MANAGEMENT OF DISEASES OF INFLORESCENCE OF MANGO

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ABSTRACT

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The present study was carried out for the assessment of suitable management practices of diseases of mango inflorescence incorporating several treatments including fungicide (Indofil M-45), insecticide (Confidor), biological mean (BAU Biofungicide), phytohormones (2, 4-D and NAA) and fertilizer (Urea) which were applied as foliar spray. Disease severity on leaves and inflorescence was recorded highest under control treatment, while lower percentage of diseases was found on the treated plants. Severity of anthracnose of mango on leaves and inflorescence per plant ranged from 2.03% to 2.84% and 0.31% to 2.70%, respectively, where BAU-Biofungicide was found superior to control the disease. Severity of red rust of mango leaves was maximum (2.48%) in control treatment, while the lowest (0.50%) was in BAU Bio-fungicide sprayed plant. The severity of powdery mildew on leaves and inflorescences per plant ranged from 0.00% to 1.89% and 0.32% to 1.54%, respectively. Indofil M-45 was found superior followed by BAU-Biofungicide to control the powdery mildew of mango. Number of mango inflorescence, average width of inflorescence, number of fruits setting, number of dropped fruits and number of healthy fruits were ranged from 0.33 to 2.33, 0.23 to 1.48 cm, 0.84 to 37.50, 0.11 to 1.22 and 0.56 to 23.66, respectively, where BAU-Biofungicide was found superior and Confidor was found good for insect infestation of mango. Considering the overall findings of the study, it was found that, foliar spray of BAU-Biofungicide along with Confidor is suitable for the management of diseases of mango inflorescence.

Key-words: 2, 4-D, BAU-Biofungicide, Mango inflorescence

INTRODUCTION

Mango (*Mangifera indica* L.) is a very popular and delicious fruit in Bangladesh. It is considered as "King of the oriental fruits". It is widely grown all over Bangladesh with the quality mangoes solely concentrated in the north-western areas especially greater Rajshahi, Dinajpur and Rangpur (Karim 1985). Mango ranks third among the tropical fruits grown in the world. The Food and Agriculture Organization (FAO 2014) of the United Nations estimates worldwide production at nearly 37,043,000 tons in 2014. In Bangladesh mango ranks second fruit in terms of area and third in production. Bangladesh produced 889176 metric ton of mango in 67842 acre of mango orchard during the period of 2013-14 (BBS 2014). 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). Although a huge number of farmers are engaged in producing production of mango but they fail to produce quality fruits due to lack of their knowledge about diseases and their management. Moreover, management of mango leaves and inflorescence diseases are neglected most of the times. As a result, most of the orchards in the country are in serious problem of production of healthy fruits. Among the diseases, Inflorescence diseases are important consideration for mango production, because healthy inflorescences are prime need and basic raw material for production of the fruits. Therefore, the present study was carried out for the suitable management practices including fungicides and BAU-Biofungicide for controlling disease inflorescence of mango.

MATERIALS AND METHODS

The experiment was carried out in the orchard of Professor Dr. Ahsan Bin Habib, Bangladesh Agricultural University campus, Mymensingh during the period from January 2015 to May 2015. The soil of the orchard is sandy loam in texture having pH 5.5 to 6.8. Soil color is dark grey due to rich in organic matter content. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Normal agronomic practices and fertilization were used for the study as per recommended dose of Fertilizer Recommendation Guide (BARC, 2012). For the control of inflorescence diseases of mango, nine different

treatments were employed viz. T_1= 2 times irrigation applied in the soil @ 10 days interval, T_2 = 4 times irrigation applied in the soil @ 10 days interval, T_3 =Indofil applied@ 2g/L as foliar spray, T_4 = BAU-Biofungicide applied @ 3% applied as foliar spray, T_5= 2, 4-D applied @ 12ppm as foliar spray, T_6 = NAA applied @ 40ppm as foliar spray, T_7 = Urea applied @ 4% as foliar spray @ 4%, T_8 = Confidor applied @ 0.2 g/L as foliar spray and T_9 = control. The spray solution/suspension was prepared by mixing required amount of chemical or BAU-Biofungicide with tap water and spraying was done with the help of Foot-pump sprayer. Only water was sprayed in case of control plots. Data were recorded on disease severity of leaves, disease severity of inflorescences and fruits, number of panicle and it's branches, length and width of panicles/plant, number of fruit setting/inflorescence, number of healthy fruits/inflorescence and number of diseased fruits/inflorescence at an interval of 10 days. The disease severity was evaluated by the following formula of Johnston (2010).

RESULTS AND DISCUSSION

Disease severity of leaves

The treatments significantly reduced the % severity of anthracnose of mango leaves over control (Table 1). The severity of anthracnose at bloom stage that ranged from 2.10 to 3.07%, where the highest and lowest counts were made in T_9 (Control) and T_6 (NAA applied @ 40 ppm as foliar spray), respectively. The severity of anthracnose at pinheaded stage that ranged from 2.00 to 2.83%, where the highest and lowest counts were made in T_9 (Control) and T_4 (BAU-Biofungicide applied @ 3% as foliar spray),

respectively. Again, the severity of anthracnose at pea stage that ranged from 1.87 to 2.63%, where the highest and lowest counts were made in T_9 (Control) and T_3 (Indofil applied @ 2g/L as foliar spray), respectively. Considering collection of data of all the stages (Bloom, pinheaded and marble stage), the highest (2.84%) severity of anthracnose was recorded in T_9 (control) and the lowest (2.03%) was recorded in T_4 (BAU-Biofungicide applied @ 3% as foliar spray). The findings are also supported by Sathe (2011) and Basak (2013). In case of leaf spot, the treatments significantly reduced the % severity of leaf spot of mango leaves over control. Considering collection of data of all the stages (Bloom, pinheaded and marble stage), the highest (3.12%) severity of leaf spot was recorded in T_9 (control) and the lowest (2.15%) was recorded in T_4 (BAU-Biofungicide applied @ 3% as foliar spray). According to Prabakar *et al.* (2008) *Trichoderma harzianum* inhibit effects in arresting the anthracnose disease causal pathogen *Colletotrichum gloeosporioides.* For red rust, the treatments significantly reduced the % severity of red rust of mango leaves over control (Table 1). Considering collection of data of all the stages (Bloom, pinheaded and marble stage), the highest (2.84%) severity of red rust was recorded in T_9 (control) and the lowest (0.50%) was recorded in T4 (BAU-Biofungicide applied @ 3% as foliar spray). Positive effect of BAU Bio-fungicide and fungicides viz. Mancazeb in controlling diseases of mango has also been reported by Siddiqui *et al.* (1987), Reza and Kader (1995), Akter *et al.* (2002), Mortuza (2007), Sarker (2008) and Chowdhury (2009).

Table 1. Effect of different management practices on % disease severity of leaves of mango

Treatments	% Disease severity of Leaves											
	Anthracnose				Leaf spot				Red rust			
	Bloom stage	Pinheaded stage	Pea stage	Mean	Bloom stage	Pinheaded stage	Pea stage	Mean	Bloom stage	Pinheaded stage	Pea stage	Mean
T_1	2.33 b	2.40 bc	2.55 a	2.42	2.30 b	2.53 bc	2.77 ab	2.53	1.20 c	1.43 c	1.53 b	1.39
T_2	2.32 b	2.50 b	2.60 a	2.47	2.43 b	2.30 cd	2.33 ab	2.35	1.30 c	1.33 c	1.43 b	1.37
T_3	2.30 b	2.10 de	1.87 d	2.09	2.33 b	2.13 d	2.00 b	2.15	0.96 c	0.90 d	0.87 cd	0.91
T_4	2.13 b	2.00 e	1.97 cd	2.03	2.10 b	2.20 cd	2.40 ab	2.27	0.47 d	0.57 e	0.47 d	0.50
T_5	2.31 b	2.33 bcd	2.37 ab	2.34	2.60 ab	2.53 bc	2.33 ab	2.48	1.27 c	1.23 c	1.43 b	1.31
T_6	2.10 b	2.23 bcde	2.60 a	2.31	2.33 b	2.17 d	2.33 ab	2.20	1.25 c	1.33 c	1.40 b	1.33
T_7	2.20 b	2.37 bcd	2.53 a	2.37	2.77 ab	2.80 ab	3.10 a	2.89	1.93 b	2.00 b	2.23 a	2.08
T_8	2.17 b	2.20 cde	2.20 bc	2.19	2.67 ab	2.77 ab	2.97 a	2.79	1.00 c	1.17 c	1.03 c	1.06
T_9	3.07 a	2.83 a	2.63 a	2.84	3.20 a	3.07 a	3.10 a	3.12	2.43 a	2.50 a	2.53 a	2.48
$LSD_{0.05}$	0.242	0.265	0.306	-	0.630	0.311	0.709	-	0.375	0.271	0.351	-
Level of significance	**	**	**	-	**	**	*	-	**	**	**	-

Figures in a column with same letter(s) do not differ significantly.
** = Significant at 1% level of probability
T_1 = 2 times irrigation @ 10 days interval, T_2 = 4 times irrigation @ 10 days interval, T_3 = Indofil M-45 applied @ 2g/L as foliar spray, T_4 = BAU-Biofungicide applied @ 3% as foliar spray, T_5 = 2, 4-D applied @ 12 ppm as foliar spray, T_6 = NAA applied @ 40 ppm as foliar spray, T_7 = Urea applied @ 4% as foliar spray, T_8 = Confidor applied @ 0.2g/L as foliar spray and T_9 = Control.

Disease severity of inflorescence

The treatments significantly reduced the % severity of anthracnose of mango inflorescence over control (Table 2). Considering collection of data of all the stages (Bloom, pinheaded and marble stage), the highest (2.70%) severity of anthracnose of inflorescence was recorded in T_9 (control) and the lowest (0.30%) was recorded in T_4 (BAU-Biofungicide applied @ 3% as foliar spray). In case of powdery mildew, the treatments significantly reduced the % severity of powdery mildew of mango inflorescence over control. Considering collection of data of all the stages (Bloom, pinheaded and marble stage), the highest (1.51%) severity of powdery mildew was recorded in T_9 (control) and the lowest (0.32%) was recorded in T_3 (Indofil applied @ 2g/L as foliar spray). Application of Indofil M-45 followed by BAU-Biofungicide resulted maximum reduction of disease severity of powdery mildew of leaves and inflorescences compared to all other treatments. These findings of the present study has been supported by Anaso and Olatunde (1989), Huq *et al.* (1994), Bernal *et al.* (1998), Nogueira *et al.* (1998) and Prasadji *et al.* (2004).

Table 2. Effect of different management practices on % disease severity of inflorescence of mango

Treatments	% Disease severity of Inflorescence							
	Anthracnose				Powdery mildew			
	Bloom stage	Pinheaded stage	Pea stage	Mean	Bloom stage	Pinheaded stage	Pea stage	Mean
T_1	2.00 b	1.17 c	1.97 b	2.00	0.90 b	1.00 b	1.20 b	1.03
T_2	1.37 c	0.00 f	1.30 c	1.34	1.03 c	0.97 b	1.07 b	1.02
T_3	0.40 ef	0.90 d	0.27 f	0.34	0.33 d	0.30 d	0.23 d	0.32
T_4	0.17 f	0.00 f	0.40 ef	0.31	0.40 d	0.43 cd	0.33 d	0.39
T_5	0.36 ef	1.23 c	0.53 e	0.46	0.43 d	0.50 c	0.53 c	0.45
T_6	0.83 de	1.33 c	0.90 d	0.88	0.40 d	0.33 d	0.63 c	0.46
T_7	2.07 ab	2.50 a	2.30 a	2.18	1.23 b	1.07 b	0.97 b	1.09
T_8	1.17 cd	2.00 b	1.33 c	1.24	1.10 b	1.00 b	0.95 b	1.01
T_9	2.50 a	2.70 a	2.90 a	2.70	1.56 a	1.37 a	1.60 a	1.51
$LSD_{0.05}$	0.447	0.271	0.171	-	0.179	0.143	0.108	-
Level of significance	**	**	**	-	**	**	**	-

Figures in a column with same letter(s) do not differ significantly.
** = Significant at 1% level of probability
T_1 = 2 times irrigation @ 10 days interval, T_2 = 4 times irrigation @ 10 days interval, T_3 = Indofil M-45 applied @ 2g/L as foliar spray, T_4 = BAU-Biofungicide applied @ 3% as foliar spray, T_5 = 2, 4-D applied @ 12 ppm as foliar spray, T_6 = NAA applied @ 40 ppm as foliar spray, T_7 = Urea applied @ 4% as foliar spray, T_8 = Confidor applied @ 0.2g/L as foliar spray and T_9 = Control.

Inflorescence parameters

The treatments significantly increased the formation of mango inflorescences per plant over control (Table 3). Considering collection of data of all the stages (Bloom, pinheaded and marble stage), the highest (2.33) number of inflorescence was recorded in T_4 (BAU-Biofungicide applied @ 3% as foliar spray) and the lowest (0.33) was recorded in T_9 (Control). The treatments significantly increased number of branches per inflorescence over control. Considering collection of data of all the stages (Bloom, pinheaded and marble stage), the highest (7.33) number of branches were recorded in T_4 (Indofil applied @ 2g/L as foliar spray) and the lowest (1.33) was recorded in T_9 (Control). The treatments significantly increased the length of inflorescence over control. Considering collection of data of all the stages (Bloom, pinheaded and marble stage), the highest (22.81 cm) length of inflorescence was recorded in T_3 (Indofil applied @ 2g/L as foliar spray) and the lowest (2.59) was recorded in T_9 (Control). The treatments significantly increased the width of inflorescence over control. Considering collection of data of all the stages (Bloom, pinheaded and marble stage), the highest (1.48 cm) width was recorded in T_4 (BAU-Biofungicide applied @ 3% as foliar spray) and the lowest (0.23 cm) was recorded in T_9 (Control).

Table 3. Effect of different management practices on inflorescence parameters of mango

Treatments	Number of inflorescence/ plant				Number of branches/ Inflorescence				Length of Inflorescence (cm)				Width of Inflorescence (cm)			
	Bloom stage	Pinheaded stage	Pea stage	Mean	Bloom stage	Pinheaded stage	Pea stage	Mean	Bloom stage	Pinheaded stage	Pea stage	Mean	Bloom stage	Pinheaded stage	Pea stage	Mean
T_1	1.00 c	1.00 e	1.00 e	1.00	2.33 d	2.33 f	2.33 f	2.33	5.93 g	6.30 g	6.10 f	6.11	0.22 e	0.27 f	0.30 g	0.26
T_2	1.05 c	1.09 e	1.00 e	1.04	2.67 d	3.00 e	3.00 e	2.89	6.50 g	6.80 g	6.50 f	6.60	0.29 e	0.43 e	0.53 f	0.42
T_3	2.00 a	2.00 b	2.00 c	2.00	6.00 a	7.00 a	8.00 a	7.33	22.70 a	23.23 a	22.50 a	22.81	0.88 cd	0.93 d	1.13 c	0.98
T_4	2.00 a	2.33 a	2.47 a	2.33	5.33 b	6.33 b	6.33 b	6.00	19.33 c	19.00 c	21.00 b	20.09	1.47 a	1.49 a	1.47 a	1.48
T_5	1.10 c	1.08 e	1.00 e	1.06	4.00 c	5.00 c	5.00 c	4.66	10.03 f	15.00 e	14.50 d	13.18	0.80 d	0.87 d	0.93 d	0.87
T_6	1.67 b	1.67 c	2.00 c	1.77	5.00 b	6.00 b	6.00 b	5.66	16.10 d	17.73 d	16.33 c	16.72	1.17 b	1.27 b	1.33 b	1.26
T_7	1.00 c	1.33 d	1.33 d	1.22	4.00 c	4.00 d	4.00 d	4.00	13.00 e	13.13 f	11.27 e	12.47	0.79 d	0.85 d	0.73 e	0.79
T_8	2.00 a	2.00 b	2.33 b	2.11	4.00 c	6.33 b	4.99 b	5.11	21.00 b	20.27 b	19.00 b	20.09	0.95 c	1.10 c	1.27 b	1.10
T_9	0.33 d	0.33 f	0.33 f	0.33	1.33 e	1.33 g	1.33 g	1.33	2.60 h	2.67 h	2.50 g	2.59	0.20 e	0.23 f	0.25 g	0.23
$LSD_{0.05}$	0.108	0.322	0.203	-	0.494	0.539	0.769	-	0.791	0.731	0.847	-	0.132	0.093	0.108	-
Level of significance	**	**	**	-	**	**	**	-	**	**	**	-	**	**	**	-

Figures in a column with same letter(s) do not differ significantly.

** = Significant at 1% level of probability

T_1 = 2 times irrigation @ 10 days interval, T_2 = 4 times irrigation @ 10 days interval, T_3 = Indofil M-45 applied @ 2g/L as foliar spray, T_4 = BAU-Biofungicide applied @ 3% as foliar spray, T_5 = 2, 4-D applied @ 12 ppm as foliar spray, T_6 = NAA applied @ 40 ppm as foliar spray, T_7 = Urea applied @ 4% as foliar spray, T_8 = Confidor applied @ 0.2g/L as foliar spray and T_9 = Control.

Fruit parameters

Considering collection of data of all the stages (Pinheaded and marble stage), the highest (37.50) number of fruits were recorded in T_4 (BAU-Biofungicide applied @ 3% as foliar spray) and the lowest (0.84) was recorded in T_9 (Control) as shown in Table 4. The treatments significantly increased the number of dropped fruits per inflorescences over control. Overall, considering the mean of dropped fruits of pinheaded, pea and marble stage, the highest (1.22) fruits dropping were recorded in T_9 (Control) and the lowest (0.11) was recorded in T_4 (3% BAU Bio-fungicide applied as foliar spray). The treatments significantly reduced the number of dropped fruits per inflorescences over control. Considering collection of data of all the stages (Pinheaded, marble and pea stage), the highest (1.00) number of diseased fruit was recorded in T_9 (Control) and the lowest (0.56) was recorded in T_4 (BAU-Biofungicide applied @ 3% as foliar spray). The treatments significantly increased the formation of healthy fruits per inflorescences over control. Considering collection of data of all the stages (Pinheaded, marble and pea stage), the highest (23.66) healthy fruits were recorded in T_4 (BAU-Biofungicide applied @ 3% as foliar spray) and the lowest (0.56) was recorded in T_9 (Control). From the findings of the present study it may be concluded that BAU-Biofungicide as an eco-friendly means can successfully be used of mango. But more studies are to be carried out in different mango growing areas of the country.

Table 4. Effect of different management practices on fruit parameters of mango

Treatments	Number of fruits / inflorescence			Number of dropped fruits / inflorescence				Number of diseased fruits / inflorescence				Number of healthy fruits / inflorescence			
	Pinheaded stage	Pea stage	Mean	Pinheaded stage	Pea stage	Marble stage	Mean	Pinheaded stage	Pea stage	Marble stage	Mean	Pinheaded stage	Pea stage	Marble stage	Mean
T_1	1.00 f	1.33 ef	1.160	0.33 d	0.33 d	0.00 c	0.22	0.33 b	0.33 c	0.33 d	0.33	1.33 f	1.33 ef	0.00 f	0.88
T_2	2.33 ef	2.00 ef	2.160	0.67 c	0.33 d	0.33 b	0.44	0.33 b	0.33 c	0.33 d	0.33	2.33 ef	2.00 ef	0.33 e	1.55
T_3	20.00 b	31.00 b	25.50	1.00 b	0.67 c	0.33 b	0.67	0.33 b	0.33 c	0.00 e	0.22	20.00 b	31.00 b	11.33 b	20.77
T_4	30.00 a	45.00 a	37.50	0.33 d	0.00 e	0.00 c	0.11	0.00 c	0.33 c	0.33 d	0.22	30.00 a	45.00 a	23.00 a	23.66
T_5	10.67 d	13.33 d	12.00	0.00 e	1.00 b	0.33 b	0.44	1.00 a	0.33 c	0.00 e	0.44	10.67 d	13.33 d	8.67 c	11.78
T_6	12.67 c	12.00 d	12.22	1.00 b	0.00 e	0.33 b	0.44	0.33 b	0.33 c	0.33 d	0.33	12.67 c	12.00 d	2.67 d	9.00
T_7	2.67 e	2.670 e	2.67	0.33 d	0.67 c	0.00 c	0.22	1.00 a	0.67 b	1.00 a	0.89	2.67 e	2.67 e	0.00 f	1.78
T_8	20.33 b	27.67 c	24.00	1.67 a	1.00 b	0.00 c	0.89	1.00 a	0.67 b	0.00 e	0.56	20.33 b	27.67 c	11.67 b	19.89
T_9	1.00 f	0.67 f	0.84	1.00 b	1.33 a	1.33 a	1.22	1.33 a	1.00 a	0.67 c	1.00	1.00 f	0.67 f	0.00 f	0.56
$LSD_{0.05}$	1.35	1.44	-	0.108	0.153	0.143	-	0.121	0.054	0.093	-	1.35	1.44	0.788	-
Level of significance	**	**	-	**	**	**	-	**	**	**	-	**	**	**	-

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T_1 = 2 times irrigation @ 10 days interval, T_2 = 4 times irrigation @ 10 days interval, T_3 = Indofil M-45 applied @ 2g/L as foliar spray, T_4 = BAU-Biofungicide applied @ 3% as foliar spray, T_5 = 2, 4-D applied @ 12 ppm as foliar spray, T_6 = NAA applied @ 40 ppm as foliar spray, T_7 = Urea applied @ 4% as foliar spray, T_8 = Confidor applied @ 0.2g/L as foliar spray and T_9 = Control.

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