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RESEARCH PAPER

Management of cotton boll rot complex through fungicides and bioagents

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Abstract: Boll rot complex is one of the major diseases of cotton which is responsible for loss of yield and quality. An experiment was conducted at Agricultural Research Station, Dharwad farm, University of Agricultural Sciences, Dharwad during *kharif* 2017 under rainfed conditions to know the efficacy of 7 fungicides and 2 bioagents for managing boll rot complex of cotton. Two control plots *viz*., one with the insecticide spray alone and the other with no spray were maintained. The experiment was laid out in replicated trial of randomized block with 11 treatments. The study revealed that among the treatments evaluated, trifloxystrobin 25% + tebuconazole 50% WG at the rate of 1.0 g/ lit (8.97 PDI), pyraclostrobin 5% + metiram 55% WG at the rate of 3.5 g/ lit (11.37 PDI) and tebuconazole 25.9% EC at the rate of 1.0 ml/ lit (12.69 PDI) were found very effective against the disease as they reduced the severity of the disease and enhanced the yield. Maximum yield of 14.11 q/ ha was recorded in the plots treated with trifloxystrobin 25% + tebuconazole 50% WG at the rate of 1.0 g/ lit. Spray of biocontrol agents also reduced the severity of disease and increased the yield significantly over the control. Tebuconazole 25.9% EC at the rate of 1.0 ml/ lit was found economical with the highest B: C ratio of 1.52:1. However, trifloxystrobin+ tebuconazole (1.43:1) and pyraclostrobin+ metiram (1.43: 1) may be recommended as the components in integrated disease management of cotton, as the combi products are broadspectrum and can take care of other foliar diseases of Bt cotton than the solo products like tebuconazole alone.

Key words: Bioagents, Boll rot complex, Fungicides, Management

Introduction

Cotton (*Gossypium* spp. Family: Malvaceae) is one of the world's leading agricultural crops which is wide spread, plentiful and economically produced and ranks first among the fibres. It is not only a source of natural fibre but also a protein and oil source in animal feed and an excellent source for pharmaceutical uses. India stands first in production with 37.70 million bales of cotton which is cultivated under the area of 122 lakh hectares with productivity of 524 kg/ha (Anon., 2018).

Cotton is vulnerable to many biotic and abiotic stresses as it is subjected to diseases caused by various pathogenic fungi, bacteria and virus and to damage by nematodes and physiological disturbances, which accounts for its low yield potential and in turn the high cost of production. *Fusarium* wilt, *Verticillium* wilt, *Alternaria* blight, angular leaf spot, boll rot and leaf curl are the major diseases which are responsible for loss of yield and quality parameters in cotton.There are many pathogens that can cause boll rot, such as *Alternaria* spp., *Ascochyta gossypii*, *Aspergillus flavus, Bacillus pumilus, Colletotrichum* spp*., Diplodia gossypina, Erwinia aroideae, Fusarium* spp., *Lasiodiplodi atheobromae, Myrothecium roridum, Pantoea agglomerans*, *Phomaexigua, Phomopsis* sp., *Phytophthora* spp., *Rhizoctonia solani* and *Xanthomonascitri* subsp.*malvacearum*.Various symptoms may be due to the existence of a complex of pathogens. Commonly, the bolls get soft and blackened or fail to crack open (Belot and Zambiasi, 2007). The losses in cotton crops caused by cotton boll rot have increased in recent years. The disease complex is considerably affecting the production chain, either by production losses and/or fibre quality.

Management of the disease renders great help in increasing the yields and improving the quality. In the absence of resistant cultivars, use of fungicides turns to be inevitable for the effective management of the disease. Along with this, biological control through the use of antagonistic microorganisms is a potential and non-chemical means of controlling plant diseases by reducing the inoculum levels of pathogen. Availability of new fungicides and bioagents necessitates evaluation to know their efficacy and to formulate spray schedule for field conditions.

Material and methods

Field experiment was conducted at Agricultural Research Station, Dharwad Farm, University of Agricultural Sciences, Dharwad during *kharif* 2017 to evaluate the field bio-efficacy of 7 fungicides and 2 bioagents for managing boll rot complex of cotton. Two control plots were maintained *viz*., one with the insecticide spray alone and the other with no spray. The solutions of fungicides and bioagents were prepared by dissolving the known quantity of them in water to get desired concentration. The experiment was conducted with randomized block design and replicated thrice on Bt cotton hybrid "Bunny Bt". The individual treatment plot size was 3.6 m × 6.0 m with spacing of 90 × 30 cms. All other cultural and pest management practices were followed as recommended in the package of practices of UAS, Dharwad and Raichur. Two sprays of each treatment were initiated immediately after the appearance of the disease in the field at an interval of 15 days.

Observations regarding severity of boll rot complex were recorded after 15 days each of first and second spray using 0 to

9 scale as given by Mayee and Datar (1986) and per cent disease index (PDI) was calculated by using the formula given by Wheeler (1969).

$$\text{Per cent disease incidence} = \frac{\text{Number of infected bolls}}{\text{Total number of bolls observed}} \times 100$$

$$\text{PDI} = \frac{\text{Sum of all the individual disease ratings}}{\text{No. of bolls assessed x Maximum disease grade}} \times 100$$

In each replication of the treatment, five plants were randomly selected and tagged for recording observations. After the harvest of the crop, average yield per plot was calculated by collecting and weighing seed cotton from all the treatments. Seed cotton of each replication was recorded and yield per hectare was computed by using net plot yield data and it was then converted to quintals per hectare. Per cent increase in yield was calculated by using the formula given below.

$$\text{Per cent increase in yield } \frac{c}{b - c} \times 100$$

Where,

b = yield obtained in treated plot

c = yield obtained in untreated plot

B: C ratio of all the treatments were calculated to know the profit obtained per treatment. The statistical analysis of randomized block design was carried out as per the procedure given by Panse and Sukhatme (1985). Per cent data were transformed to arc sine values and analysed statistically.

Results and discussion

Per cent disease index (PDI): All fungicides and bioagents evaluated were significantly superior over the control with respect to per cent disease reduction. After two sprays, the least per cent disease index was observed in plots treated with trifloxystrobin 25% + tebuconazole 50% WG at the rate of 1.0 g/ lit (8.97 PDI) followed by pyraclostrobin 5% + metiram 55% WG at the rate of 3.5 g/ lit (11.37 PDI). This may be attributed to the two modes of action of combined products. These findings are in agreement with the works of Zancan *et al*. (2011), where the combi products of fungicides belonging to strobilurin and triazole groups were effective. T_2-tebuconazole 25.9% EC at the rate of 1.0 ml/ lit has also showed less per cent boll rot (12.69 PDI). However, the maximum per cent disease index was observed in the untreated plot (37.37 PDI) and the plot sprayed only with dimethoate 30% EC at the rate of 1.75 ml/ lit (35.85 PDI), as there was no application of fungicides (Table 1) (Fig.1).

Among different treatments tested, the maximum per cent reduction over control was recorded in the plots treated with trifloxystrobin 25% + tebuconazole 50% WG at the rate of 1.0 g/ lit (75.99%) followed by pyraclostrobin 5% + metiram 55% WG at the rate of 3.5 g/ lit (69.58 %) and tebuconazole 25.9 % EC at the rate of 1.0 ml/ lit (66.03%). However, the least was recorded in the plots treated with dimethoate 30 % EC at the rate of 1.75 ml/ lit (4.06%).

Use of bioagents has also reduced per cent boll rot when compared to the controls. Plots treated with *Trichoderma harzianum* + *Pseudomonas fluorescens* and *Trichoderma harzianum* followed by *Pseudomonas fluorescens* has recorded 26.02 PDI and 27.11 PDI, respectively. This indicates the positive influence of bioagents against the pathogens due to antagonism (Naik and Hiremath, 2003; Afrin, 2016).

Table 1. Field evaluation of fungicides and bioagents against boll rot complex

Treatment No.	Description	Dosage per litre	PDI		Per cent reduction over control	Yield (q/ ha)	Per cent increase over control	B: C ratio
			After1st spray	After2nd spray				
T_1	Spray of hexaconazole 5% EC	1.0 ml	19.32(26.07)*	17.60(24.80)	52.89	11.99	46.77	1.43
T_2	Spray of tebuconazole 25.9% EC	1.0 ml	15.45(23.14)	12.69(20.86)	66.03	13.07	59.99	1.52
T_3	Spray of mancozeb 75%WP	2.0 g	22.66(28.41)	20.82(27.14)	44.29	11.49	40.68	1.36
T_4	Spray of propiconazole 25% EC	1.0 ml	23.60(29.05)	20.93(27.22)	43.98	11.11	36.00	1.31
T_5	Spray of (trifloxystrobin 25% + tebuconazole 50% WG)	1.0 g	12.16(20.40)	8.97(17.42)	75.99	14.11	72.68	1.43
T_6	Spray of COC + streptocycline	3.0 g + 0.5 g	19.07(25.88)	17.31(24.58)	53.67	12.38	51.49	1.36
T_7	Spray of (pyraclostrobin 5% + metiram 55% WG)	3.5 g	14.54(22.41)	11.37(19.70)	69.58	13.53	65.64	1.43
T_8	Spray of *Trichoderma harzianum*+ *Pseudomonas fluorescens*	5 g + 5 g	27.44(31.58)	26.02(30.66)	30.38	9.92	21.45	1.16
T_9	Spray of *Trichoderma harzianum* followed by*Pseudomonas fluorescens*	10 g	28.18(32.05)	27.11(31.37)	27.44	9.48	16.05	1.11
T_{10}	Spray of dimethoate 30% EC	1.75 ml	33.11(35.12)	35.85(36.77)	4.06	8.40	2.75	0.99
T_{11}	Control (untreated)		34.14(35.74)	37.37(37.67)		8.17		0.98
S.Em. ±			1.33	1.22		0.13		
C. D. at 5%			3.94	3.6		0.388		
C. V.			8.24	7.81		9.39		

* Arc sine values

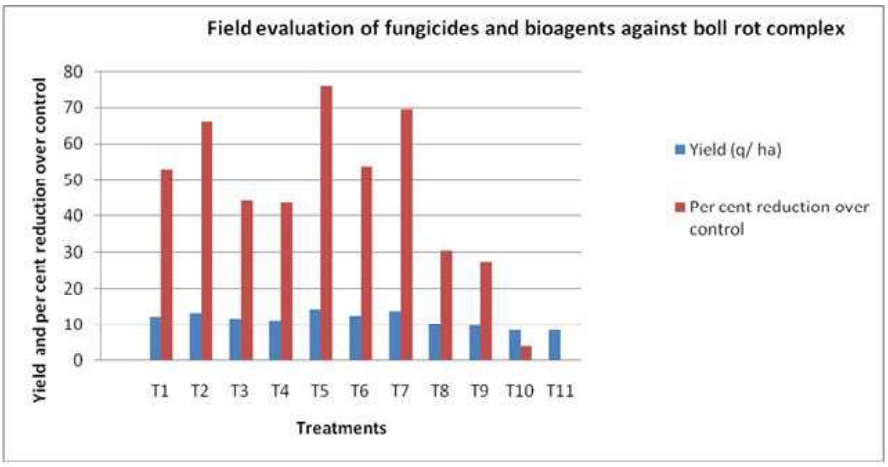

Fig. 1 . Field evaluation of fungicides and bio agents against boll rot complex

Yield: Any plant protection measures adopted will usually result in increase in the yields. In the present investigation, yields were higher in treatments T_5 and T_7, when compared with control.

Out of 11 treatments, the maximum yield (q/ ha) was recorded in T_5- trifloxystrobin 25% + tebuconazole 50% WG at the rate of 1.0 g/ lit (14.11 q/ ha) followed by T_7- pyraclostrobin 5% + metiram 55% WG at the rate of 3.5 g/ lit (13.53 q/ha) and T_2- tebuconazole 25.9% EC at the rate of 1.0 ml/ lit (13.07 q/ ha). However, the least yield was recorded in T_{11}- untreated control (8.17 q/ha) and T_{10}- dimethoate 30 % EC at the rate of 1.75 ml/ lit (8.40 q/ha) (Table 1) (Fig.1).

B:C ratio: Among the treatments, T_2- tebuconazole 25.9 % EC at the rate of 1.0 ml/ lit recorded the highest B: C ratio of 1.52: 1 followed by T_5- trifloxystrobin 25% + tebuconazole 50% WG at the rate of 1.0 g/ lit (1.43: 1) T_7- pyraclostrobin 5% + metiram 55% WG at the rate of 3.5 g/ lit (1.43: 1) and T_1-hexaconazole 5 % EC at the rate of 1.0 ml/ lit(1.43: 1). However, the least B: C ratio was recorded in T_{11}- untreated control (0.98: 1) and T_{10}- dimethoate 30% EC at the rate of 1.75 ml/ lit (0.99: 1) (Table 1).

The Benefit: Cost ratio (B: C ratio) speaks about the practical use of treatments which have been tried for the management of the disease. Higher Benefit: Cost ratio means the feasibility of its incorporation in the cultivation practices which may be followed by the farming community. In the present study, T_2 has given higher Benefit: Cost ratio. This may be attributed to the less cost of fungicides and better management of the boll rot disease. Though tebuconazole recorded highest B:C ratio (1.52:1) compared to combi products like trifloxystrobin+ tebuconazole, the latter may be recommended. As the combi products are broad spectrum and can take care of other foliar diseases of Bt cotton than the solo products like tebuconazole alone.

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