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RESEARCH ARTICLE

Efficacy of bactericides and antibacterial chemicals against bacterial blight of pomegranate

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ABSTRACT

Bacterial blight of pomegranate caused by *Xanthomonas axonopodis* pv *punicae* has become a severa disease in Maharashtra, Karnataka and Andhra Pradesh. Among the different strategies available for the management of the disease, use of chemicals tends to be more assured. Hence, an attempt was made to evaluate the available bactericides and antibacterial chemicals for their efficacy against the disease. The study included both *in vitro* and *in vivo* methods. Laboratory assay revealed the superior efficacy of bactinash-200 with an inhibition zone of 15.07 mm followed by bronip (14.67 mm) and plantomycin (13.77 mm) in suppressing the growth of the pathogenic bacterium. Further, field evaluation over the seasons showed that, bronip (0.05%) was significantly effective in recording the minimum disease incidence (17.18%) followed by bactinash-200 (23.26%) and bactrinashak (24.30%) at the similar concentration. In respect of reducing the disease severity, bactinash-200 (7.33 PDI) followed by bronip (7.87 PDI) were found significantly effective after 5th application of treatments. The efficacy of all the antibacterial chemicals was significantly low with Bordeaux (1%) mixture as least effective antibacterial chemical (61.38% incidence and 30.90 PDI). Correspondily highest yield of 10.20 tons/ha was obtained in bronip treated plot followed by at par yield level (9.28 tons/ha) in bactrinashak treated plot. Maximum disease incidence (68.57%) and severity (42.93 PDI) was recorded in untreated check plot.

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INTRODUCTION

Bacterial blight of pomegranate caused by *Xanthomonas axonopodis* pv. *punicae* deemed earlier as disease of minor importance assumed its severity during 2002 in the states of Maharashtra, Karnataka and Andhra Pradesh. The disease prevailed in all the seasons *viz.*, Mrigbahar, Hastbahar and Ambiabahar and continued to damage the crop for subsequent 4-5 years. Unable to manage the disease, growers were put in dire straits and many have uprooted their crop owing to unbearable losses. Pomegranate, the boon commercial fruit crop to the farmer turned as a big bane after the disease out break.

Among the several strategies available for disease management, protection through chemicals is an vital approach and is more assured to the farmers. However, very little information is available on chemical management of bacterial diseases that to bacterial blight of pomegranate. Rangaswamy (1962) stated that spraying of 5:5:50 Bordeaux mixture and one per cent perenox 1:50 lime sulphur could control bacterial disease on pomegranate. Chakravarti and Rangarajan (1966) studied the *in vitro* effect of streptocycline on seven

species of *Xanthomonas*, six species of *Erwinia* and one each of *Pseudomonas, Corynebacterium* and *Agrobacterium*. Although large number of chemicals are available in the market as bactericides, but their efficacy against the particular disease is yet unknown. Hence, efforts were made to evaluate commercially available bactericides and antibacterial chemicals against bacterial blight pathogen, the disease of pomegranate.

MATERIAL AND METHODS

Evaluation was carried by both *in vitro* and *in vivo* method.

***In vitro* evaluation :**

In vitro assay included nine treatments comprising six commercially available bactericides and three antibacterial chemicals, each evaluated at two concentrations by inhibition zone assay. The list of chemicals along with concentrations is furnished as under.

Sr. No.	Bactericides/Antibacterial chemicals	Concentration (%)	
1.	Bacterinashak	0.05	0.1
2.	Bactinash 200	0.05	0.1
3.	Bronip	0.05	0.1
4.	K-cycline	0.05	0.1
5.	Plantomycin	0.5	1
6.	Streptocycline	0.05	0.1
7.	Bleaching powder	0.5	1
8.	Bordeaux mixture	0.5	1
9.	Copper oxychloride	0.2	0.3

The bacterial pathogen was multiplied with the inoculation of culture in 20 ml of Nutrient broth. The pathogen was allowed to grow at 30^0C for 72 hours. After the incubation, the pathogenic suspension was seeded into lukewarm Nutrient agar medium. The seeded medium was poured into sterilized Petriplates and then allowed to solidify. Then the bactericides solution was prepared by dissolving the required quantity of each chemical in sterilized distilled water, so as to get the desired concentration. The filter paper discs (Whatman No.42) measuring 5mm diameter were soaked for five minutes in respective treatment solution and then placed on to the surface of the seeded medium. The inoculated plates were kept in refrigerator at 5^0C for 4 hours so as to allow the diffusion of chemical into the medium followed by incubation at 30^0C for 72 hours. The observations were drawn for the production of inhibition zone. Data obtained were analyzed statistically.

Field evaluation :

Field trial was conducted with similar set of chemicals. The trial was carried out in two seasons *viz.*, Mrigbahar (June-December) of 2007 and Ambiabahar (Feb-August) of 2008 in farmers field. The experiment was setup in Randomized Complete Block Design (RCBD) with three replications and there were four plants for each treatment. All the bactericides were used at 0.05 per cent concentration in combination with copper oxychloride @ 0.2 per cent. Among the antibacterial chemicals, Bordeaux mixture and bleaching powder were sprayed each at 1 per cent concentration and copper oxychloride alone was used at 0.2 per cent concentration.

A total of five sprays were given at an interval of 10 days between each spray with first spray at the disease onset. Observations were drawn for the disease incidence and severity on fruits before and after third and fifth spray using the following 0-6 scale developed by Anonymous (2006):

Grade	Pre cent infection on fruit
0	0.0
1	upto 1
2	>1-10
3	>10-20
4	>20-40
5	>40-70
6	>70-100

Per cent disease incidence and per cent disease severity index was calculated by applying the following formula :

$$\text{Per cent disease incidence} = \frac{\text{Number of fruits inf ected}}{\text{Total number of fruits}} \times 100$$

$$\text{Per cent disease index} = \frac{\text{Sum of individual disease ratings}}{\text{Total number of fruits examin ed}} \times \frac{100}{\text{Maximum grade}}$$

RESULTS AND DISCUSSION

Results obtained after *in vitro* evaluation reveled the significant superior efficacy of bactinash-200 with an inhibition zone of 15.07 mm (Table 1 and Fig. 1 and 2) followed by bronip (14.67 mm) and plantomycin (13.77 mm) with at par efficacy between each other. The other chemicals *viz.*, K-cycline, copper oxychloride, Bordeaux mixture, bactrinashak, bleaching powder and streptocycline, exhibited at par moderate efficacy each other.

Between the concentrations, efficacy was significant from lower to higher concentration with greater efficacy at higher concentration.

Interaction effect between bactericides and concentrations revealed that, bronip (0.1%) and bactinash-200 (0.1%) were highly effective with an inhibition zone of 17.67 mm and 17.27 mm, respectively followed by plantomycin @ 1 per cent (16.23mm). The efficacy between these bactericides was non-significant. The moderate effective treatments were copper oxychloride @ 0.3 per cent (11.97 mm), K-cycline @ 0.1per cent (11.56 mm), plantomycin @ 0.5 per cent (11.30 mm), Bordeaux mixture @ 1 per cent (10.47 mm)

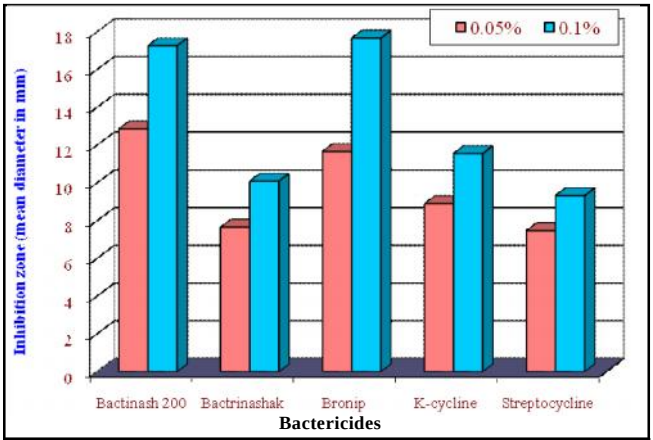

Fig. 1 : *In vitro* evaluation of bactericides on the growth of *Xanthomonas axonopodis pv. punicae*

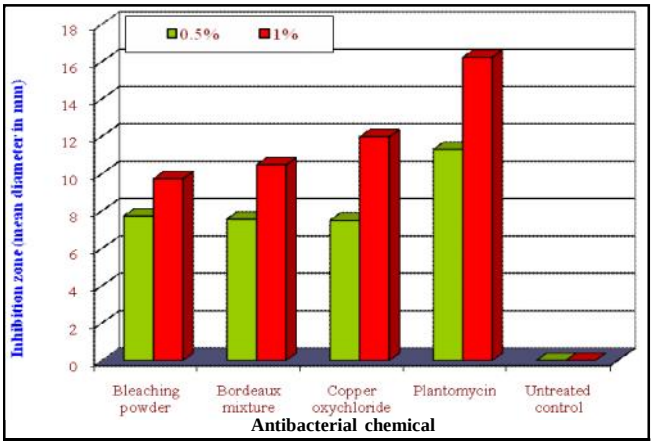

Fig. 2 : *In vitro* evaluation of antibacterial chemical on the growth of *Xanthomonas axonopodis pv. punicae*

and bactrinashak @ 0.1 per cent (10.10 mm) being at par with each other in efficacy. Copper oxychloride @ 0.5 per cent was found least effective with an inhibition zone of 7.50 mm.

In vitro evaluation of any pesticide molecule provides preliminary information about the efficacy of particular chemical in a shortest period of time and therefore serves as a basis for field assay.

Sharma *et al.* (1981) obtained the highest inhibition effect on the growth of *Xanthomonas vesicatoria* by the combined treatment of streptocycline and copper sulphate. Venugopal (1983) studied the *in vitro* sensitivity of different isolates of *Xanthomonas campestris* pv. *mangiferae indicae* to streptomycin and poushamycin @ 100 and 250 ppm concentrations, respectively.

The present findings are in agreement with the report of Manjula *et al.* (2002), who recorded the highest inhibition on the growth of pathogen by poushamycin (0.05%) and K-cycline (0.05%) treatments. However, they also reported that, bacterinol (0.05%) and bacteriomycin (0.05%) were equally effective against the pathogen. The technical grade of bacteriomycin, bactinash-200 and bronip is same as 2 bromo 2 nitro propane 1.3 diol.

Field evaluation :

The similar chemicals comprising bactericides and antibacterial chemicals were subjected for evaluation to test their field efficacy. The evaluation was carried out in two seasons.

Mrigbahar season trial :

It was observed that, incidence and severity of bacterial blight before the imposition of treatment was non-significant.

Results (Table 2) obtained after 3 sprays revealed that,

Table 1: *In vitro* evaluation of bactericides and antibacterial chemicals on the growth of *Xanthomonas axonopodis* pv. *punicae*

Sr. No.	Bactericides	Inhibition zone (mean diameter in mm)		
		0.05%	0.1%	Mean
1.	Bactinash-200	12.86 (3.71)#	17.27 (4.27)	15.07 (3.99)
2.	Bactrinashak	7.66 (2.94)	10.10 (3.32)	8.88 (3.13)
3.	Bronip	11.67 (3.56)	17.67 (4.32)	14.67 (3.94)
4.	K-cycline	8.90 (3.14)	11.56 (3.54)	10.23 (3.34)
5.	Streptocycline	7.47 (2.91)	9.33 (3.21)	8.40 (3.06)
	Antibacterial chemicals	0.5%	1.0%	Mean
6.	Bleaching powder	7.73 (2.95)	9.73 (3.27)	8.73 (3.11)
7.	Bordeux mixture	7.57 (2.93)	10.47 (3.38)	9.02 (3.16)
8.	Copper oxychloride	7.50 (2.92)*	11.97(3.58)**	9.74 (3.25)
9.	Plantomycin	11.30 (3.51)	16.23 (4.14)	13.77 (3.83)
10.	Untreated control	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
	Mean	8.27 (2.96)	11.43 (3.40)	9.85 (3.18)
	Source	S.Em		C.D. (P=0.01)
	Bactericides (B)	0.093		0.35
	Concentration (C)	0.041		0.16
	Interaction (B × C)	0.13		0.50

$\sqrt{x+1}$ transformed values * : Copper oxychloride @ 0.2% ** : Copper oxychloride @ 0.3%

bronip (24.16% incidence and 3.64 PDI), bactrinashak (24.11 % incidence and 4.51 PDI) and bactinash-200 (27.77% incidence and 4.28 PDI) each at 0.05 per cent concentration used in combination with copper oxycholoride (0.2%) were highly effective in reducing the disease. These bactericides possessed at par efficacy each other but their efficacy was significantly superior over other treatments except K-cycline (0.05%).

Among the antibacterial chemicals, the bleaching powder (1%) and copper oxychloride (0.2%) significantly exhibited lower field efficacy with higher disease incidence and severity, respectively. Maximum disease incidence and severity of 67.35 per cent and 21.54 PDI was recorded in untreated check plot.

Efficacy after five sprays revealed that, bronip (0.05%) in combination with COC (0.2%) was significantly effective with lowest disease incidence of 12.99 per cent. The next best effective bactericides were bactrinashak (20.53%), bactinash-200 (23.62%) and K-cycline (27.50%), which possessed at par efficacy each other and recorded significantly superior efficacy over other treatments in reducing the disease incidence. In respect of disease severity, all the bactericides except plantomycin were found effective with lower disease severity ranging between 3.71 to 4.69 PDI. All the antibacterial chemicals were found least effective with the record of high disease incidence and severity.

Ambiabahar season trial (2008) :

Bacterial blight incidence and severity before the treatment application was non significant and almost uniform in the plots (Table 3). Significant differences among the treatments were observed after third application of bactericides. Significantly minimum disease incidence of 30.12 per cent was recorded in bronip treated plot followed by bactinash-200 (31.54%), bactrinashak (32.81%), K-cycline (34.02%) and streptocycline (36.62%). The antibacterial chemicals *viz.*, bleaching powder @ 1 per cent (45.07%), Bordeaux mixture @ 1 per cent (49.32%) were found less effective. Copper

Table 2 : Field evaluation of commercially available bactericides and antibacterial chemicals on the incidence and severity of bacterial blight of pomegranate during Mrigbahar (June-December) 2007

Sr. No.	Bactericides / antibacterial chemicals	Concentration (%)	Incidence and severity of bacterial blight on fruits at different spray intervals					
			Before spray		After 3 sprays		After 5 sprays	
			Per cent incidence	Per cent disease index	Per cent incidence	Per cent disease index	Per cent incidence	Per cent disease index
1.	Bactinash-200 +	0.05	30.69	4.71	27.77	4.28	23.62	3.71
	Copper oxychloride	0.2	(33.33)	(12.37)	(31.71)	(11.73)	(28.99)	(11.06)
2.	Bactrinashak +	0.05	42.07	6.44	24.11	4.51	20.53	4.69
	Copper oxychloride	0.2	(40.42)	(14.57)	(29.18)	(12.02)	(26.77)	(12.35)
3.	Bronip + Copper	0.05	29.36	5.73	24.16	3.64	12.99	3.83
	oxychloride	0.2	(32.74)	(13.74)	(29.39)	(10.54)	(21.05)	(11.02)
4.	K cycline + Copper	0.05	35.04	7.58	31.35	5.76	27.50	4.11
	oxychloride	0.2	(36.27)	(15.97)	(34.05)	(13.89)	(31.62)	(11.66)
5.	Plantomycin +	0.05	22.52	5.67	36.03	14.24	45.58	17.33
	Copper oxychloride	0.2	(28.27)	(13.62)	(36.83)	(21.95)	(42.52)	(24.55)
6.	Streptocycline +	0.05	38.21	6.85	35.79	5.26	32.82	4.56
	Copper oxychloride	0.2	(38.15)	(15.13)	(36.70)	(13.18)	(34.92)	(12.27)
7.	Bleaching powder	1	35.61	5.34	69.34	16.24	61.21	23.93
			(36.61)	(13.18)	(56.38)	(23.59)	(51.52)	(29.19)
8.	Bordeux mixture	1	30.73	6.51	41.38	12.57	68.54	30.07
			(33.61)	(14.63)	(40.00)	(20.66)	(55.91)	(33.19)
9.	Copper oxychloride	0.2	28.37	5.58	62.84	16.04	54.46	24.35
			(32.15)	(13.57)	(52.45)	(23.38)	(47.53)	(29.52)
10.	Untreated control	–	33.53	6.39	67.35	21.54	76.43	44.56
			(35.33)	(14.55)	(55.17)	(27.56)	(60.99)	(41.86)
	SEm ±		1.89	1.04	1.96	1.46	1.78	1.27
	C.D. (P=0.05)		NS	NS	5.84	4.34	5.29	3.77

Figures in parentheses are angular transformed values
Variety : Bhagwa
Time of pruning : II week of July, 2007
Number of sprays : 5
Date of I spray : 24th Sept., 2007
Spray interval : 10 days

oxychloride (0.2%) was found least effective with the record of maximum disease incidence of 53.99 per cent and its efficacy was at par with untreated control.

Similarly, disease severity recorded in all the bactericides treated plot was significantly less and ranged between 12.61 (bactinash-200) to 17.81 (K-cycline) per cent disease index. The antibacterial chemicals were also found moderately effective with the record of lower disease severity ranging between 24.17 (Bleaching powder) to 26.70 PDI (Bordeaux mixture).

Similar trend in respect of efficacy of bactericides was observed after fifth spray. Significantly lowest disease incidence of 21.37 per cent was recorded in bronip treated plot followed by bactinash-200. The next best effective treatments were bactrinashak and streptocycline with per cent disease incidence of 28.07 and 29.44, respectively. Performance of all the antibacterial chemicals in controlling the disease was very poor, which recorded higher disease incidence which ranged from 51.17 per cent (bleaching powder) to 56.37 per cent (copper oxychloride). Highest disease incidence of 67.98 per cent was recorded in untreated check plot.

Disease severity recorded after fifth spray exhibited the superior efficacy of bronip and bactinash-200 with lower per cent disease index. Streptocycline and bactrinashak were the next best effective bactericides. The antibacterial chemicals significantly showed lower efficacy against the disease severity.

Pooled performance over the years :

Average performance of bactericides and antibacterial chemicals tested over the seasons revealed that (Table 4 and Fig. 3), after third application of treatments, bronip (27.14%) followed by bactrinashak (28.46%), bactinash 200 (29.66%) and K-cycline (32.69%) were significantly effective against the disease incidence. Remaining bactericides *viz.*, streptocycline and plantomycin were the next best treatments with less disease incidence of 36.21 and 38.21 per cent, respectively.

The disease severity recorded in all the bactericides treated plots was at par each other with minimum disease

Table 3 : Field evaluation of commercially available bactericides and antibacterial chemicals on the incidence and severity of bacterial blight of pomegranate during Ambiabahar (February-August) 2008

Sr. No.	Bactericides / antibacterial chemicals	Concentration (%)	Incidence and severity of bacterial blight on fruits at different spray intervals					
			Before spray		After 3 sprays		After 5 sprays	
			Per cent incidence	Per cent disease index	Per cent incidence	Per cent disease index	Per cent incidence	Per cent disease index
1.	Bactinash-200 +	0.05	41.15	14.35	31.54	12.61	22.90	10.95
	Copper oxychloride	0.2	(39.91)	(22.23)	(34.12)	(20.75)	(28.54)	(19.18)
2.	Bactrinashak +	0.05	37.65	13.26	32.81	13.50	28.07	11.61
	Copper oxychloride	0.2	(37.78)	(21.26)	(34.84)	(21.33)	(31.88)	(19.75)
3.	Bronip + Copper	0.05	38.44	17.63	30.12	14.53	21.37	9.74
	oxychloride	0.2	(38.22)	(24.45)	(33.24)	(22.21)	(27.45)	(17.66)
4.	K cycline + Copper	0.05	37.21	19.00	34.02	17.81	32.20	16.09
	oxychloride	0.2	(37.57)	(25.83)	(35.66)	(24.89)	(34.53)	(23.44)
5.	Plantomycin +	0.05	37.74	14.28	40.38	16.26	48.70	20.56
	Copper oxychloride	0.2	(37.84)	(22.05)	(39.43)	(23.76)	(44.26)	(26.91)
6.	Streptocycline +	0.05	39.21	16.30	36.62	13.63	29.44	11.58
	Copper oxychloride	0.2	(38.74)	(23.67)	(37.23)	(21.55)	(32.84)	(19.75)
7.	Bleaching powder	1	41.59	21.95	45.07	24.17	51.17	27.76
			(40.10)	(27.84)	(42.16)	(29.43)	(45.69)	(31.77)
8.	Bordeux mixture	1	42.53	20.51	49.32	26.70	54.22	31.74
			(40.69)	(26.88)	(44.62)	(31.05)	(47.43)	(34.22)
9.	Copper oxychloride	0.2	41.17	18.71	53.99	25.74	56.37	28.71
			(39.90)	(25.60)	(47.30)	(30.46)	(49.67)	(32.36)
10.	Untreated control	–	39.15	20.42	57.34	31.84	67.98	41.28
			(38.73)	(26.69)	(49.24)	(34.37)	(55.58)	(39.95)
	SEm ±		2.22	1.96	1.53	1.64	1.91	1.97
	C.D. (P=0.05)		NS	NS	4.53	4.86	5.68	5.85

Figures in parentheses are angular transformed values
Variety : Bhagwa
Time of pruning : 10 – 15th March, 2008
Number of sprays : 5
Date of I spray : 12th June, 2008
Spray interval : 10 days

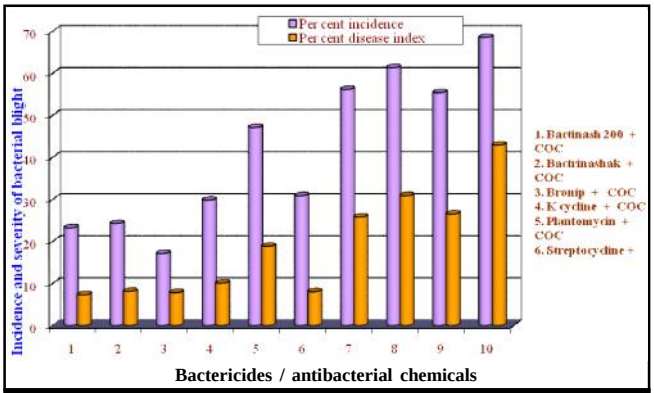

Fig. 3 : Field evaluation of commercially available bactericides and antibacterial chemicals against the incidence and severity of bacterial blight of pomegranate over the seasons Mrigbahar 2007 and Ambiabahar 2008 (after five sprays)

severity of 8.52 PDI in bactinash-200 treated plot. The performance of antibacterial chemicals was significantly poor as compared to bactericides. Maximum disease incidence and severity of 65.98 per cent and 26.69 PDI was observed in untreated check plot.

Efficacy of bactericides pooled over the seasons indicated the similar trend after fifth application of treatments. The bactericide, bronip was found significantly very effective in recording the minimum disease incidence of 17.18 per cent. The next best effective treatments were bactinash-200 (23.26%) and bactrinashak (24.30%). Plantomycin was found significantly least effective among all the bactericides with disease incidence of 47.14 per cent. In general, disease severity recorded in all the treated plots was correspondingly less than incidence. The lowest disease severity of 7.33 PDI was recorded with bactinash-200 followed by bronip (7.87 PDI) with at par efficacy each other. Streptocycline and K-cycline were the next best treatments. The bactericide plantomycin was found significantly least effective with more disease severity of 18.89 PDI.

Among the antibacterial chemicals, Bordeaux mixture was least effective with incidence and severity of 61.38 per cent and 30.90 PDI. Maximum disease incidence (68.57 %) and severity (42.93 PDI) was recorded in untreated check plot.

Table 4 : Field evaluation of commercially available bactericides and antibacterial chemicals against the incidence and severity of bacterial blight of pomegranate over the seasons, Mrigbahar 2007 and Ambiabahar 2008 (Pooled)

Sr. No.	Bactericides / antibacterial chemicals	Concentration (%)	Incidence and severity of bacterial blight on fruits at different spray intervals					
			Before spray		After 3 sprays		After 5 sprays	
			Per cent incidence	Per cent disease index	Per cent incidence	Per cent disease index	Per cent incidence	Per cent disease index
1.	Bactinash-200 +	0.05	35.92	9.53	29.66	8.52	23.26	7.33
	Copper oxychloride	0.2	(36.80)	(17.96)	(33.00)	(16.94)	(28.82)	(15.63)
2.	Bactrinashak + Copper	0.05	39.87	9.86	28.46	9.01	24.30	8.15
	oxychloride	0.2	(39.14)	(18.25)	(32.14)	(17.36)	(29.41)	(16.58)
3.	Bronip + Copper	0.05	33.91	11.66	27.14	9.09	17.18	7.87
	oxychloride	0.2	(35.53)	(19.73)	(31.38)	(17.32)	(24.38)	(14.68)
4.	K cycline + Copper	0.05	36.13	13.29	32.69	11.79	29.85	10.11
	oxychloride	0.2	(36.92)	(21.38)	(34.86)	(20.08)	(33.10)	(18.42)
5.	Plantomycin + Copper	0.05	30.14	9.98	38.21	15.25	47.14	18.89
	oxychloride	0.2	(33.23)	(18.35)	(38.18)	(22.92)	(43.38)	(25.73)
6.	Streptocycline +	0.05	38.72	11.58	36.21	9.45	30.89	8.07
	Copper oxychloride	0.2	(38.46)	(19.79)	(36.97)	(17.84)	(33.89)	(16.41)
7.	Bleaching powder	1	38.60	13.64	57.21	20.21	56.19	25.84
			(38.42)	(21.62)	(49.14)	(26.69)	(48.59)	(30.56)
8.	Bordeux mixture	1	36.63	13.51	45.36	19.64	61.38	30.90
			(37.23)	(21.58)	(42.34)	(26.29)	(51.61)	(33.77)
9.	Copper oxychloride	0.2	34.77	12.14	58.42	20.89	55.42	26.54
			(36.10)	(20.40)	(49.85)	(27.15)	(48.10)	(30.98)
10.	Untreated control	–	33.17	13.36	65.98	26.69	68.57	42.93
			(35.13)	(21.42)	(54.36)	(31.10)	(55.92)	(40.93)
	SEm ±		1.60	1.27	1.37	1.15	1.32	1.23
	C.D. (P=0.05)		NS	NS	4.06	3.43	3.90	3.66

Figures in parentheses are angular transformed values

Results on yield :

Data on yield during Mrigbahar season revealed the highest significant fruit yield of 9.72 t/ha (Table 5 and Fig. 4) obtained by the treatment with bronip followed by bactrinashak (8.90 t/ha) and bactinash-200 (8.20 t/ha). Significantly lower yield of 4.25 t/ha was recorded in Bordeaux mixture treated plot. Lowest fruit yield of 1.88 t/ha was recorded in untreated check plot.

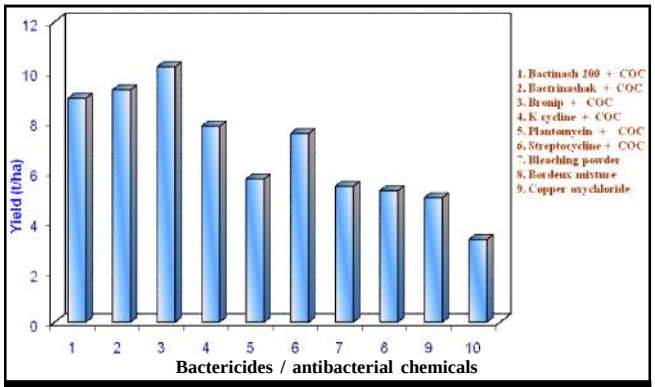

Fig. 4 : Efficacy of different bactericides and antibacterial chemicals on the yield of pomegranate in bacterial blight management trial (pooled over the seasons)

Similar trend was observed in Ambiabahar season trial, that highest fruit yield of 10.68 t/ha was recorded in bronip treatment followed by bactinash-200 and bactrinashak treatments. The other bactericides *viz.*, streptocycline and K-cycline recorded the yield of 8.34 t/ha and 8.25 t/ha, respectively.

Pooled average yield over the seasons revealed the highest significant yield of 10.20 t/ha in bronip treated plot followed by bactrinashak with at par yield of 9.28 t/ha. Copper oxychloride among all the treatments, recorded significantly lowest yield of 4.97 t/ha. However, its yield level was at par with other antibacterial chemicals. Lowest yield of 3.30 t/ha was observed in untreated check plot.

Suriachandrasevlam *et al.* (1993) suggested the application of paushamycin (0.05%) in combination with copper oxychloride (0.2%) for the control of bacterial disease on pomegranate caused by *Xanthomonas axonopodis* pv. *punicae.* Atulchand and Gupta (1994) stated that, the same bacterium could be effectively controlled by sprays of Bordeaux mixture (5:5:50) or any other copper fungicide with an interval of 15 days. The results obtained in the present investigation indicated the poor performance of Bordeaux mixture probably due to the more disease severity attributed to the aggressive pathogen and favourable environment.

Table 5 : Efficacy of different bactericides and antibacterial chemicals on the yield of pomegranate in bacterial blight management trial during 2007 and 2008

Sr. No.	Bactericides / antibacterial chemicals	Concentration (%)	Mrigbahar 2007			Ambiabahar 2008			Pooled over seasons		
			Yield (kg/plant)	Yield (t/ha)	% inc. over control	Yield (kg/plant)	Yield (t/ha)	% inc. over control	Yield (kg/plant)	Yield (t/ha)	% inc. over control
1.	Bactinash-200 + Copper oxychloride	0.05 0.2	16.40	8.20	336.17	19.33	9.67	105.31	17.87	8.94	170.90
2.	Bactrinashak + Copper oxychloride	0.05 0.2	17.80	8.90	373.40	19.30	9.65	104.88	18.55	9.28	181.21
3.	Bronip + Copper oxychloride	0.05 0.2	19.43	9.72	417.02	21.35	10.68	126.75	20.39	10.20	209.09
4.	K cycline + Copper oxychloride	0.05 0.2	14.79	7.39	293.08	16.50	8.25	75.16	15.65	7.83	137.27
5.	Plantomycin + Copper oxychloride	0.05 0.2	9.67	4.83	156.91	13.20	6.60	40.13	11.44	5.72	73.33
6.	Streptocycline + Copper oxychloride	0.05 0.2	13.47	6.73	257.97	16.68	8.34	77.07	15.08	7.54	128.48
7.	Bleaching powder	1	8.23	4.12	119.15	13.48	6.74	43.09	10.86	5.43	64.54
8.	Bordeux mixture	1	8.50	4.25	126.06	12.47	6.24	32.48	10.49	5.25	59.09
9.	Copper oxychloride	0.2	7.50	3.75	99.47	12.35	6.17	30.99	9.92	4.97	50.61
10.	Untreated control	–	3.77	1.88	–	9.42	4.71	–	6.59	3.30	–
	SEm ±		0.448	0.224	–	1.302	0.651	–	0.70	0.36	–
	C.D. (P=0.05)		1.33	0.665	–	3.87	1.934	–	2.08	1.06	–

Figures in parentheses are angular transformed values

Similarly, the present findings on efficacy of streptocycline and other bactericides were in accordance with the results obtained by Manjual *et al.* (2002) as they observed the effective control of bacterial blight of pomegranate with the sprays of streptocycline, K-cycline and bacterinol-100. The technical grade of bacterinol -100 is same as that of bronip/ bactrinashak/bactinash-200 *i.e.*, 2 bromo-2 nitro propane, 1,3, diol.

Least bacterial leaf spot incidence on grapevine was recorded in the plots treated with streptocycline or streptomycin sulphate at 0.05 per cent concentration (Ravikumar *et al.*, 2002). Yenjerappa *et al.* (2004) reported the superior efficacy of streptocycline (0.05%) in combination with copper oxychloride (0.2%) in mitigating the bacterial blight menace of pomegranate. The present findings also emphasized the significant efficacy of streptocycline with copper oxychloride against bacterial blight of pomegranate. However, in the present study the significant superior efficacy was exhibited by other bactericides *viz.*, bronip, bactinash-200 and bactrinashak, but their efficacy was at par with streptocycline.

The results are similar with the reports of Ravikumar and Yenjerappa (2005), who have obtained the effective control of bacterial blight of pomegranate with five sprays of bactrinashak (0.05%) in combination with copper oxychloride (0.2%) with highest yield and maximum benefit cost ratio. However, in the present investigation, the efficacy of bactrinashak stood next to bronip or bactinash 200 with at par efficacy in controlling the bacterial light of pomegranate.

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