J Agric Rural Dev ***7****(1&2), 115-120, June 2009* *ISSN 1810-1860*

SCHOOL OF AGRICULTURE AND RURAL DEVELOPMENT
KwI I cjx Dbqb ¯‹j

Available online at
http://www.banglajol.info/index.php/jard

JARD
Journal of Agriculture & Rural Development

Integrated Crop Management to Control Anthracnose (*Colletotrichum gloeosporioides)* of Mango

M. N. A. CHOWDHURY[1*] & M. A. RAHIM[2]

[1]*Spices Research Center, Bangladesh Agricultural Research Institute, Shibganj, Bogra, Bangladesh*
[2]*Department of Horticulture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh*

ABSTRACT

An experiment was conducted to develop an Integrated Crop Management (ICM) practice for controlling anthracnose (Colletotrichum gloeosporioides) of mango with emphasis on non-chemical means and achieving higher yield. The treatments were T_1 = Pruning (P) + Weeding (W) + Spading (S) + Fertilizer application + Garlic Extract (3 times) + Irrigation (14 days interval); T_2 = P+W+S + Fertilizer application +GE (2 times) + Dithane M-45 (one time) + Irrigation (14 days interval); T_3 = P+W+S + Fertilizer application + Bagging (60 days before harvest) + Irrigation (14 days interval); T_4 = P+W+S + Fertilizer application + Dithane M-45 (3 times) + Irrigation (14 days interval) and T_5 = Control (Untreated). It was found that T_4 treated plant resulted the highest (14%) fruit retention per plant followed by T_1 (13.75%). The lowest (8.50%) was obtained from T_5 (control) at 60 DAFS. Treatments T_4 and T_1 produced the highest percentage (94 and 92, respectively) of healthy fruits and the lowest (86%) was obtained from T_5 (control). The highest yield was obtained from T_4 and T_1 treatment (18.88 and 17.47 t/ha, respectively) and the lowest (4.48 t/ha) was found in T_5. The highest (26.50) soluble solid was obtained form treatment T_4 followed by T_1 (25.75) and the lowest (24.00) was recorded from T_5. The highest disease incidence and severity was found in T_5 (66.67% and 3.00%, respectively).

Key words: Mango, integrated management, anthracnose, yield.

INTRODUCTION

In Bangladesh in terms of total area and production of fruit crops, mango ranks first in area and third in production. It occupies 50990 hectares of land and total production is 242605 tons per annum with an average yield of 4.75 tons per hectare (BBS, 2005). But the yield is very low compared to that of India, Pakistan and many other mango growing countries in the world (Hossain and Ahmed, 1994). One of the reasons behind the low yield is diseases caused by fungi, bacteria, nematode, viruses etc. In Bangladesh 18 mango diseases have been reported. Among these nine are major and the rest are minor (Meah and Khan, 1987). The most common diseases of mangoes are anthracnose (*Colletotrichum gloeosporioides)* (Causal fungus), stem-end rot (Causal fungus), powdery mildew (Causal fungus) and mango malformation (Causal agent). Anthracnose one of the most important disease in Bangladesh. It is the major pre and post-harvest disease of the fruit in all mango producing areas in the world. Anthracnose attacks flowers, young fruits, leaves and twigs. It also appears as a storage disease of mature fruits. Symptoms appear as black, slightly

* Corresponding author: Senior Scientific Officer, Spices Research Center, Bangladesh Agricultural Research Institute, Shibganj, Bogra

sunken lesions of irregular shape, which gradually enlarge and cause blossom blight, leaf spotting, fruit staining and fruit rot. In Bangladesh, about 25 to 30% loses (Reza and Kader, 1995) of total production due to anthracnose and stem end rot. The secondary spread is through rain drops. Integrated Crop Management (ICM) is a broad ecological approach to control disease in a compatible manner. It advocates control of the pests and diseases through the combination of several control practice without depending on heavily toxic chemicals. ICM has a holistic approach to crop production based on sound ecological understanding. Indiscriminate use of the chemicals is not only hazardous to living being but disrupt the natural ecological balance by killing the beneficial soil microbe (Ansari, 1995). So, alternatives have to be developed to control anthracnose in order to guarantee safe food production as well as the environment.

The integration of a number of practices with the aim to reduce or eliminate negative side effects caused by chemicals used for controlling major mango diseases is the most realistic option for solving the problem. Field burning of crop residues, soil tillage, fertilization, irrigation, weeding, and other horticultural practices used to control or reduce losses from plant disease can be beneficial to the environment and thereby maintain sound ecological balance (Maloy, 1993). Research work in relation to anthracnose disease management of mango is not so enough. However, the available literature confirming these aspects has been presented. Fruit bagging with brown paper reduce the mango anthracnose reported by Rahman *et al*, 2000. Fruit-bagging at an early stage with soil surface-mulching was the most effective method for the control of mango anthracnose disease and decreased the number of fungicides application required in the field (Ann *et al*. 1998). Diseased twigs and leaves, which fall on the ground, are a potential source of penetration. Such plant debris falling on the orchard should be collected and all infected twigs from the tree should be pruned away and such refuge should be burnt because fungus has long saprophytic survival ability on dead twigs (Singh, 1996). Maintenance of field sanitation, collect and burn fallen fruits and tree trashes are effective to reduce sources of inoculum (Anonymous, 1994). Chauhan and Joshi (1990) reported that Caster oil (5 %), eucalyptus oil (1 %), garlic bulb, ginger, mango, turmeric and lantana leave also significantly controlled the mango fruit anthracnose. Ahmed and Islam (2000) stated that neem and garlic extract were effective against Bipolaris oryzae at 1:1 dilution. Amendments of soil with individual application of mustard oil cake, urea, tripple supper phosphate, muriate of potash, zinc sulphate and calcium sulphate and their mixed application reduced the level of infection of anthracnose on immature guava fruits compared with application of manure's (Hossain *et al*. 1996). Hossain (1994) reported that when the fruits attain the size of "pea" for 3-4 times at an interval of 10-15 days checks fruit dropping resulting satisfactory production. With this view, the present study was undertaken to develop a package of technologies for controlling mango anthracnose; to increase the yield and quality mango per unit area of land and to reduce it's the cost of production.

MATERIALS AND METHODS

The investigation was carried out from July 2002 - July 2003 at Germplasm Centre (GPC), Fruit Tree Improvement Project (FTIP), Department of Horticulture, BAU, Mymensingh. The single-factor experiment was conducted in randomized complete block design (RCBD) with 4 replications. The treatments were T_1 = Pruning (P) + Weeding (W) + Spading (S) + Fertilizer application (CD-10 Kg, urea-250g, TSP-250g, MP-350g, Gypsum- 100g and Zinc sulphate-10g/plant) + Garlic Extract (3 times) + Irrigation (14 days interval); T_2 = P+W+S + Fertilizer application (CD-10 Kg, urea-250g, TSP-250g, MP-350g, Gypsum- 100g and Zinc sulphate-10g/plant) +GE (2 times) + Dithane M-45 (one time) + Irrigation (14 days interval); T_3 = P+W+S + Fertilizer application (CD-10 Kg, urea-250g, TSP-250g, MP-350g, Gypsum- 100g and Zinc sulphate-10g/plant) + Bagging (60 days before harvest) + Irrigation (14 days interval); T_4 = P+W+S + Fertilizer application (CD-10 Kg, urea-250g, TSP-250g, MP-350g, Gypsum- 100g and Zinc sulphate-10g/plant) + Dithane M-45 (3 times) + Irrigation (14 days interval) and T_5 = Control (Untreated). The variety was Amrapali and spacing was 2.5m x 2.5m. The name of the plant extract is Garlic (*Allium sativum*). Ten gram of sample was taken in an electric blender and 100 ml distilled water was added. The concentration was 1:10. The content was macerated and a suspension prepared. The suspension of plant extracts was sprayed individually by hand sprayer. Pruning, weeding and spading were done after fruit harvest, before

flowering and after fruit sets. Irrigation was applied following basin method @ 50 litre of water per plant according to treatment. After harvest ten fresh fruits were selected randomly from each treatment for post harvest study. Disease incidence and severity was calculated at 6, 8 and 10 days after harvest. Horsfall and Barratt (1945) grading scale was used for calculating severity. The recorded parameters were fruit retention per plant (%); total number of healthy fruits per plant (%); total number of diseased fruits per plant (%); disease incidence (%); % surface area infected per fruit; fruit weight (g) Fruit size (cm); Yield/plant; yield (t/ha) and total soluble solids (TSS). The benefit-cost ratio (BCR) analysis was done. The collected data were tabulated and analyzed by a statistical program MSTAT-C.

RESULTS AND DISCUSSION

There was variation in respect of fruit set per inflorescence as influenced by different package treatments (Table 1). It was observed that treatment T_4 produced the highest fruit set per inflorescence while T_5 gave the lowest in this regard. Different package treatments showed significant variation in fruit retention per inflorescence at different days after fruit set (Table 1). The maximum number of fruit retention was obtained in treatment T_4 followed by T_1 (2.40), T_2 and T_3 at 60 DAFS. The lowest was observed in T_5 at same days after fruit set. Significantly the highest fruit retention per plant was recorded from T_4 treated plant followed by T_1, T_2 and T_3 and the lowest was obtained from T_5 at 60 DAFS (Table 1). Optimum dose of fertilizer, sanitation (pruning + weeding + spading), irrigation and spraying of Dithane M-45 combindly reduced the fruit infection, which brought to the highest fruit set and fruit retention per inflorescence and per plant. It was observed that there was a significant effect on the number of healthy fruits per plant (Table 1). Treatment T_4 gave the highest number of healthy fruits per plant followed by T_1, T_2 and T_3 and the lowest was obtained from T_5 at 60 DAFS. Number of diseased fruits per plant in most of the cases was higher in T_4 treatment at different DAFS. The highest number of diseased fruits per plant was recorded from T_3 treated plant and the lowest from T_4 treatment followed by T_1, T_2 and T_5 at 60 DAFS. There was significant difference in total number of fruits per plant among different treatments (Table 2). It was found that total number of fruits per plant was higher (83.00) in T_4 treated plant followed by T_1, T_2 and T_3 and the lowest number was recorded from T_5. The number of fruits per plant was higher in T_4 and T_1 than control. This result might be due to plant attained higher fruit retention and less fruit infection, which led to the higher yield per plant as compared to control. Weight of individual fruit was found significant among the treatments (Table 2). The highest weight of individual fruit was observed in T_5 and the lowest was found incase of T_4. Weight of individual fruit was more in control than T_4 and T_1 treatments. This was possibly due to higher yield per plant in T_4 and T_1 than control, which led to lower individual fruit weight. It was observed that different package treatments had significant influence on percentage of healthy fruits per plant. Percentage of healthy fruits per plant was recorded the highest (94.00) from T_4 treatment followed by T_1, T_2 and T_3 and the lowest was recorded from T_5. Treatments T_1 and T_2 reduced the inocula (conidia) production and fruit infection, which led to the highest number and percentage of healthy fruits per plant and the lowest percentage of diseased fruits per plant.

Table 1. Effect of integrated management on fruit set, fruit retention and disease incidence of mango anthracnose

Treatments	FS/I	Fruit retention/inf. at different DAFS			Fruit retention/plant (%) at different DAFS			No. of healthy fruits/plant (%) at different DAFS			No. of diseased fruits/plant (%) at different DAFS		
		20	40	60	20	40	60	40	50	60	40	50	60
T_1	17.50	6.20	3.40	2.40	35.00	19.50	13.75	91.18	89.58	88.33	8.82	10.42	11.67
T_2	15.00	5.70	2.97	1.95	37.75	19.50	13.50	89.90	88.69	87.18	10.10	12.31	12.82
T_3	16.00	6.05	2.88	1.93	38.50	17.75	12.00	86.12	85.49	84.46	13.88	14.51	15.54
T_4	18.50	8.20	3.67	2.60	44.50	20.25	14.00	93.20	92.31	92.00	6.80	7.69	8.00
T_5	12.60	4.60	1.93	1.05	36.50	15.75	8.50	87.05	85.85	85.71	12.95	14.14	14.29
LSD 5%	3.68	1.18	0.64	0.42	3.47	2.34	2.29	2.27	2.80	3.24	0.95	0.81	1.68
1%	2.62	1.66	0.90	0.60	4.86	3.28	3.22	3.18	3.92	4.55	1.33	1.14	2.35
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**	**

There was highly significant variation among the treatments in respect of percentage of diseased fruits per plant (Table 2). The highest percentage (14) of diseased fruits per plant was found in T_5 (control) and the lowest was found in T_4 treated plant followed by T_1, T_2 and T_3. Healthy fruits yield per plant from different treatments was highly significant. Treatment T_4 gave the highest fresh fruit yield per plant followed by T_1, T_2 and T_3. The lowest (2.80 kg) yield per plant was obtained from T_5 (control) treated plant. Yield of healthy fruits per hectare was found to be statistically significant different due to the different treatments. Among the treatments, the highest yield was obtained from treatment T_4 followed by T_1, T_2 and T_3 and the lowest was found in T_5. These findings might be due to the highest number of fruit per plant, which led to the highest yield per plant and per hectare too. There was significant difference in total soluble solids due to different treatments. The highest soluble solid was obtained form treatment T_4 followed by T_1 and T_3 and the lowest was recorded from T_5. The data relating to cost of production (Table 2) revealed that the highest BCR was obtained from treatment T_4 and the lowest BCR was obtained from T_3 treated plant. From economic analysis of cost of production, it was observed that application of different integrated package treatments, treatment T_4 and T_1 gave the highest return than control. It was due to the fact that treatment (T_4 and T_1) gave the highest yield, which led to the highest return.

Table 2. Effect of integrated management on yield and quality of mango

Treatments	TNF/plant	Wt. of indi. fruit (g)	TNHF/plant (%)	TNDF/plant (%)	Healthy fruits yield/plant (kg)	Healthy fruits yield (t/ha)	TSS	BCR
T_1	75.00	177.00	92.00	8.00	11.42	17.47	25.75	3.38
T_2	70.00	183.00	89.75	10.25	9.20	14.72	24.25	2.88
T_3	64.00	184.00	89.25	10.75	8.70	13.92	21.00	2.28
T_4	83.00	168.00	94.00	6.25	11.80	18.88	26.50	3.85
T_5	21.00	188.00	86.00	14.00	2.80	4.48	24.00	2.21
LSD 5%	4.72	3.45	5.12	2.11	1.42	2.45	1.79	-
1%	6.61	4.83	7.18	2.96	1.99	3.10	2.51	-
Level of significance	**	**	**	**	**	**	*	-

FS/I = Fruit Set per Inflorescence at the initial stage
DAFS = Days after fruit set
Inf. = Inflorescence
* = Significant at 5% level
** = Significant at 1% level
TNF = Total no. of fruits
Indi. = Individual
TNHF= Total no. of Healthy fruits
*= Spacing 2.5 m x 2.5 m
P = Pruning
W = Weeding
S = Spading
GE = Garlic extract
TNDF= Total no. of diseased fruits
TSS = Total Soluble Solid
BCR= Gross return / Total cost of production
Note=Price of mango was considered to be TK 20/Kg

T_1 = P+W+S + Fertilizer application + GE (3 times) + Irrigation (14 days interval)
T_2 = P+W+S + Fertilizer application + GE (2 times)+ Dithane M-45 (one time) + Irrigation (14 days interval)
T_3 = P+W+S + Fertilizer application + Bagging (60 days before harvest) + Irrigation (14 days interval)
T_4 = P+W+S + Fertilizer application + Dithane M-45 (3 times) + Irrigation (14 days interval)
T_5 = Control (Untreated)

Considerable variation was observed in respect of disease incidence due to different treatments (Table 3). The highest incidence was found in T_5 and the lowest from T_4 treated fruits followed by T_1 (10%), T_2 and T_3 at 10 days after harvest. Fruit area diseased influenced by different treatments at different DAH. The highest fruit area diseased was found in T_5 (control) treated fruits and the lowest (0%) fruit area diseased was observed in T_4 followed by T_1, T_2 and T_3. This result was possible for the combined application of different integrated management practices. Therefore, disease incidence and severity was lower in T_4 and T_1 than control.

Among the different package treatments, treatment T_4 and T_1 resulted the highest number of fruit set, fruit retention and number of fresh fruits than control. Optimum dose of fertilizer, sanitation (Pruning + Weeding + Spading), irrigation and spraying of Dithane-M-45 and garlic extract combindly reduced the fruit infection which bring to the highest fruit set, fruit retention and fresh

fruits. Treatment T_4 and T_1 produced the highest fresh fruits yield per plant and per hectare than control. T_4 and T_1 treatments resulted the lowest disease incidence and severity than control. From this above findings it may be concluded that treatment T_4 and T_1 is the best treatments for higher yield and quality mango production.

Table 3. Effect of integrated management on disease incidence and severity of mango

Treatments	Incidence (%) at DAH			Severity/ FAD (%) at DAH		
	6	8	10	6	8	10
T_1	0.00	0.00	10.00	0.00	0.33	0.33
T_2	10.00	13.33	13.33	0.00	0.00	0.67
T_3	10.00	30.00	46.67	0.33	0.67	1.33
T_4	0.00	0.00	0.00	0.00	0.00	0.00
T_5	20.00	53.33	66.67	0.67	2.00	3.00
LSD 5%	2.22	1.71	1.22	0.05	0.15	0.18
1%	3.12	2.40	1.71	0.07	0.22	0.26
Level of significance	**	**	**	**	**	**

** = Significant at 1% level
DAH = Days after harvest
FAD = Fruit area diseased
P = Pruning
W = Weeding
S = Spading
GE = Garlic extract

T_1 = P+W+S + Fertilizer application + GE (3 times) + Irrigation (14 days interval)
T_2 = P+W+S + Fertilizer application + GE (2 times) + Dithane M-45 (one time) + Irrigation (14 days interval)
T_3 = P+W+S + Fertilizer application + Bagging (60 days before harvest) + Irrigation (14 days interval)
T_4 = P+W+S + Fertilizer application + Dithane M-45 (3 times) + Irrigation (14 days interval)
T_5 = Control (Untreated)

ACKNOWLEDGEMENT

The author express their sincere thanks to Swiss Foundation for Development and International Co-operation, Embassy of Switzerland, Dhaka for awarding a scholarship and all logistic supports to complete the study through Fruit Tree Improvement Project (FTIP), BAU-DH.

LITERATURE CITED

Ahmed, M. F. and M. T. Islam. 2000. Efficacy of some fungicides and plant extracts. Against Bipolaris oryzae, M. S. Thesis. Dept. of P. Path. Bangladesh Agricultural University, Mymensingh. 69p.

Ann, P. J., L. S. Lu, T. Y. Chuang and C. W. Kao. 1998. Effect of fruit bagging and mulching on control of mango fruit anthracnose disease. *Plant Path., Bull.*, **7**(1), 19-26.

Anonymous, 1994. The Mango Technical Committee. The Philippines recommends for mango. Los Banos, Laguana: PCARRD and PARRFI, 124p.

Ansari, M. M. 1995. Control of Sheath blight of rice by Plant extracts. *Indian Phytopath*., **48**(3), 268-270.

BBS. 2005. Monthly Statistical Bulletin, Bangladesh (July, 2002). Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning. Government of The Peoples' Republic of Bangladesh. pp. 390-392.

Chauhan, H. L. and H. U. Joshi. 1990. Evaluation of phyto-extracts for control of mango fruit anthracnose. Proc. Nat. Symp., : 455-459.

Doidge, E. M. 1932. Black spot of mangoes. Farming South Africa, **7**, 89-91.

Horsfall, J. G. and R. W. Barratt. 1945. An improved grading system for measuring plant diseases. Phytopath., 35: 655.

Hossain M. D., M. B. Meah and M. A. Kashem.1996. Biochemical changes of guava fruit due to infection of anthracnose as influenced by soil amendments. *Bangladesh J. Plant Path*., **12** (1-2), 33-36.

Hossain, A. K. M. A. 1994. Production Technology of Mango. Horticulture Research Centre, BARI, Gazipur. 122p.

Hossain, A. K. M. A. and A. Ahmed. 1994. A monograph on mango varieties in Bangladesh. HRC-BARI and FAO/UNDP Mango Improvement Project. p. 3.

Maloy, O. C. 1993. Plant Disease Control : Principles and Practices. John Wiley and Sons, INC. NY. pp. 303-318.

Meah, M. B. and A. A. Khan.1987. Survey of diseases of some important fruit and vegetable crops of Bangladesh. Ann. Prog. Rep., (1986-87). pp 1-28.

Rahman, M. M., D. Sarker, J. C. Barman and S. N. Alam. 2000. Bagging practice to control mango fruit fly. Regional Horticulture Research Station, BARI, Nawabgonj. pp. 59-64.

Reza, M. M. A. and K. A. Kader 1995. Efficacy of pre-harvest field sprays of fungicide on the control of anthracnose and stem end rot of mango. Annual Report. Regional Horticultural Research Institute, Nawabgonj. pp 55-58.

Singh, L. B. (1960). The Mango Botany Cultivation and Utilization. The mango Leonard Hill Ltd., London. 230p.