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Field Evaluation of Some Selected Chemicals against Bacterial Blight in Cotton

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Authors' contributions

This work was carried out in collaboration among all authors. Author SS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors NS and FMA managed the analyses of the study. Author FMA managed the literature searches and edited the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The aim of this study is to evaluate the comparative efficacy of some selected chemicals and antibiotic in controlling bacterial blight of cotton variety CB-9 *in vivo.* A field experiment was carried out at the Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh to study efficacy of selected chemicals against bacterial blight of cotton with ten treatments arranged in Randomized Complete Block Design (RCBD).Cotton plant was affected by bacterial blight at all stages of its development. The disease spread from the cotyledons to the leaves followed by the main stems, branches and bolls. Field evaluation of selected chemicals revealed that Streptomycin Sulphate was highly effective against bacterial blight of cotton caused by *Xanthomonas axonopodis* pv. *malvacearum.* The highest germination (92%) was found in the treatment where cotton seed was treated with Streptomycin Sulphate at 0.15% which was followed by seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150 ppm. The lowest disease severity in terms of PDI (22.66%) was found in Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150 ppm subsequently after three foliar sprays at 105 DAS. Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150 ppm reduced the disease severity by

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44.46% over control and increased the yield of seed cotton 34.58% over control. Streptomycin Sulphate showed higher affectivity against bacterial blight of cotton compared with other tested fungicides.

Keywords: Angular leaf spot; Xanthomonas axonopodis pv. malvacearum; cotton; chemicals; antibiotics; in vivo.

1. INTRODUCTION

Bacterial Blight (BB), caused by *Xanthomonas axonopodis* pv. *Malvacearum* is a devastating disease affecting the growth, development and yield of cotton [1], among the recorded 60 diseases of cotton [2], affects all the aerial parts of the plant and known as angular leaf spot, vein blight, black arm and boll rot depending on the plant part infected [3,4]. Bacterial blight severity is higher at high ambient temperatures (86-97°F) and high relative humidity conditions. The pathogen spread most effectively by splashing water, particularly rain water. Bacteria can enter the plant through natural openings like stomata, nectarines, or through wounds. Bangladesh, the second largest cotton user, is also the largest importer of raw cotton in the world [5]. The Cotton Development Board has set a target of production of 1 lakh 72 thousands bales of cotton by 2017-2018 and has fixed a work plan of cotton cultivation in 1 lakh hectare land by the year of 2030 to fulfill 10-15% needs of the total local demand though country's present cotton production can meets only 3-4% of total annual requirement of local spinning mills [5]. There are many constraints of production of cotton in Bangladesh among them disease is the most serious one [6]. In Bangladesh for controlling bacterial blight, farmers are using copper fungicides (Cupravit 50 WP), Diathane M-45 and Sulphate but not able to manage the disease.

The extent of the bacterial blight problem in a field will depend on the susceptibility of the cotton cultivar, the extent to which the pathogen has spread through the field, and the duration of favorable weather for disease development [7]. Management of bacterial blight is a challenging problem due to its systemic infection. Breeding resistant varieties has also been proved not to be satisfactory. The adjustment of date of sowing of cotton, regular spraying with antibiotics and fungicides, flooding, sanitation etc. may reduce the incidence of the disease [6]. The present research was therefore conducted to find out the efficacy of some selected chemicals against bacterial blight of cotton in the field condition.

2. MATERIALS AND METHODS

A field experiment was carried out to study efficacy of different selected chemicals against bacterial blight of cotton with ten treatments in Randomized Complete Block Design (RCBD) single factor with three replications in variety CB-9. Seeds were treated with Cupravit 50 WP (0.4%), Indofil M-45 (0.4%) and Streptomycin Sulphate (0.015% and 0.15%) either alone or in combination (Table 1). Treatment combinations were T_1 = Seed treatment with Cupravit 50 WP at 0.4% ; T_2= Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4%; T_3 = Seed treatment with Streptomycin Sulphate at 0.15%; T_4 = Seed treatment with Cupravit 50 WP at 0.4% + Foliar spray with Cupravit 50 WP at 0.2%; T_5= Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4% + Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_6= Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate150ppm ; T_7 = Foliar spray with Cupravit 50 WP at 0.2% ; T_8 = Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_9 = Foliar spray with Streptomycin Sulphate at 150 ppmand T_{10} = Control. Required amount of each chemical was taken in a 500 ml Erlenmeyer flask containing 150 g of seeds. Afterwards treated seeds were dried for an hour under shade and were immediately sown in the field. First spray was undertaken after disease initiation and subsequent sprays at an interval of 15 days. In ten treatments one control (unsprayed) treatment was blight disease to allow developing. Observations on disease incidence and severity were recorded at 30 DAS, 60 DAS, 90 DAS and 120 DAS and also seed cotton yield. Percent of diseased leaf area was recorded from four leaves from each of the 4 randomly selected plants per plot. These data were recorded at 30 days intervals, one day before application of chemicals.The recorded data on various parameters were statistically analyzed by using MSTAT statistical package programme. Difference among different treatment means were compared by Duncan`s new Multiple Range Test (DMRT).

Table 1. Selected chemicals, their trade name, active ingredient and concentration used in management of bacterial blight of cotton in the field

Trade Name	Active ingredient	Chemical name	Concentration (%)	
Cupravit 50 WP	Copper Oxychloride	Copper chloride oxide hydrate	0.2	0.4
Indofil M-45	Mancozeb- 80 WP	N-(2,6 dimethyl phenyl)-N (methoxyacetyl)-alanine methyl ester ($C_{14}H_{21}NO_4$)	0.2	0.4
Streptomycin Sulphate	Streptomycin Sulphate	Streptomycin Sulphate	0.015	0.15

The disease severity was recorded by using the following standard scale [8].

Grade	Percent leaf infection
0	0.00
1	Up to 1
2	>1-10
3	> 10- 20
4	>20- 40
5	>40-100

From total grade of 16 leaves in each plot, PDI and percent disease control were calculated as per standard methods [9] as follows:

$$\text{PDI} = \frac{\text{Sum total of grades} \times 100}{\text{No.of leaves examined} \times \text{maximum grade}}$$

$$\%\ \text{disease control} = \frac{\text{PDI in control} - \text{PDI in treatment} \times 100}{\text{PDI in control}}$$

3. RESULTS

3.1 Comparative Effect of Some Selected Chemicals on Percent Germination of Cotton Seed

Effects of some seed treating chemicals on percent germination were recorded under the natural condition and presented in Fig. 1. There was a significant variation among the treated and the untreated treatments. The highest germination (92%) was found in T_3 (Seed treatment with Streptomycin Sulphate at 0.15%) which was followed by T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate 150 ppm) and T_5 (Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4% + Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%). The lowest germination (72%) was recorded in untreated T_{10} (Control) which was statistically alike to T_9 (Foliar spray with Streptomycin Sulphate at 150ppm).

3.2 Comparative Effect of Different Treatments on Percent Leaf Area Diseased (LAD) of Cotton

Comparative effect of different treatments on percent leaf area diseased (LAD) of cotton recorded at 15 days intervals are presented in Table 2. Percent diseased leaf area was significantly varied in different treatments at different days after sowing. LAD was minimum in all plots at 60 DAS while foliar sprays were started. At 60 DAS, the highest LAD (1.67%) was recorded in control plot. The minimum LAD (0.69%) were recorded in T_6 (Seed treatment with Streptomycin at 0.15% + Foliar spray with Streptomycin at 150 ppm) treatment which was statistically similar with T_3 (Seed treatment with Streptomycin Sulphate at 0.15%), T_4 (Seed treatment with Cupravit 50 WP at 0.4% + Foliar spray with Cupravit 50 WP a t0.2%) and T_5 (Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4% + Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%). At 75 DAS, the highest LAD (5.68%) was recorded in control plot. The minimum LAD (1.94%) were recorded in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150 ppm) treatment which was followed by T_9 (2.19%) and T_3 (2.00%). At 90 DAS, the highest LAD (8.34%) was recorded in control plot. The minimum LAD (3.30%) was recorded in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150 ppm) treatment which was statistically alike with T_9 (Foliar spray with Streptomycin Sulphate at 150 ppm) and T_3 (Seed treatment with Streptomycin Sulphate at 0.15%). At 105 DAS, the highest LAD (10.50%) was recorded in control plot. The minimum LAD (4.26%) were recorded in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate Sulphate at 150 ppm) treatment which was statistically identical with T_9 (Foliar spray with Streptomycin Sulphate at 150 ppm) at 4.79% and

T_3 (Seed treatment with Streptomycin Sulphate at 0.15%) at 4.66%.

3.3 Comparative Effect of Different Treatments on Percent Diseased Index

Comparative effect of different treatments on percent diseased index (PDI) of cotton recorded at 15 days intervals are presented in Table 3. Percent diseased index was significantly varied in different treatments at different days after sowing. At 60 DAS, the maximum PDI (9.44%) was recorded in control plotwhich was followed by T_1 (Seed treatment with Cupravit 50 WP at 0.4%) at 9.16%. The minimum PDI (5.16%) was recorded in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150 ppm) treatment which was followed by T_3 (Seed treatment with Streptomycin Sulphateat 0.15%) at 6.20%. At 75 DAS, the highest PDI (23.64%) was recorded in control plot. The minimum PDI (12.21%) was recorded in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150 ppm) treatment which was statistically alike with T_3 (Seed treatment with Streptomycin Sulphateat 0.15%) at 12.30%. At 90 DAS, the highest PDI (33.46%) was recorded in control plot. The least PDI (19.56%) was recorded in T_6(Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150ppm) treatment. At 105 DAS, the peak PDI (40.80%) was recorded in control plot. The minimum PDI (22.66%) was recorded in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150ppm) treatment. Percent decrease of PDI over control at 105 DAS, the maximum percent disease control (44.46%) was recorded in T_6 (Seed treatment with Streptomycin Sulphateat 0.15% + Foliar spray with Streptomycin Sulphate at 150 ppm) treatment which was statistically identical with T_3 (Seed treatment with Streptomycin Sulphate at 0.15%) at 15.32%.Other than the control treatment the least percent disease control (12.48%) was recorded in T_1 (Seed treatment with Cupravit 50 WP at 0.4%).

3.4 Comparative Effect of Different Treatments on Plant Height, Number of Branches per Plant and Number of Fruiting Branches per Plant of Cotton

Data on Plant height, number of branches per plant and number of fruiting branches per plant were presented in Table 4. The longest plant (138.10 cm) was measured in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate150 ppm) treatment which was statistically similar with T_2 (Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4%), T_3 (Seed treatment with Streptomycin Sulphate at 0.15%), T_4(Seed treatment with Cupravit 50 WP at 0.4% + Foliar spray with Cupravit 50 WP at 0.2%), T_5 (Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4% + Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%) and T_9 (Foliar spray with Streptomycin Sulphate at 150 ppm). The shortest plant (95.99 cm) was measured in T_{10} (control) treatment (Table 4).

The maximum number of branch per plant (23.92) was observed in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150 ppm) treatment. The minimum number of branch per plant (16.00) was observed in T_{10} (control) treatment (Table 4).

The maximum number of fruiting branch per plant (15.75) was observed in T_6 treatment, which was statistically similar with T_3 (Seed treatment with Streptomycin Sulphate at 0.15%). The minimum number of fruiting branch per plant (11.66) was observed in T_{10} (control) treatment (Table 4).

3.5 Comparative Effect of Different Treatments on Number of Bolls per Plant, Healthy Bolls per Plant, Rotten Bolls per Plant and Weight of Seed Cotton of Ten Bolls per Plant

Significant effect of different treatments on total number of bolls per plant, healthy bolls per plant, rotten bolls per plant and weight of seed cotton of ten bolls per plant were determined and the result presented in Table 5. It was observed that the treatments showed significant effect on those yield contributing characters. The formation of total number of bolls per plant among the treatments ranged from 22.75 to 15.75 where the utmost number of bolls per plant (22.75) was obtained from T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate150 ppm) treatment. This was followed by T_3 (Seed treatment with Streptomycin Sulphate at 0.15%), T_5 (Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4% + Foliar spray with Cupravit

50 WP at 0.2% and Indofil M-45 at 0.2%), T_9 (Foliar spray with Streptomycin Sulphateat 150ppm) and T_8 (Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%). The lowest number of bolls per plant (15.75) was observed from T_{10} (control) treatment. The data revealed that the highest healthy bolls per plant (19.62) were observed in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate 150ppm) treatment. The minimum healthy bolls per plant (8.17) was observed in T_{10} (control) treatment. The maximum rotten bolls per plant (6.07) were observed in T_{10} (control) treatment. The minimum rotten bolls per plant (2.67) were observed in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate 150 ppm) treatment. The maximum weight of seed per ball (44.43 gm) was observed in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate 150ppm) treatment. The minimum weight of seed per ball (35.01) was observed in T_{10} (control) treatment (Table 5).

3.6 Comparative Effect of Different Treatments on Seed Cotton Yield and Stalk Yield of Cotton

Seed cotton yield was significantly varied in different treatments which presented in Table 6. Yield of seed varied from one treatment to another ranging 0.67 to 0.94 kg/plot and 1.53 to 2.16 ton/ha. The highest seed cotton yield (0.94 kg/plot and 2.16 ton/ ha) was obtained from T_6(Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate 150 ppm) treatment that was followed by T_3 (Seed treatment with Streptomycin Sulphate at 0.15%) at 0.86 kg/plot and 1.97 kg/plot and ton/ha, respectively. The lowest seed cotton yield (0.67 and 1.53 kg/plot and ton/ ha, respectively) was obtained in T_{10} (control) treatment.

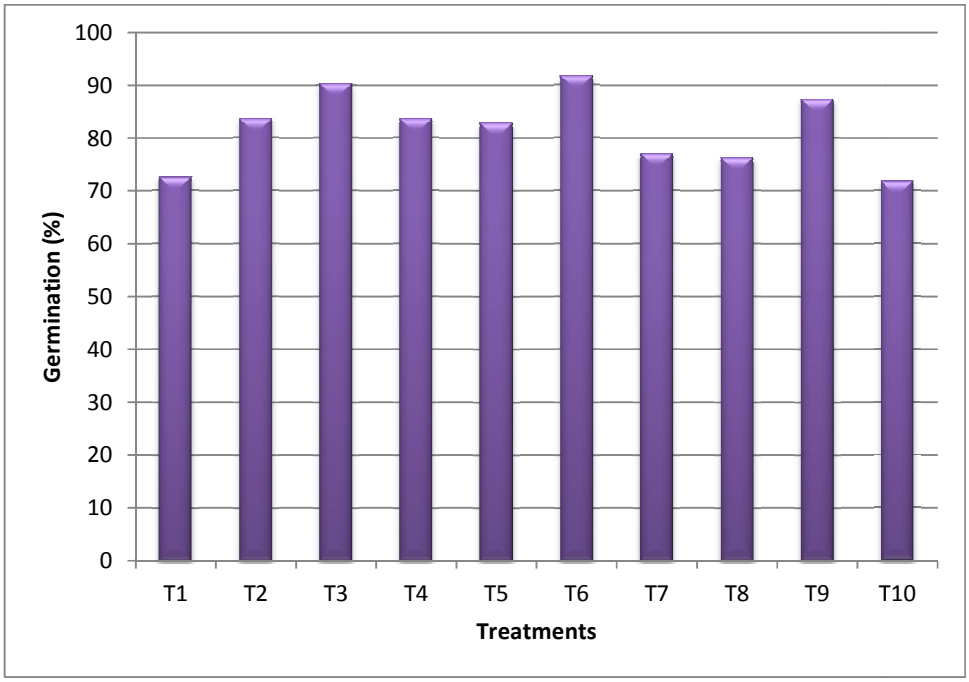

Fig. 1. Comparative effect of some selected chemicals on percent of germination of cotton seed

T_1 = Seed treatment with Cupravit 50 WP at 0.4%; T_2= Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4%; T_3 = Seed treatment with Streptomycin Sulphate at 0.15%; T_4 = Seed treatment with Cupravit 50 WP at 0.4% + Foliar spray with Cupravit 50 WP at 0.2%; T_5= Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4% + Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_6= Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150ppm; T_7 = Foliar spray with Cupravit 50 WP at 0.2%; T_8 = Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_9= Foliar spray with Streptomycin Sulphate at 150 ppm;T_{10} = Control

Table 2. Comparative effect of different treatments on percent Leaf Area Diseased (LAD) of cotton

Treatments	% Leaf area diseased			
	60DAS	75 DAS	90 DAS	105 DAS
T_1	1.13 cd	4.26 b	7.52 b	9.28 b
T_2	0.94 de	2.76 de	5.79 de	6.18 de
T_3	0.78 e	2.00 fg	3.88 g	4.66 gh
T_4	0.69 e	2.72 e	5.22 ef	5.69 ef
T_5	0.76 e	2.24 f	4.96 f	5.26 fg
T_6	0.82 e	1.94 g	3.30 g	4.26 h
T_7	1.41 abc	3.25 c	6.74 c	6.97 c
T_8	1.50 ab	3.00 cd	6.46 cd	6.46 cd
T_9	1.32 bc	2.19 fg	4.10 g	4.79 gh
T_{10}	1.67 a	5.68 a	8.34 a	10.50 a
LSD $_{(0.05)}$	0.28	0.27	0.77	0.67
CV (%)	5.02	5.15	7.95	6.13

Each data represents the mean value of three replications. Values followed by the same letter within a column are not significantly different (p≤ 0.05) according to Duncan's multiple range test

T_1 = Seed treatment with Cupravit50 WP at 0.4%; T_2= Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4%; T_3 = Seed treatment with Streptomycin Sulphate at 0.15%; T_4 = Seed treatment with Cupravit 50 WP at 0.4% + Foliar spray with Cupravit 50 WP at 0.2%; T_5= Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4% + Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_6= Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150ppm; T_7 = Foliar spray with Cupravit 50 WP at 0.2%; T_8 = Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_9= Foliar spray with Streptomycin Sulphate at 150 ppm; T_{10} = Control

Table 3. Comparative effect of different treatments on Percent Diseased Index (PDI) of cotton

Treatments	Disease severity in PDI (%)				% Decrease of PDI over control at 105 DAS
	60DAS	75 DAS	90 DAS	105 DAS	
T_1	9.16 b	21.73 ab	30.70 ab	35.71 b	12.48 f
T_2	8.20 e	16.40 bcd	24.13 de	28.94 de	29.07 c
T_3	6.20 i	12.30 d	21.28 ef	34.56 bc	15.29 ef
T_4	7.35 f	15.83 bcd	29.03 bc	31.75 cd	22.18 d
T_5	7.06 g	14.11 cd	29.75 b	33.80 bc	17.16 e
T_6	5.16 j	12.21 d	19.56 f	22.66 g	44.46 a
T_7	8.58 c	19.35 abc	26.32 cd	29.99 de	26.49 c
T_8	8.49 d	17.54 abcd	26.41 cd	26.75 ef	34.44 b
T_9	6.68 h	13.26 cd	21.75 ef	23.70 fg	41.91 a
T_{10}	9.44 a	23.64 a	33.46 a	40.80 a	0.00 g
LSD $_{(0.05)}$	0.05	6.02	3.13	3.16	3.34
CV (%)	5.08	8.08	6.97	5.96	7.99

Each data represents the mean value of three replications.Values followed by the same letter within a column are not significantly different (p≤ 0.05) according to Duncan's multiple range test

T_1 = Seed treatment with Cupravit 50 WP at 0.4%; T_2= Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4%; T_3 = Seed treatment with Streptomycin Sulphate at 0.15%; T_4 = Seed treatment with Cupravit 50 WP at 0.4% + Foliar spray with Cupravit 50 WP at 0.2%; T_5= Seed treatment with Cupravit 50 WP at0.4% and Indofil M-45 at 0.4% + Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_6= Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150 ppm; T_7 = Foliar spray with Cupravit 50 WP at 0.2%; T_8 = Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_9= Foliar spray with Streptomycin Sulphate at 150 ppm; T_{10} = Control

Table 4. Comparative effect of different treatments on plant height, number of branch per plant and number of fruiting branch per plant of cotton

Treatments	Plant height at harvest (cm)		Number of branches per plant		Number of fruiting branch per plant	
T_1	99.17	c	16.00	d	12.20	c
T_2	131.40	a	21.50	abc	12.66	c
T_3	137.90	a	22.83	ab	15.32	a
T_4	134.60	a	21.42	abc	12.96	bc
T_5	135.70	a	21.83	abc	13.16	bc
T_6	138.10	a	23.92	a	15.75	a
T_7	103.80	c	19.75	bc	12.05	c
T_8	119.90	b	18.67	cd	12.27	c
T_9	136.40	a	22.25	abc	14.46	ab
T_{10}	95.99	c	16.00	d	11.66	c
LSD $_{(0.05)}$	8.16		3.29		1.64	
CV (%)	7.86		9.38		7.20	

Each data represents the mean value of three replications. Values followed by the same letter within a column are not significantly different (p≤ 0.05) according to Duncan's multiple range test

T_1 = Seed treatment with Cupravit 50 WP at 0.4%; T_2= Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4%; T_3 = Seed treatment with Streptomycin Sulphate at 0.15%; T_4 = Seed treatment with Cupravit 50 WP at 0.4% + Foliar spray with Cupravit 50 WP at 0.2%; T_5 = Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4% + Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_6= Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150ppm; T_7 = Foliar spray with Cupravit 50 WP at 0.2%; T_8 = Foliar spray with Cupravit 50 WP at0.2% and Indofil M-45 at 0.2%; T_9= Foliar spray with Streptomycin Sulphate at 150 ppm; T_{10} = Control

Table 5. Comparative effect of different treatments on number of bolls perplant, healthy bolls per plant, rotten bolls per plant and weight ofseed cotton of ten bolls per plantof cotton

Treatmens	Total no. of bolls/plant		Healthy bolls/ plant		Rotted bolls/plant		Weight of seed cotton of ten bolls per plant(g)	
T_1	11.50	d	12.75	b	5.17	b	36.59	d
T_2	17.33	bc	13.92	b	3.42	cd	40.19	abcd
T_3	17.92	b	14.58	b	3.58	c	44.17	ab
T_4	12.92	d	9.00	c	3.58	c	40.53	abcd
T_5	17.50	bc	13.92	b	3.13	cd	41.17	abcd
T_6	22.75	a	19.62	a	2.67	d	44.43	a
T_7	12.33	d	8.92	c	3.25	cd	37.72	cd
T_8	16.67	bc	14.58	b	5.42	b	38.05	bcd
T_9	17.25	bc	9.67	c	3.50	cd	43.93	abc
T_{10}	15.75	c	8.17	c	6.07	a	35.01	d
LSD $_{(0.05)}$	1.65		1.92		0.80		5.56	
CV (%)	5.93		8.92		11.66		8.07	

Each data represents the mean value of three replications. Values followed by the same letter within a column are not significantly different (p≤ 0.05) according to Duncan's multiple range test

T_1 = Seed treatment with Cupravit 50 WP at 0.4%; T_2= Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4% ; T_3 = Seed treatment with Streptomycin Sulphate at 0.15%; T_4 = Seed treatment with Cupravit 50 WP at 0.4% + Foliar spray with Cupravit 50 WP at 0.2%; T_5 = Seed treatment with Cupravit 50 WP at 0.4% and Indofil M-45 at 0.4% + Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_6= Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150ppm; T_7 = Foliar spray with Cupravit 50 WP at 0.2%; T_8 = Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_9= Foliar spray with Streptomycin Sulphate at 150 ppm; T_{10} = Control

Table 6. Comparative effect of different treatments on seed cotton yield and stalk yield of cotton

Treatments	Seed cotton yield (kg/plot)		Seed cotton yield (ton/ha)		Stalk yield (kg/plot)		Stalk yield (ton/ha)		Seed cotton yield increase over the control
T_1	2.81	cd	1.64	bcd	5.15	ab	2.97	c	22.44
T_2	2.96	bcd	1.70	bcd	5.57	ab	3.20	abc	28.00
T_3	3.43	ab	1.97	ab	5.94	a	3.42	ab	32.49
T_4	3.07	bcd	1.77	bcd	5.72	ab	3.29	abc	29.89
T_5	3.15	bcd	1.81	bcd	5.89	a	3.39	ab	31.92
T_6	3.75	a	2.16	a	6.13	a	3.53	a	34.58
T_7	2.78	cd	1.60	cd	5.38	ab	3.06	bc	24.62
T_8	2.89	bcd	1.66	bcd	5.46	ab	3.14	bc	26.56
T_9	3.35	abc	1.93	abc	5.87	a	3.38	ab	31.67
T_{10}	2.67	d	1.53	d	4.01	b	2.31	d	-
$LSD_{(0.05)}$	0.52		0.31		1.64		0.33		
CV (%)	9.76		10.01		7.33		10.36		

Each data represents the mean value of three replications.Values followed by the same letter within a column are not significantly different (p≤ 0.05) according to Duncan's multiple range test

T_1 = Seed treatment with Cupravit50 WP at 0.4% ; T_2= Seed treatment with Cupravit 50 WP at0.4% and Indofil M-45 at 0.4% ; T_3 = Seed treatment with Streptomycin Sulphate at 0.15% ; T_4 = Seed treatment with Cupravit 50 WP at 0.4% + Foliar spray with Cupravit 50 WP a t0.2% ; T_5 = Seed treatment with Cupravit 50 WP at0.4% and Indofil M-45 at 0.4% + Foliar spray with Cupravit 50 WP at 0.2% and Indofil M-45 at 0.2%; T_6= Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150ppm ; T_7 = Foliar spray with Cupravit 50 WP at0.2% ; T_8 = Foliar spray with Cupravit 50 WP at0.2% and Indofil M-45 at 0.2% ; T_9= Foliar spray with Streptomycin Sulphate at 150ppm ;T_{10} = Control

The highest stalk yield (1.53 and 3.53 kg/plot and ton/ ha, respectively) was obtained from T_6(Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate 150ppm) treatment. The lowest stalk yield (1.00 and 2.31 kg/plot and ton/ha, respectively) was obtained in T_{10} (control) treatment.

4. DISCUSSION

Three chemicals viz.Cupravit 50 WP, Indofil M-45 and Streptomycin Sulphate used as seed treatment or foliar spray or both seed treatment and foliar spray were used for the control of bacterial blight of cotton. All treatments significantly reduced percentage disease index over control. This finding is supported by many researcher [2,10,11,12]. Among the different treatments, the lowest disease index (22.66%) and the highest disease control (44.46%) were recorded at 105 DAS in T_6(Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate 150ppm) where seeds were treated with Streptomycin Sulphate at 0.15% + foliar spray with Streptomycin Sulphate at150ppm were given. The second best control was found in the plots (T_9) where Streptomycin Sulphate at 150ppm was foliar sprayed. The highest PDI (40.80%) were recorded in control (T_{10}) and it was statistically different from the other treatments.

In the present experiment, it has been found that all the treatments resulted significant effect on plant height, number of branches per plant and number of fruiting branches per plant.This pronouncement is supported by some scientists [2,10,11,12].

Significant effect of different treatments on number of bolls per plant, healthy bolls per plant, rotten bolls per plant and weight of seed cotton of ten bolls per plant was observed. The utmost totalnumber of bolls per plant (22.75) was obtained from T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin Sulphate at 150ppm)treatment and the lowest number oftotal bolls per plant (15.75) was observed from control which was supported [2].

Seed cotton and stalk yield performance different significantly from one treatment to another. Yield of seed cotton and stalk were the highest in T_6 (Seed treatment with Streptomycin Sulphate at 0.15% + Foliar spray with Streptomycin at 150ppm). The next highest yield was found in T_3 where the plots were sprayed with Seed treatment with Streptomycin Sulphate at 0.15%. The results of the present investigation clearly indicated that treated plots of Streptomycin Sulphate increase both seed cotton and stalk yield. Three sprays of Agrimycin-100

(Streptomycin + Oxytetracycline) + Blitox-50 (Copper oxychloride) reduced disease intensity 46.49% and increased yield of seed cotton by 26.57% has been reported [9]. It is also reported that bacterial blight of cotton (*Xanthomonas campestris* pv. *malvacearum*) was effectively controlled by spraying mixture of Agrimycin-100 (0.01%) + Blitox-50 (Copper oxychloride) at 0.2% and yield of seed cotton was increased [13]. Copper oxychloride in combination with Streptomycin Sulphate gave satisfactory control against bacterial blight and the highest yield (904 kg/ha) has also been reported [14]. Streptomycin Sulphate was also highly effective against *Xanthomonas campestris* pv. *malvacearum* In in vitro condition [15]. In another study Streptomycin Sulphate (0.1%) was not found effective in controlling cotton boll rot [16]. The findings of the present studies pointed out that seed treatment and foliar spray with Streptomycin Sulphate may be advisable as the best way to management of bacterial blight of cotton with increasing yield.

5. CONCLUSION

In the field condition seed treatment with Streptomycin Sulphate @ 0.15% + Foliar spray with Streptomycin Sulphate @ 150 ppm gave the superior result and reduced disease intensity of bacterial blight by 44.46% and increased the yield of seed cotton up to 34.58%. Findings of the present studies pointed out that seed treatment and foliar spray with Streptomycin Sulphate may be advisable as the best way for management of bacterial blight of cotton with increasing the yield of seed cotton.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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