.28	80.20	10.33	114.81	774.69	679.88
IPM 5	11.73[F]	175.95	35.80	140.43	8.33	184.56	(-8.61)	---
IPM 6	65.07[B]	976.05	21.90	96.48	10.33	128.71	847.34	658.33
IPM 7	62.93[C]	943.95	21.90	80.20	10.33	112.43	831.52	739.59
IPM 8	0[G]	0	1.19	2.00	---	3.19	(-3.19)	---

[1]Based on 100 sample panicles per tree, Means with common letters are not significantly different at P=0.05 using DMRT

[2]Based on P 15/kg price

[3]Prorated expenses based on 100 sample panicles per tree

Summary, and Recommendations

Economic analysis showed that IPM I provided the highest net income of P 872.83 per 100 sample panicles. This was followed by IPM 6 with P847.20, IPM 7 with P 831.53 and IPM 4 with P 774.69 per 100 sample panicles per tree. Trees treated using IPM 7 had the highest return of investment (ROI) of 739.66% followed by IPM 4 with 675.29%, IPM I with 565.83% and IPM 6 with 658.28%. Thus, these 4 integrated pest management strategies are recommended to boost mango fruit yield and profit. Without pruning and bagging of fruits, yield and net income would decrease even if recommended fungicides and insecticides were applied at ETL.

Calendar spraying with insecticide and fungicide may provide better protection of mango flowers and fruits from leafhoppers infestation and anthracnose infection but this strategy is very expensive resulting in very low to negative net Incomes.

Literature Cited

Bato, S. M., 1978. The Biology, Ecology and Confrol ofI. clypealis Leth. Ph. D. Thesis. UPLB, Laguna, Phil.

Bato, S.M., F.F. Sanchez and O.P. Malijan. 1983. Integrated Pest Control of Mango Leamoppers. NCPC Leaflet Series No. 10. UPLB.

Bergonia. I-LT. and C.C. Diloy. 1974. Hot Water Treatment Suppresses Anthracnose Black Spot-on Ripe Mangoes. Plant Protection News. 3 (12):164.

Bondad, N.D. 1980. Research Needs to Fill Gaps in Mango Flowering Technology: Bagging. PCARR Special Project Progress Report.

Bondad, N.D. 1985. Mango Bagging. Ani. Husb. and Agric. J. 2(6): 11-14.

Cabahug, L.M. 1994. Underlying Mechanism ofVHT-induced Internal Breakdown of Carabao Mango. Ph. D. Thesis. UPLB, Laguna, Phil.

Corey, F. M. Jr. 1986. Some Ecological Studies and Economic Injury Levels of the Leamoppers (Idioscopus clypealis Leth) of Mango, Mangifera indica. Ph. D. Thesis. UPLB, Laguna, Phil.

Covacha, S. 1982. Pruning Studies in Mango. PCARRD Research Highlights. Los Bafios. Laguna. p.37.

Golez, H. G. and I-LG. Bignayan. 1993. Pest Management for Mango. In:Mango Production and Processing Technologies- PCARRD. Laguna.

Greenfields, 1984. The New Productivity Technology for Mango Farmers. Greenfields

Jacobs, C. J., H.T. Brodick, H.D. Swarts and N. J. Muller. 1973. Control of Postharvest Decay of Mango Fruit in South Africa. Plant Dis. Rep. 57(2): 172176.

Nachiappan, R.M. 1982. Studies on Certain Aspects of Natural Incidence of Mango Leafioppers on Different Varieties of Mango and their Control with Chemical Insecticide. Ph. D. Thesis. Annamalia University, India.

Ortega, V.C. 1979. Bagging of Mango Fruits. A paper presented during the Second National Symposium on Fruits. Dec. 12-14, Cebu City.

Palo, M.A. 1932. Anthracnose and Imported Insect Pests of Mango in the Philippines with a Report on Blossom Spraying Experiment. Phil. J. of Sci. 48:209-235.

PCARRD. 1978. The Philippine Recommends for Mango. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Laguna.

Pordesimo, A.A. 1979. Control of Mango Flower and Fruit Disease. Annual Report.

UPLB-PCARRD Project No. 149.

Sangchote, S. 1987. Postharvest Disease of Mango and their Losses. Kasetsart Journal. 21:81-85.

Valmayor, R.V. 1962. The Mango. Its Botany and Production, UPLB, Laguna.

Appendix Table 1. Labor Cost

Labor Cost (P)						
Treatment	Flower Induction	Pruning	Spraying[1]	Bagging	Harvesting	Total
IPM 1	1.19	2.39	14.33	4.78	1.59	24.28
IPM 2	1.19	2.39	31.85	---	1.59	37.98
IPM 3	1.19	2.39	31.85	---	---	35.43
IPM 4	1.19	2.39	14.33	4.78	1.59	24.28
IPM 5	1.19	---	31.85	---	1.59	35.60
IPM 6	1.19	---	14.33	4.78	1.59	21.90
IPM 7	1.19	---	14.33	4.78	1.59	21.90
IPM 8	1.19	---	---	---	---	1.19

86 pesos /man-day.

[1] IPM1, IPM4, IPM6, IPM7 were sprayed 6x; IPM2, IPM3 and IPM5 were sprayed 10x

Appendix Table 2. Cost of Chemicals

Cost of Chemicals (P)					
Treatment	Inducer[1]	Fungicide[2]	Insecticide[3]	Fertilizer[4]	Total
IPM 1	2.00	16.28	66.79	11.41	96.48
IPM 2	2.00	27.12	111.31	19.01	159.44
IPM 3	2.00	27.12	---	19.01	48.13
IPM 4	2.00	---	66.79	11.41	80.20
IPM 5	2.00	27.12	111.31	---	140.43
IPM 6	2.00	16.28	66.79	11.41	96.48
IPM 7	2.00	---	66.79	11.41	80.20
IPM 8	2.00	---	---	---	2.00

[1] 50g/100 panicles at P 0.04/g

[2] 10.43g/100 panicles at P 0.26/g; at IPM1 and IPM6 were sprayed 6x; IPM2, IPM3, IPM5 were sprayed 10x

[3] 5.48ml/100 panicles at P 2.03/ml; IPM1, IPM4, IPM6, IPM7 were sprayed 6x; IPM2, IPM5 were sprayed 10x

[4] 1.88g/100 panicles at P0.16/g; IPM1, IPM4, IPM6 and IPM7 were sprayed 6x, IPM2, IPM3 were sprayed 10x

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Appendix Table 3. Miscellaneous expenses per tree

Miscellaneous Expenses (P)			
Treatment	Newspaper[1]	Crate[2]	Total
IPM 1	2.00	8.33	10.33
IPM 2	---	8.33	8.33
IPM 3	2.00	---	2.00
IPM 4	2.00	8.33	10.33
IPM 5	---	8.33	8.33
IPM 6	2.00	8.33	10.33
IPM 7	2.00	8.33	10.33
IPM 8	---	---	

[1]0.66kg of newspaper /100 panicles at P 3.00/kg.
[2]1 crate/tree at 25.00/pc.