

ORIGINAL RESEARCH ARTICLE**Leaf Blight of Mango in Nurseries of Major Mango Growing Areas in Bangladesh and its Management**

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ABSTRACT

Leaf blight of mango in nurseries of major mango growing areas in Bangladesh viz. Rajshahi, Chapai Nawabganj and Dinajpur were investigated. A total of 56 varieties of mango (43, 17 and 17 in Rajshahi, Chapai Nawabganj and Dinajpur respectively) were surveyed, where the mean of % plant infection, % incidence and % severity in Rajshahi were from 3.33 to 33.06, 4.10 to 23.18 and 6.60 to 17.85, respectively. In Chapai Nawabganj, the % plant infection was 11.11 to 23.33, the % incidence was 10.67 to 23.67 and % severity was 13.89 to 15.29. In Dinajpur, 6.19 to 12.14% plant infection, 6.00 to 15.85% incidence and 5.00 to 13.50% severity were recorded. Antibiotic sensitivity test revealed that most of the isolates of *Pseudomonas syringae* pv. *syringae* collected from mango were sensitive to Gentamycin and Erythromycin. Under the net house condition, six different treatments (i) 0.05 % Gentamycin (ii) 0.05 % Erythromycin, (iii) 0.05 % Doxycycline (iv) 0.05 % copper sulphate (v) 2 % BAU-biofungicide and (vi) Control were used for controlling bacterial leaf blight of mango (Variety: Amropali). BAU-biofungicide was found superior in controlling bacterial leaf blight of mango that increased 8.76% plant height and 47.45% branch but reduced 54.14% disease incidence and 53.13% disease severity over control when applied as foliar spray at 2% followed by 0.05 % copper sulphate and 0.05 % erythromycin.

Key Words: Mango, leaf blight, *Pseudomonas syringae* pv. *syringae*, management

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Introduction

Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae, is named as the “King of Fruits” of Bangladesh. It is a unique in its nutritional quality, taste, consumer’s preference etc., among the fifty kinds of fruits grown in Bangladesh (Ahmad, 1985). Mango ranks the second in terms of the size of plantation area and the third in its production quality among the fruits grown in Bangladesh (Kobra *et al.* 2012). In Bangladesh, the leading mango growing districts are Chapai Nawabganj, Rajshahi, Rangpur, Dinajpur and Kushtia (Anonymous, 2014). Production of mango in Bangladesh was 945059 metric tons in 30666 ha of land 2011 and 2012 (BBS, 2013). Disease is a major cause for lower production of mango in Bangladesh, where major diseases occur in mango are scab, anthracnose, stem end rot, bacterial leaf spot, bacterial leaf blight, powdery mildew, die-back, rust and malformation. Among the bacterial diseases of mango, bacterial leaf blight caused by *Pseudomonas syringae* pv. *syringae* is an emerging disease and a great threat for production of healthy mango saplings in different nurseries of Bangladesh (Hossain, 2011). The apical necrosis or bacterial leaf blight results in significant economic losses and is one of the primary factors limiting mango fruit production in Southern Spain and Portugal as reported by Cazorla *et al.* (1992). In Bangladesh, the disease has been reported by Hossain (2011) for the first time and found to be caused by *Pseudomonas syringae* pv. *syringae* (Hossain, 2012). Bacterial diseases are explosive; by the time symptoms are recognized, the pathogen is often entrenched and well on its way to destroying the crop and lead to devastating financial losses to farmers (McManus and Stockwell, 2000). In developed countries, antibiotics are used in limited extent to control bacterial diseases of plants. Antibiotics are effective against most gram-positive and some gram negative bacteria (Kanfer *et al.* 1998). Since no chemicals were screened in Bangladesh to control the dangerous diseases, the present research works was undertaken to survey leaf blight of mango saplings in the nurseries of selected locations viz. Rajshahi, Chapai Nawabganj and Dinajpur and to evaluate some

antibiotics, such as copper sulphate and BAU-biofungicide for the management of bacterial leaf blight of mango.

Materials and Methods**2.1. Survey on the Incidence and Severity of Nursery Diseases of Mango Saplings**

Survey was conducted at different nurseries of three major mango growing areas of Bangladesh viz. Rajshahi, Chapai Nawabganj and Dinajpur from 13 October 2013 to 10 April, 2014. Altogether 56 varieties of mango were surveyed (Table 1). During the survey 30 saplings of mango for each variety were randomly selected from each location (nursery). Number of saplings and number of healthy and diseased saplings were recorded from the selected nurseries. Each of the selected saplings was observed carefully and symptoms of leaf blight disease were recorded following the descriptions of Singh (1968, 1978, 1998), Pathak (1980), Burhan (1987), and Rawal (1997). The disease incidence and severity were evaluated following the formula of Rai and Mamatha (2005), and Johnston (2000), respectively.

2.2. Antibiotic Sensitivity Test of *Pseudomonas syringae* pv. *syringae*

The isolation, identification, multiplication and purification of the bacterial isolates were done as previously described (Afrose *et al.* 2014). Diseased leaves were collected from the nurseries and kept in sterile polythene bag and transported to the laboratory. Tissue planting (leaf cutting) method was used for collection of bacteria. The cut infected portions of the leaf were washed and cleaned in distilled water, and plated on nutrient agar (NA). Plates were incubated at 28 °C for 2 days. Cream or off white colored colony of bacteria was appeared after incubation on NA medium. The cream color on the NA media was the colony of *P. syringae* pv. *syringae* (Ferdous, 2012). After isolation, the bacterial isolates

were purified by streaking a single colony of each isolate followed by sub-culturing on nutrient agar medium as described by Kelman (1954). The isolates bacteria were identified using the method of Islam *et al.* (2013) and preserved in 10% skim milk, kept at -20 °C in antibiotic sensitivity test.

Sensitivity of *P. syringae* pv. *syringae* isolates to different antibiotics was determined *in-vitro* by employing Kirby-Bauer disc diffusion method (Larkin, 2006). The procedure involved measuring the diameter of the zone of inhibition that results from diffusion of the agent into the medium surrounding the disc. Antimicrobial discs of 0.05% of Gentamycin, Erythromycin and Doxycycline were used for the test. With a sterile pipette, a drop of test culture of bacteria was added onto NA plate. Sterile glass spreader was used to spread the culture homogeneously on the medium. The plate was allowed to sit at room temperature for at least 3 to 5 minutes, but no more than 15 minutes, in order to fix the surface of the agar plate to dry before proceeding to the next step. Three antibiotic discs were placed aseptically onto the surface of the inoculated plates with the help of a sterile forceps followed by incubation at 35 ± 2 °C. After 48 hrs of incubation, the zone sizes were measured. The plates were examined and the diameter of each zone of complete inhibition was measured in millimeter (mm). At the time of measuring, zone diameters were always rounded up to the next mm. All measurements were made by examining the back of the plate, which is illuminated with reflected light. The zone size was recorded. Growth up to the edge of the disc was reported as a zone of 0 mm. Distinct, discrete colonies within an obvious zone of inhibition were not considered. Based in the diameter of the inhibition zone, the results of antibiotic sensitivity was reported as sensitive (S), intermediate (I), or resistant (R).

2.3. Management of Bacterial Leaf Blight of Mango Saplings

The pot experiment was carried out from July 2013 to June 2014

Table 1. Saplings of mango varieties evaluated at nurseries of three major mango growing areas in Bangladesh

Location	No. of Variety Screened	Name of Variety
Rajshahi	43	BARI Am-2, BARI Am-3, BARI Am-4, Harivanga, Gopalbhog, Khirsapat, Langra, Fazli, Surmai Fazli, Ashwina, Rani Pochondo, Laxmanbhog, Baromasi, Mollika, Thaidop, Bombai, BAU Am-14, GM, Himsagor, Surjopuri, Vobani, Fonia, Rosuntaki, Vadori, Rajrani, Sobja, Brindaboli, Shukurkondo, Nobab Pochondo, Suborna, Michridana, Khudi Khirshapat, Ogree, Kohitur, Kuapahari, Dilshat, Larua, Begeum Pochondo, Dudhsor, Shova Pochondo, Bimola, Jorda and Ramprosad
Chapai Nawabgonj	17	BARI Am-1, BARI Am-2, BARI Am-3, BARI Am-4, BARI Am-6, BARI Am-7, BARI Am-8, BARI Am-9, Mollika, Gopalbhog, Khirsapat, Langra, Fazli, Ashwina, Rani Pochondo, Baromasi and Bombai
Dinajpur	17	Amropali, BARI Am-4, Harivanga, Gopalbhog, Michribhog, Langra, Fazli, Chatapora, Ashwina, Mollika, Surjopuri, Kejoai, Mohochonok, Kodua Fajli, Nak Fajli, Philippine Super Sweet and Philippine Drop Am

Table 2. Status of bacterial leaf blight of mango saplings at three different major mango growing areas in Bangladesh in the month of October to April, 2013-2014

Sl. No.	Location*	% plant infection		% disease incidence		% disease severity	
		Min	Max	Min	Max	Min	Max
1	Rajshahi	3.33	33.06	4.10	23.18	6.60	17.85
2	Chapai Nawabgonj	11.11	23.33	10.67	23.67	13.89	15.29
3	Dinajpur	6.19	12.14	6.00	15.86	5.00	13.50

*Data represents the mean of 5000 saplings of five nurseries in each location

Higher percentage of leaf blight incidence and severity were observed in BARI Am-1, BARI Am-4, BARI Am-6, BARI Am-7, BARI Am-9, Gopalbhog, Langra, Fazli and most of the local varieties viz. Harivanga, Ashwina, Rani Pochondo, Laxmanbhog, Baromasi, Himsagor, Surjopuri, Vobani, Suborna, Michridana and Khudi Khirshapat. Leaf blight was not found in the variety of Mollika, Thaidop, GM and Begum Pochondo in Rajshahi, Mollika in Chapai Nawabgonj and, Nak Fazli, Kejoai and Surjopuri in Dinajpur. Variation of leaf blight outbreak has also been supported by Hossain and Sarker (2009), Hossain (2011), Hossain *et al.* (2011 and 2012).

in the net house, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh. Under this trial three-years-old mango saplings were grown in pots to investigate the bacterial leaf blight disease. For the control of Bacterial Leaf Blight (BLB) disease of mango, the variety Amropali was used because this variety is good for its cultivation in Mymensingh region. In addition it is liable to infection by leaf blight disease. This study was done in Mymensingh with six different treatments. The treatments were: (i) T₁ = 0.05 % Gentamycin applied as foliar spray (ii) T₂ = 0.05 % Erythromycin applied as foliar spray (iii) T₃ = 0.05% Doxycycline applied as foliar spray; (iv) T₄ = 0.05% copper sulphate applied as foliar spray, (v) T₅ = 2 % BAU-biofungicide applied as foliar spray and (vi) T₆ = Untreated control. The experiment was laid out in Completely Randomized Design (CRD) with three replications. The data were recorded on the height of the saplings (cm), total number of branches per sapling, total number of leaves per sapling, number of diseased leaves per sapling and percent leaf area diseased per sapling. Thereafter, the incidence and severity of bacterial leaf blight of mango were assayed using the formula of Rai and Mamatha (2005), and, Johnston (2000), respectively.

3. Results and Discussions

3.1. Incidence and Severity of Bacterial Leaf Blight of Mango Saplings

Altogether 56 varieties of mango saplings were evaluated in order to determine the incidence and severity of bacterial leaf blight disease in the nurseries of Rajshahi, Chapai Nawabgonj and Dinajpur as shown in Table 1. Bacterial leaf blight was found in all locations as well as in all nurseries, but there was a wide variation of disease incidence and severity as shown in Table 2.

3.2 Antibiotics Sensitivity Test of *Pseudomonas syringae* pv. *syringae* Collected from Rajshahi, Chapai Nawabgonj and Dinajpur

Twelve isolates of *Pseudomonas syringae* pv. *syringae* collected from blighted leaf of mango saplings from Rajshahi, Chapai Nawabgonj and Dinajpur were tested for antibiotics sensitivity against commonly used three different antibiotics viz. Gentamycin, Erythromycin and Doxycycline. The isolates were

recorded as resistant (R), intermediate (I) and sensitive (S) to the antibiotics to determine the antibiotics sensitivities using Kirby-Bauer disc diffusion method as illustrated in Fig. 1 and Table 3.

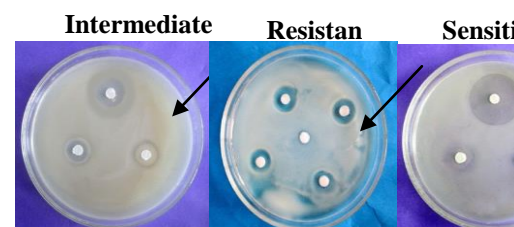


Fig. 1. Antibiotic sensitivity pattern of *P. syringae* pv.

Table 3. Antibiotics sensitivity of *Pseudomonas syringae* pv. *syringae* collected from blighted leaf of mango saplings from Rajshahi, Chapai Nawabgonj and Dinajpur

Location	Antibiotics %	Reaction of Isolates		
		Resistant (R) mm	Intermediate (I) mm	Sensitive (S) mm
Rajshahi	GEN- 0.05	-	MR1 (13.50) MR3 (14.50) MR4 (13.50)	MR2 (17.00)
	E- 0.05	-	MR1 (18.00) MR4 (16.5)	MR2 (27.50) MR3 (27.50)
	DO- 0.05	MR1 (12.00) MR2 (13.00) MR3 (8.50) MR4 (7.00)	-	-
Chapai Nawabgonj	GEN- 0.05	MC1 (10.00) MC4 (12.00)	-	MC2 (19.00) MC3 (15.5)
	E- 0.05	MC1 (11.00)	MC3 (14.5) MC4 (19.5)	MC2 (24.5)
	DO- 0.05	MC1 (0.00), MC2 (0.00), MC3 (13.50)	MC4 (18.50)	-
Dinajpur	GEN- 0.05	-	MD4 (20.00)	MD1 (15.00) MD2 (18.00) MD3 (15.00)
	E- 0.05	-	MD3 (15.00)	MD1 (35.00) MD2 (35.00) MD4 (35.00)
	DO- 0.05	MD1 (11.00) MD2 (13.00) MD3 (10.00) MD4 (13.00)	-	-

Legend: GEN= Gentamycin, E= Erythromycin, DO= Doxycycline

MR= Isolates of *P. syringae* pv. *syringae* collected from blighted leaf of mango saplings from Rajshahi,

MC= Isolates of *P. syringae* pv. *syringae* collected from blighted leaf of mango saplings from Chapai Nawabgonj,

MD= Isolates of *P. syringae* pv. *syringae* collected from blighted leaf of mango saplings from Dinajpur

Among the four isolates of *P. syringae* pv. *syringae* of Rajshahi, none of the isolates were resistant against Gentamycin (GEN-0.05) and Erythromycin (E-0.05). On the other hand, all the isolates showed resistance against Doxycycline (DO-0.05). Isolates MR1, MR3 and MR4 showed intermediate reaction to the Gentamycin and isolates MR1 and MR4 showed intermediate reaction to Erythromycin. But none of the isolates were found to show intermediate reaction against Doxycycline. Again isolate MR2 was sensitive to both Gentamycin and Erythromycin. Only isolate MR3 was sensitive to Erythromycin. In case of Chapai Nawabgonj, isolates MC1 and MC4 were found to show resistance against Gentamycin (GEN-0.05) and Isolate MC1 was found to show resistance against Erythromycin (E-0.05). On the other hand, all the isolates except for isolate MC4 were resistant to Doxycycline (DO-0.05). None of the isolates showed intermediate reaction to Gentamycin. But isolates MC3 and MC4 showed intermediate reaction to Erythromycin and isolates MC4 showed to Doxycycline. Again, isolate MC2 was sensitive to both Gentamycin and Erythromycin and isolate MC3 was sensitive to

Gentamycin. Four isolates of *P. syringae* pv. *syringae* of Dinajpur were tested against three antibiotics and none of the isolates show resistance against Gentamycin (GEN-0.05) and Erythromycin (E-

0.05). On the other hand, all the isolates were resistant to Doxycycline (DO-0.05). Intermediate reaction was found in case of isolate MD4 and MD3 to Gentamycin and Erythromycin, respectively. But none of the isolates were found to show intermediate reaction against Doxycycline. Again, all the isolates except for isolate MD4 were sensitive to Gentamycin. And in case of Erythromycin, all the isolates except for isolate MD3 showed sensitive reaction. But none of the isolates were sensitive to Doxycycline. Orlans *et al.* (2011) reported that out of 189 isolates of *Pseudomonas* spp, 188 isolates were susceptible to Gentamycin. Akinbowale *et al.* (2007) also observed *Pseudomonas* spp. as sensitive to Gentamycin. The findings were also supported by Hossain *et al.* (2012). They reported that isolates of *P. syringae* pv. *syringae* collected from different locations were sensitive to Gentamycin, Kanamycin, Erythromycin and Chloramphenicol.

3.3. Management of Bacterial Leaf Blight of Mango Saplings

The effect of different treatments on plant height of mango were determined and presented in Table 4. Significant variation of plant height was observed under different management practices. All the treatments increased the plant height of mango over the control group. Considering the mean plant height, the highest plant height was 143.86 cm observed in T_1 (Gentamycin) which was 25.05% over the control group followed by T_3 (Doxycycline). On the other hand, the lowest increase of plant height (8.76%) over the control group was observed in T_5 (BAU-Biofungicide). Basak *et al.* (2014) also reported that increase of plant height was highest in Gentamycin treated plant.

The effect of different treatments on number of branches per plant was determined as shown in Table 5. Wide variation in the number of branches per plant was observed when different management practices were applied. The maximum increase number of branch/plant over control was found in T_3 (Doxycycline) which was 69.90% followed by T_5 = 47.45% (BAU-Biofungicide). Basak *et al.* (2014) found highest number of branches per / plant of mango in Erythromycin and BAU-biofungicide treated plants.

Significant variation in the disease incidence was observed when different treatments were applied (Table 6). All the treatments significantly reduced the incidence of bacterial leaf blight of mango over the control group. The mean incidence of leaf blight was lowest (17.52%) in T_5 (BAU-Biofungicide) 54.14% with of reduction over the control group followed by T_4 (Copper sulphate). The lowest reduction (29.16%) of bacterial leaf blight incidence over the control group was observed in T_3 (Doxycycline). The findings of the present study are supported by Basak *et al.* (2014), Akhtar (2011) and Chowdhury (2009).

The effect of different treatments on severity of leaf blight of mango was presented in Table 7. All the treatments significantly reduced severity of bacterial leaf blight of mango over the control group. The mean bacterial leaf blight severity of mango was lowest (6.73%) in T_5 (BAU-biofungicide), which reduced 53.13% severity over control followed by T_4 (copper sulphate) and T_2 (Erythromycin). The lowest reduction (39.62%) over control was observed in T_3 (Doxycycline). Findings of the present study have also been supported by Basak *et al.* (2014).

Table 4. Effect of antibiotics, copper sulphate and BAU-biofungicide on sapling height of mango

Treatments	Sapling Height (cm)												Mean Sapling height(cm)	% Increase over control
	July 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	June 2014		
T_1	125.33	132.83	139.67	142.83	143.67	145.17	147.50	148.33	148.67	149.50a	150.83	152.00	143.86	25.05
T_2	115.67	121.33	125.50	131.17	131.83	132.00	132.67	132.67	132.67	133.83c	134.67	136.67	130.06	13.06
T_3	112.83	121.83	130.83	136.67	138.83	141.50	144.17	144.33	144.33	145.33	146.50	148.33	137.95	19.91
T_4	115.33	119.5	124.67	126.83	127.00	127.17	127.67	127.67	127.67	128.83	129.17	131.67	126.10	9.61
T_5	111.67	120.67	124.17	125.83	126.00	126.33	126.67	127.00	127.00	127.50	128.00	130.66	125.12	8.76
T_6	102.67	106.17	108.83	110.67	112.17	114.33	116.67	118.67	120.67	122.00e	123.17	124.50	115.04	-
LSD_{0.05}	3.34	2.92	3.10	3.24	2.73	2.13	3.22	3.13	3.31	2.72	2.50	3.68		
CV (%)	1.65	1.36	1.38	1.41	1.17	0.91	1.37	1.32	1.39	1.14	1.03	1.51		

Data represents the mean values of three replications

T_1 = 0.05 % Gentamycin applied as foliar spray
 T_2 = 0.05 % Erythromycin applied as foliar spray
 T_3 = 0.05 % Doxycycline applied as foliar spray
 T_4 = 0.05% copper sulphate applied as foliar spray
 T_5 = 2 % BAU-biofungicide applied as foliar spray
 T_6 = Untreated control

Table 5. Effect of antibiotics, copper sulphate and BAU-biofungicide on number of branches per sapling of mango

Treatments	Number of branches per sapling												Mean branches/sapling	% Increase over control
	July 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	June 2014		
T_1	2.00	3.33	3.67	3.67	2.33	2.00	2.00	2.33	2.33	2.67	3.00	3.00	2.70	37.76
T_2	1.67	2.00	2.00	2.33	2.33	2.33	2.33	2.67	2.67d	2.67	2.67	3.00	2.39	21.94
T_3	3.33	2.00	2.33	2.33	3.67	3.00	3.00	3.67	4.00	4.00	4.33	4.33	3.33	69.90
T_4	2.00	2.33	2.33	2.67	2.67	2.67	2.67	3.00	3.00	3.00	3.33	3.67	2.78	41.84
T_5	2.00	2.00	2.33	2.33	3.00	3.00	3.00	3.00	3.33	3.33	3.67	4.00	2.89	47.45
T_6	1.33	1.33	1.67	1.67	2.00	2.00	2.00	2.00	2.33	2.33	2.33	2.50	1.96	-
LSD_{0.05}	0.42	0.42	0.36	0.34	0.32	0.30	0.30	0.30	0.36	0.22	0.30	0.36		
CV (%)	11.24	10.67	8.55	7.67	6.66	6.54	6.54	5.88	6.93	4.08	5.07	5.97		

Data represents the mean values of three replications

T_1 = 0.05 % Gentamycin applied as foliar spray
 T_2 = 0.05 % Erythromycin applied as foliar spray
 T_3 = 0.05 % Doxycycline applied as foliar spray
 T_4 = 0.05 % copper sulphate applied as foliar spray
 T_5 = 2 % BAU-biofungicide applied as foliar spray
 T_6 = Untreated control

Table 6. Effect of antibiotics, copper sulphate and BAU-biofungicide on percent disease incidence of mango

Treatments	Disease incidence (%)												Mean	% Reduction over control
	July 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	June 2014		
T ₁	25.67	36.43	48.00	32.80	26.33	21.77	19.77	17.43	15.33	12.67	11.67	9.33b	23.10	39.53
T ₂	30.67	29.67	44.43	40.33	22.93	21.17	18.33	15.10	12.67	9.33	7.67	6.00c	21.52	43.66
T ₃	42.67	37.87	51.30	39.63	28.67	24.33	22.27	20.00	18.00	15.00	14.00	11.00b	27.06	29.16
T ₄	20.83	42.00	52.43	31.30	20.83	14.27	13.67	11.67	11.67	10.00	9.17	9.33b	20.60	46.07
T ₅	27.33	30.33	40.00	34.77	21.97	13.93	12.20	9.67	8.67	7.33	0.00	4.00c	17.52	54.14
T ₆	36.00	39.67	54.77	44.67	41.00	35.33	30.67	32.63	38.67	36.67	33.33	35.00a	38.20	-
LSD _{0.05}	2.95	2.36	2.80	3.35	3.50	2.75	4.09	3.17	4.08	3.36	2.83	2.13		
CV (%)	5.41	3.69	3.25	5.06	7.31	7.10	11.77	10.04	13.13	12.44	12.55	9.66		

Data represents the mean values of three replications

T₁ = 0.05 % Gentamycin applied as foliar spray
 T₂ = 0.05 % Erythromycin applied as foliar spray
 T₃ = 0.05 % Doxycycline applied as foliar spray
 T₄ = 0.05 % copper sulphate applied as foliar spray
 T₅ = 2 % BAU-biofungicide applied as foliar spray
 T₆ = Untreated control

Table 7. Effect of antibiotics, copper sulphate and BAU-biofungicide on percent disease severity of mango

Treatments	Disease severity (%)												Mean	% Reduction over control
	July 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	June 2014		
T ₁	16.90	14.90	15.67	7.77	9.40	7.90	4.93	5.33	3.07	4.67	5.33	5.00	8.41	41.43
T ₂	15.77	10.90	12.90	9.33	6.10	4.90	4.30	6.50	3.30	6.00	6.00	4.87	7.57	47.28
T ₃	17.50	15.00	16.90	10.60	8.57	7.53	6.90	4.93	5.17	4.00	3.40	3.50	8.67	39.62
T ₄	18.50	14.83	14.17	9.50	6.40	6.10	5.60	4.23	4.77	3.27	3.00	4.00	7.61	47.00
T ₅	15.70	11.03	11.03	11.57	7.83	4.73	6.57	4.07	3.03	2.17	0.00	3.00	6.73	53.13
T ₆	19.83	19.83	20.50	16.47	14.83	16.60	14.60	10.60	9.27	10.57	10.90	8.33	14.36	-
LSD _{0.05}	0.96	1.44	0.96	1.04	0.71	0.64	0.94	0.78	0.37	0.75	0.52	0.36		
CV (%)	3.13	5.64	3.59	5.33	4.54	4.54	7.43	7.34	4.33	8.16	6.05	4.26		

Data represents the mean values of three replications

T₁ = 0.05 % Gentamycin applied as foliar spray
 T₂ = 0.05 % Erythromycin applied as foliar spray
 T₃ = 0.05 % Doxycycline applied as foliar spray
 T₄ = 0.05 % copper sulphate applied as foliar spray
 T₅ = 2 % BAU-biofungicide applied as foliar spray
 T₆ = Untreated control

The mean temperature in 2013-2014 ranged from 17.3 °C to 29.6 °C and rainfall ranged from 0.0 to 338.8 mm, where relative humidity (RH) ranged from 64.5 % to 86.6% as shown in Fig. 2. Under the above condition, leaf blight incidence and severity ranged from 30.67 to 54.77% and 8.33 to 20.50%, respectively. It

has been found that leaf blight incidence was higher under higher humidity and relatively higher temperature. These findings are also in accordance with the findings of Khan (2014).

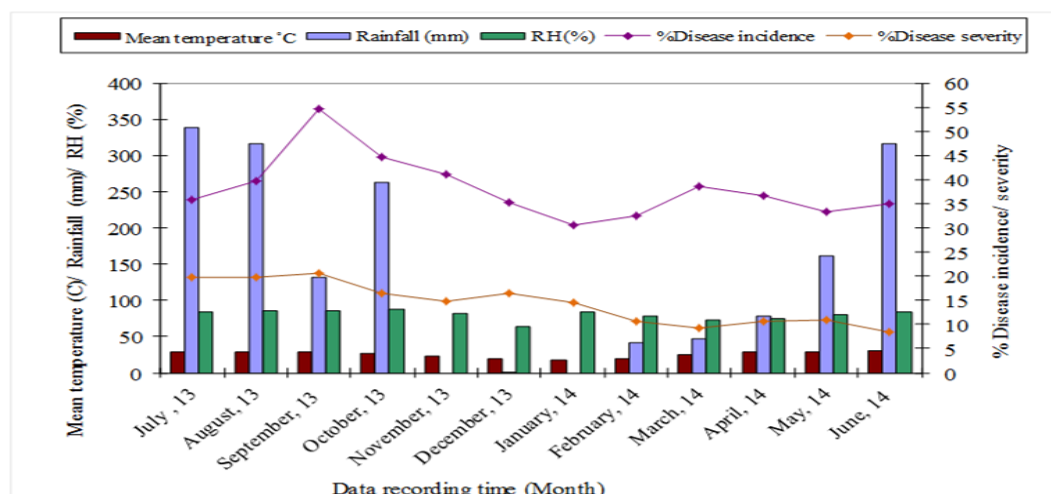


Fig. 2. Effect of weather on the incidence and severity of bacterial leaf blight disease of mango in 2013-2014.

Conclusion

Bacterial leaf blight (*Pseudomonas syringae* pv. *syringae*) of mango is a great threat to the quality and healthy mango saplings in order to get higher fruit production. Most of the isolates of *P. syringae* pv. *syringae* were sensitive to Gentamycin and Erythromycin. In net house test, BAU-biofungicide (2%) was found superior in controlling bacterial leaf blight of mango, that increased 8.76% plant height, 47.45% branches and reduced 54.14% disease incidence and 53.13% disease severity followed by Copper sulphate (0.05%) and Erythromycin (0.05%) over the control group when applied as foliar spray. BAU-biofungicide may be considered as an alternative means of controlling bacterial leaf blight of mango in the country.

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