
Field evaluation of various chemicals and bioagent against Bacterial Blight of Desi Cotton

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In India, the states of Maharashtra (26.63%), Gujarat (17.96%) and Andhra Pradesh (13.75%) and also Madhya Pradesh are the leading cotton producing states, these states have a predominantly tropical wet and dry climate. Bacterial blight cause yield loss of 38.78 per cent. Losses are less when only leaves are infected but when stem lesions are formed, the losses may be high as upto 90%. The experiment was planned to evaluate the twelve spray treatments viz. 10 chemicals, one bioagent and one untreated control in natural field conditions against *Xanthomonas axonopodis* pv. *malvacearum* causing bacterial blight of cotton in Desi varieties. First spray was given at first appearance of disease and subsequent two sprays were given at 15 days interval. Observations on disease incidence (PI) and disease severity (PDI) were recorded before one day of each spray. Among the chemicals and bioagent tested the results obtained after third spray indicated that significantly lowest disease incidence of 20.84 % was recorded by the treatment streptomycin + copper oxychloride followed by the treatment streptomycin + carbendazim (20.92 %), streptomycin + copper hydroxide (20.96 %), bordeaux mixture (21.35 %), but all four treatments found at par in succession as against the unsprayed control 51.18 per cent (PI) and lowest disease severity of 10.22 % was recorded by the treatment streptomycin + Copper oxychloride followed by the treatment streptomycin + carbendazim (11.33 %), streptomycin + copper hydroxide (13.00 %), streptomycin (13.45 %).

Keywords : Bacterial blight, Bt cotton, *Xanthomonas axonopodis* pv. *malvacearum*,

INTRODUCTION

Cotton (*Gossypium* spp.) is the most extensively cultivated commercial crop and is a major fibre crop of global importance and has high commercial value. Cotton locally known as "White Gold" is also a kind of cash crop.

Cotton is grown commercially in the temperate and tropical regions of more than 70 countries. Specific areas of production include countries such as China, USA, India, Pakistan, Uzbekistan, Turkey, Australia, Greece, Brazil, Egypt etc where climatic conditions suit the natural growth requirements of cotton, which includes periods of hot and dry weather and adequate moisture obtained through irrigation.

Cotton is mainly grown for fibre needs of the human. Cotton almost accounts 65 per cent of fibre production in India. Edible oil is extracted from cotton seed and de-oiled cakes are used as a cattle feed, which is a good source of high-quality protein for animals. Cotton cake after extraction of oil is used as a good organic manure which contains near about 6 per cent nitrogen, 3 per cent phosphorus and 2 per cent potash.

India is the only country in the world where all the four cultivated species of cotton, viz. *G.hirsutum*, *G.arboreum*, *G.herbaceum* and *G.barbadense*, are cultivated on commercial scale, besides their hybrid combinations. The diversity of cotton cultivars and cotton agroclimatic zones in India is considerably larger as compared to other major cotton growing countries in the world.

India has the largest cotton area in the world with about 115.53 lakh hectares under cultivation

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accounting for one-fourth of the global cotton area and has emerged as the world's second largest cotton producer in 2013-14. China is the world's leading cotton producer. It has been estimated that cotton contributes to approximately 30% of the Indian agricultural gross domestic product and considerable export earnings (Anonymous, 2014).

In India, the states of Maharashtra (26.63%), Gujarat (17.96%) and Andhra Pradesh (13.75%) and also Madhya Pradesh are the leading cotton producing states, these states have a predominantly tropical wet and dry climate. Area under cotton in Maharashtra is 38.72 lakh ha and production is around 78.25 lakh bales with an average productivity of 360.80 kg / ha (Anonymous, 2014).

Amongst the several factors responsible for reduction in yield and quality deterioration of cotton in India, diseases play a vital role. Cotton crop in India is known to suffer from number of diseases. Important diseases of cotton are given in the following.

Fungal diseases of cotton include Wilt, caused by *Fusarium oxysporum f.sp vasinfectum*, Verticillium wilt by *Verticillium dahliae*, Alternaria blight by *Alternaria crospora*, Grey mildew by *Ramularia areola*, Anthracnose by *Colletotrichum gossypii* and Ascochyta blight by *Ascochyta gossypii*. Few bacterial diseases such as Bacterial blight and Crown gall, caused by *Xanthomonas axonopodis pv. malvacearum* and *Agrobacterium tumefaciens*, respectively as well as a viral disease caused by Cotton leaf curl virus (CLCuV) also occur on cotton.

Among this, bacterial blight is one of the most important diseases of cotton and was first reported from Alabama (USA) by Atkinson in 1891. The disease was first reported in India from Rajapalayam, Tamil Nadu in 1918.

There are earlier reports of management of diseases of cotton by both chemical and biological treatments (Hosagoudar and Chattanvar, 2008; Chattannavar *et al.* 2013)

Bacterial blight of cotton caused by *Xanthomonas axonopodis pv. malvacearum* is one of the serious

diseases of cotton. It is recorded in almost every country in the world which grows cotton. It is an important disease of cotton in India, Pakistan, China, South East Asia, South America, Australia and Europe. In India, it is an economically important disease in almost all the states wherever cotton is grown viz. Andhra Pradesh, Haryana, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu and Western Uttar Pradesh

MATERIALS AND METHODS

In vivo evaluation of chemicals and bioagent

A field experiment on management of bacterial blight of cotton was conducted (Plate I) at Cotton Research Scheme, Parbhani. Experiment was laid out in Randomized Block Design with 12 treatments replicated thrice. Unsprayed plants were served as control and three sprays were given as per schedule given in treatment details (Table 1).

Experimental details for desi cotton

Design	: RBD
Treatments	: 12
Replication	: 3
Plot size	: 5.85 m x 4.5 m
Spacing	: 45 x 22.5 cm
Spacing between plots	: 0.5 m
Spacing between replication	: 1 m
Variety	: PA 255
Season	: <i>Kharif</i>
Location	: Cotton Research Scheme, VNMKV, Parbhani.

Spraying schedule

1. First spray immediately after disease appearance.
2. Subsequent spray at 15 days after first spray.
3. Immediately after receipt of rains during flowering / seed setting.

Observations on disease incidence and severity were recorded at 15 days interval after each spray.

Table 1: Treatment Details

Tr.No	Treatments	Trade name	Concentration
T ₁	Streptomycin sulphate	Streptocycline	100 ppm
T ₂	Streptomycin + Tetracycline	Plantomycin	100 ppm
T ₃	2-bromo-2-nitropropane-1,3-diol	Bactrinashak	100 ppm
T ₃	2-bromo-2-nitropropane-1,3-diol	Bactrinashak	100 ppm
T ₄	Copper hydroxide 77 WP	Kocide	0.25%
T ₅	Copper oxychloride 50WP	Blitox	0.25%
T ₆	<i>Pseudomonas fluorescens</i>	-	0.2%
T ₇	Carbendazim (Methyl-2-benzimidazolecarbamate)	Bavistin	0.1%
T ₈	Bordeaux mixture	-	1%
T ₉	Streptomycin sulphate + Copper hydroxide 77 WP	-	100 ppm + 0.25%
T ₁₀	Streptomycin sulphate + Copper oxychloride 50WP	-	100 ppm + 0.25%
T ₁₁	Streptomycin sulphate + Carbendazim	-	100 ppm + 0.1%
T ₁₂	Control		

Spraying schedule

1. First spray immediately after disease appearance.
2. Subsequent spray at 15 days after first spray.
3. Immediately after receipt of rains during flowering / seed setting. Observations on disease incidence and severity were recorded at 15 days interval after each spray.

RESULTS AND DISCUSSION

In vivo evaluation of different chemicals and bioagent against *Xanthomonas axonopodis* pv. *malvacearum*

A general view of Desi cotton growing field and symptoms of disease are shown in Figs. 1 & 2.

Per cent disease incidence for Desi cotton

Data on disease incidence is presented in Table 2 and Fig. 3. Results obtained were significant at first, second and third spray. All the treatments

recorded significantly low disease incidence over control at first, second and third spray. Mean per cent disease incidence ranged from 13.37% to 28.10%.

The disease initiated at 60 days after sowing (DAS). The disease incidence were recorded before spraying of various chemicals and bioagent and the per cent disease incidence ranged from 11.11 % to 19.16 %. In plot, treatment T₁₀ recorded low per cent incidence of 11.11 % and maximum observed in control plot of 19.16 % PI.

Among the twelve chemicals and bioagent sprayed, at the end of first spray significantly lowest disease incidence of 15.41 % was recorded by treatment streptocycline plus copper oxychloride followed by treatment streptocycline plus carbendazim (17.49 %), but was par at with treatment streptocycline + copper hydroxide (18.60 %). This was followed by the treatment streptocycline with recorded disease incidence of 19.58 % .There was no control of pathogen in single spray. After the first spray there was increase in per cent disease incidence to a range of 15.41 % to 26.39 %.

At the end of second spray significantly lowest disease incidence of 13.05 % was recorded by

Table 2: *In vivo* efficacy of chemicals and biocontrol agent on per cent disease incidence of *Xanthomonas axonopodis* pv. *malvacearum* on Desi cotton var. PA 255

Tr.No	Treatments	Trade name	Concentration
T ₁	Streptomycin sulphate	Streptocycline	100 ppm
T ₂	Streptomycin + Tetracycline	Plantomycin	100 ppm
T ₃	2-bromo-2-nitropropane-1,3-diol	Bactrinashak	100 ppm
T ₃	2-bromo-2-nitropropane-1,3-diol	Bactrinashak	100 ppm
T ₄	Copper hydroxide 77 WP	Kocide	0.25%
T ₅	Copper oxychloride 50WP	Blitox	0.25%
T ₆	<i>Pseudomonas fluorescens</i>	-	0.2%
T ₇	Carbendazim (Methyl-2-benzimidazolecarbamate)	Bavistin	0.1%
T ₈	Bordeaux mixture	-	1%
T ₉	Streptomycin sulphate + Copper hydroxide 77 WP	-	100 ppm + 0.25%
T ₁₀	Streptomycin sulphate + Copper oxychloride 50WP	-	100 ppm + 0.25%
T ₁₁	Streptomycin sulphate + Carbendazim	-	100 ppm + 0.1%
T ₁₂	Control		

*Mean of the three replications and Figures in parenthesis are transformed value

Table 2: *In vivo* efficacy of chemicals and biocontrol agent on disease severity of *Xanthomonas axonopodis* pv. *malvacearum* of Desi cotton

Tr. No	Treatments	Conc.	PDI before spray	Per cent disease intensity (PDI)			Mean PDI	PDC
				I	II	III		
T ₁	Streptocycline	100 ppm	8.67 (17.12)	13.76 (21.77)	10.44 (18.84)	9.11 (17.56)	11.10 (19.39)	51.89
T ₂	Plantomycin	100 ppm	12.53 (20.72)	16.64 (24.05)	13.45 (21.51)	12.2 (20.44)	14.09 (22.00)	38.93
T ₃	Bactrinashak	100 ppm	13.46 (21.51)	17.96 (24.95)	14.77 (22.58)	12.67 (20.84)	15.13 (22.79)	34.45
T ₄	Copper hydroxide	0.25 %	11.33 (19.65)	15.89 (23.44)	12.44 (20.65)	10.77 (19.15)	13.03 (21.08)	43.53
T ₅	Copper oxychloride	0.25 %	12.2 (20.44)	16.33 (23.82)	13.0 (21.09)	11.66 (19.95)	13.67 (21.62)	40.81
T ₆	<i>Pseudomonas fluorescens</i>	0.2 %	14.11 (22.03)	20.23 (26.70)	17.0 (24.31)	14.11 (22.03)	17.11 (24.35)	25.87
T ₇	Carbendazim	0.1 %	9.45 (17.89)	15.45 (23.09)	11.33 (19.64)	10.22 (18.63)	12.33 (20.45)	46.57
T ₈	Bordeaux mixture	1 %	9.0 (17.45)	15.22 (22.92)	10.86 (19.23)	9.34 (17.77)	11.80 (19.97)	48.85
T ₉	Streptocycline + Copper hydroxide	100 ppm + 0.25 %	8.22 (16.65)	12.09 (20.34)	9.89 (18.32)	8.45 (16.89)	10.14 (18.52)	56.07

Table 3 : *In vivo* efficacy of chemicals and biocontrol agent on disease severity of *Xanthomonas axonopodis* pv. *malvacearum* of Desi cotton

Tr. No	Treatments	Conc.	PDI before spray	Per cent disease intensity (PDI)			Mean PDI	PDC
				I	II	III		
T ₁	Streptocycline	100 ppm	8.67 (17.12)	13.76 (21.77)	10.44 (18.84)	9.11 (17.56)	11.10 (19.39)	51.89
T ₂	Plantomycin	100 ppm	12.53 (20.72)	16.64 (24.05)	13.45 (21.51)	12.2 (20.44)	14.09 (22.00)	38.93
T ₃	Bactrinashak	100 ppm	13.46 (21.51)	17.96 (24.95)	14.77 (22.58)	12.67 (20.84)	15.13 (22.79)	34.45
T ₄	Copper hydroxide	0.25 %	11.33 (19.65)	15.89 (23.44)	12.44 (20.65)	10.77 (19.15)	13.03 (21.08)	43.53
T ₅	Copper oxychloride	0.25 %	12.2 (20.44)	16.33 (23.82)	13.0 (21.09)	11.66 (19.95)	13.67 (21.62)	40.81
T ₆	<i>Pseudomonas fluorescens</i>	0.2 %	14.11 (22.03)	20.23 (26.70)	17.0 (24.31)	14.11 (22.03)	17.11 (24.35)	25.87
T ₇	Carbendazim	0.1 %	9.45 (17.89)	15.45 (23.09)	11.33 (19.64)	10.22 (18.63)	12.33 (20.45)	46.57
T ₈	Bordeaux mixture	1 %	9.0 (17.45)	15.22 (22.92)	10.86 (19.23)	9.34 (17.77)	11.80 (19.97)	48.85
T ₉	Streptocycline + Copper hydroxide	100 ppm + 0.25 %	8.22 (16.65)	12.09 (20.34)	9.89 (18.32)	8.45 (16.89)	10.14 (18.52)	56.07
T ₁₀	Streptocycline + Copper oxychloride	100 ppm + 0.25 %	6.43 (14.69)	10.22 (18.63)	8.67 (17.11)	7.31 (15.64)	8.73 (17.13)	62.17
T ₁₁	Streptocycline+ Carbendazim	100 ppm + 0.1 %	7.55 (15.93)	11.66 (19.95)	9.22 (17.67)	7.89 (16.31)	9.59 (17.98)	58.45
T ₁₂	Control (Untreated)		15.44 (23.08)	21.56 (27.65)	23.5 (28.83)	24.21 (29.43)	23.09 (28.64)	
	SE ±		0.58	0.97	1.00	0.67		
	CD at 5%		1.73	2.86	2.94	1.97		

*Mean of the three replications and Figures in parenthesis are transformed value

treatment streptocycline + copper oxychloride followed by treatment streptocycline+ carbendazim (14.02 %), but was par at with treatment streptocycline + copper hydroxide (14.72 %). This was followed by the treatment streptocycline with recorded disease incidence of 15.55 %. The results obtained after third spray indicated that significantly lowest disease incidence of 11.66 % was recorded by the treatment streptocycline + copper hydroxide followed by the treatment streptocycline + carbendazim (12.36 %), streptocycline + copper hydroxide (12.77 %), streptocycline (13.33 %), the later three treatments found at par in succession.

Disease severity (PDI) for Desi cotton

Data on disease severity is presented in Table 2 and Fig 4. The results on disease severity were significant over control at first, second and third spray.

The disease severity was recorded before spraying of various chemicals and bioagent and the per cent disease incidence ranged from 6.43 % to 15.44 %. In plot, treatment T₁₀ recorded low per cent incidence of 6.43 % and maximum observed in control plot of 15.44 % PDI.

All the treatments recorded significantly low disease severity over control at first, second and third spray. Mean per cent disease severity ranged from 8.73 % to 23.09 %.

Among the ten chemicals and bioagent sprayed, at the end of first spray significantly lowest disease severity of 10.22 % was recorded by treatment streptocycline+ copperoxychloride followed by treatment streptocycline + carbendazim(11.66 %), streptocycline + copper hydroxide (12.09 %), streptocycline (13.76 %).

There was no control of pathogen in single spray. After the first spray there was increase in per cent



Fig. 1: General view of Desi Cotton Field



A) Angular leaf spot of cotton



B) Boll rot

Fig. 2: Typical symptoms of Xam on Desi Cotton (var. PA 255)

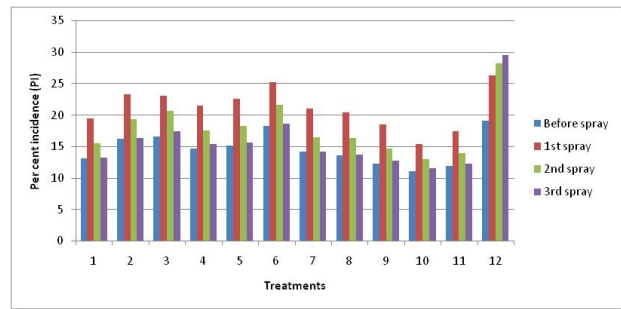


Fig. 3: In vivo efficacy of chemicals and biocontrol agent on per cent disease incidence of *Xanthomonas axonopodispv. malvacearum* of desi cotton

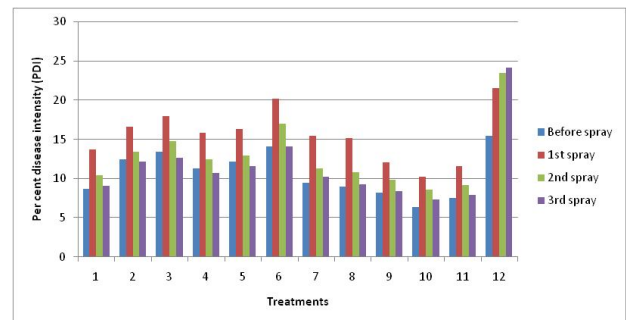


Fig. 4: In vivo efficacy of chemicals and biocontrol agent on disease severity of *Xanthomonas axonopodispv. malvacearum* of desi cotton

disease severity to a range of 10.22 % to 21.56 %.

At the end of second spray significantly lowest disease severity of 8.66 % was recorded by the treatment streptomycin + copper oxychloride, but was at par with treatment streptomycin + carbendazim (9.23 %). this was followed by streptomycin + copper hydroxide (9.89 %), streptomycin (10.44 %).

The result obtained after third spray indicated that significantly lowest disease severity of 7.31 % was recorded by the treatment streptomycin + copper oxychloride followed by the treatment streptomycin+ carbendazim (7.89 %), streptomycin + copper hydroxide (8.45 %), streptomycin (9.11 %). The mean PDI ranged from 8.73 to 23.09. Disease index was reduced significantly in plot treated as compared to untreated control.

Among the ten chemicals and bioagent sprayed lowest mean disease severity of 8.73 was recorded by the treatment streptomycin + copper oxychloride and this reduced disease to an extent of 62.17 %. This was followed by the treatment

streptocycline+ carbendazim (9.59 %) and streptocycline + copper hydroxide (10.14 %) with reduction in disease to an extend of 58.45 to 56.07 per cent respectively.

Similar results were obtained by several previous workers such as Kumaret al. (2006), ,Ingole et al. (2011, 2015), Jagtap et al. (2012), Kumhar et al. (2018) and Jat et al.(2022). Lokesh et al. (2014) reported on the use of antibiotics for control of bacterial blight of pomegranate, while Prasad et al.(2018) also reported the management of bacterial blight of rice through use of antibiotics.

It is thus clear that management of severe diseases of cotton such as bacterial blight can be done through judicious use of chemicals and biologicals.

DECLARATION

Conflict of Interest. Authors declare no conflict of interest.

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