Estimation of crop losses due to Rust (*Phakopsora gossypii* (Arth.) Hirat.f.) disease in *Bt* cotton hybrid

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ABSTRACT: A field trial was conducted at Regional Agricultural Research Station, Lam, Guntur, during *kharif* 2009-2010, 2010-2011 and 2011-12, to estimate the losses due to rust disease in *Bt* cotton hybrid, RCH 2. Propiconazole ((0.1%)) was sprayed at 15 days interval starting from 75 days to 135 days after sowing. Lowest mean per cent disease intensity (PDI) of 10.7 was recorded with Propiconazole ((0.1%)) sprays at 75, 90, 105 and 120 days after sowing. Pooled data showed reduction of disease in all treatments. Yield data from different treatments showed that protection by spraying Propiconazole ((0.1%)) from 75 days after sowing at 15 days interval up to 120 days resulted in avoidable losses to the tune of 34.05 per cent with benefit cost ratio of 1.82.

Key words: Cotton, rust disease, yield losses

Cotton is one of the ancient and important commercial crops and supplier of the principal raw material for a flourishing textile industry. Cotton crop is affected by a number of foliar diseases including leaf spots/blights, grey mildew and rust throughout the season. In India, foliar diseases (fungal, bacterial and viral) including boll rot have been estimated to cause yield losses up to 20 to 30 per cent (Mayee *et al.*, 2007). During the surveys and evaluation of *Bt* cotton entries, rust caused by *Phakopsora gossypii* (Arth.) Hirat.f was recorded to the tune of 35.0, 40.50, 50.0 PDI during 2004 – 2005, 2005–2006 and 2006-2007 , respectively (Anonymous, 2005, 2006, 2007). Though the disease occurs during later part of crop season it may cause losses in late sown as well as prolonged irrigated crop and no estimates are available on yield losses caused by this disease. Loss data including the importance of diseases and their control are prerequisites for economic management of diseases and for evaluating present crop protection practices. Estimation of total annual crop losses due to any one particular disease is difficult to do accurately as yield is a complex trait governed by several factors. However, during the present investigation an attempt was made to estimate crop losses using a rust susceptible

Bt hybrid and need based protection against other pests and diseases was suitably followed. Preliminary studies under All India Coordinated Programme showed 0.1 per cent propiconazole as effective fungicide against rust disease. Hence experiment was conducted to estimate the preventable losses due to this emerging disease.

MATERIALS AND METHODS

An experiment was conducted at Regional Agricultural Research Station, Lam, Guntur for 3 *kharif* seasons of 2009-2012. *Bt* cotton hybrid RCH 2 was sown on 19.08.09 (BG), 13.07.10 and 26.7.11 (BG II) adopting a spacing of 105 x 60 cm in plots of 31.5 sq. m. Since farmers have been using BG II version of hybrids and RCH 2 BG was not available, RCH 2 BG II was used in subsequent years. Ten treatments *viz.*, T_1 – Propiconazole (0.1%) spray at 75 days after sowing (DAS); T_2 - Propiconazole (0.1%) sprays at 75 and 90 DAS; T_3 - Propiconazole (0.1%) sprays at 75, 90 and 105 DAS; T_4 - Propiconazole (0.1%) sprays at 75, 90, 105 and 120 DAS; T_5 - Propiconazole (0.1%) sprays at 75, 90, 105, 120 and 135 DAS; T_6 - Propiconazole (0.1%) sprays at 90, 105, 120 and 135 days after sowing; T_7 - Propiconazole (0.1%) sprays at 105, 120 and 135 DAS; T_8 -

Propiconazole (0.1%) sprays at 120 and 135 DAS; T_9 - Propiconazole (0.1%) spray at 135 DAS; and T_{10} – water spray with 3 replications were imposed in randomized block design. Ten plants at random were tagged in each plot and 10 leaves (3 lower, 4 middle and 3 upper) from each plant were scored for disease intensity adopting 0 to 4scale (Sheo Raj, 1988). Depending on the scores collected per cent disease intensity (PDI) was calculated.

$$PDI = \frac{\text{Sum of numerical ratings}}{\text{Total number of leaves scored x maximum rating}} \times 100$$

Yield data from three replications of each treatment was recorded and per cent yield loss was estimated. Decrease / increase in the disease/ yield over control were calculated using the formula:

$$\frac{T - C}{C} \times 100 \text{ where}$$

T = PDI or yield (q/ha) of respective treatment
C = PDI or yield of control

Treatmentwise net returns and benefit cost ratio was calculated.

RESULTS AND DISCUSSION

Data on disease intensity during three consecutive years revealed that PDI of rust disease ranged from 8.8 to 35.0 in different treatments (Table 1). During 2009-2010 intensity of rust varied from 11.3 to 23.0 per cent. T_4 recorded lowest PDI of 11.3 with 50.87 per cent in the control. T_3 and T_5 were statistically *on par* with T_4 in disease control. Untreated plots recorded maximum PDI of 35.0 during *kharif* 2010 while minimum PDI of 8.8 with 74.85% control was obtained in T_4 plots. Next best treatment, T_5 was *on par* with T_4 in reducing the disease intensity (Table 1). Twelve to 29 per cent rust

was recorded during *kharif,* 2011 and T_4 gave 58.62 per cent control of rust disease. Pooled data for 3 years showed disease reduction in all the treatments however T_4 was significantly superior in controlling rust disease.

During *kharif,* 2009 all treatments increased the yield. T_4 recorded maximum yield of 942kg/ha while minimum yield of 561kg/ha was recorded in untreated plots. Maximum yield of 1938kg/ha was obtained with T_4 and minimum yield of 1349kg/ha with T10 during 2010 – 2011. A yield of 1587kg/ha was recorded in T_4 as against 1037kg/ha in untreated control (2011 – 2012). Pooled data showed that T_4 was superior with maximum yield of 1489kg/ha.

All treatments reduced yield losses due to rust disease in comparison to control during three seasons. Maximum losses to the tune of 40.45 per cent were recorded during *kharif,* 2009 as against protection with nil losses in T_4. Control plots recorded losses up to 30.39 per cent in 2010 while T_4 avoided losses to the maximum extent (0.0%). During *kharif,* 2011, 34.66 per cent loss was recorded in control plots. Pooled data showed that T_4 prevented losses to the tune of 34.05 per cent. Occasional early occurrence in the life of crop causing decreased photosynthesis and increased transpiration coupled with defoliation could seriously reduce yields, for example during 1963, cotton rust was reported to have depressed yields as much as 24 per cent (Johnston, 1963) and it was also reported as one of the devastating diseases in northern Karnataka (Hillocks, 1991).

Net profits varied from Rs14315 to Rs 32405 in different treatments. Among the treatments T_4 recorded maximum net profit of Rs 32405. Unprotected plots resulted in net profit of Rs 9673 and benefit cost ratio of 1.26. Highest benefit cost ratio of 1.82 was obtained with T_4. Therefore farmers are advised to spray propiconazole (0.1%) from 75 DAS at 15 days interval to protect cotton crop against rust disease.

Table 1. Disease intensity and control of rust disease in Bt cotton hybrid, RCH 2

Treatments	Disease intensity (%)				Disease control (%)				Yield (kg/ha)				Yield loss (%)			
	2009-2010	2010-2011	2011-2012	Mean	2009-2010	2010-2011	2011-2012	Mean	2009-2010	2010-2011	2011-2012	Mean	2009-2010	2010-2011	2011-2012	Mean
T_1	15.7 (23.34)	22.9 (28.59)	20.0 (26.56)	**19.5 (26.21)**	31.74	34.57	31.03	**32.45**	764	1647	1270	**1227**	18.90	15.02	19.97	**17.6**
T_2	14.0 (21.97)	18.8 (25.7)	17.0 (24.35)	**16.6 (24.04)**	39.13	46.29	41.38	**42.27**	811	1706	1344	**1287**	13.91	11.97	15.31	**13.57**
T_3	12.0 (20.27)	18.6 (25.55)	16.8 (24.2)	**15.8 (23.42)**	47.83	46.86	42.07	**45.59**	871	1706	1407	**1328**	7.54	11.97	11.34	**10.81**
T_4	11.3 (19.64)	8.8 (17.25)	12.0 (20.27)	**10.7 (19.09)**	50.87	74.85	58.62	**61.45**	942	1938	1587	**1489**	0.0	0.0	0.0	**0.0**
T_5	13.7 (21.72)	10.8 (19.19)	16.0 (23.58)	**13.5 (21.56)**	40.43	69.14	44.83	**51.47**	911	1812	1439	**1387**	3.29	6.50	9.33	**6.85**
T_6	14.3 (22.22)	15.0 (22.79)	17.4 (24.65)	**15.6 (23.26)**	37.83	57.14	40.0	**44.99**	883	1772	1333	**1329**	6.26	8.57	16.01	**10.75**
T_7	15.7 (23.34)	21.5 (27.63)	19.7 (26.35)	**19.0 (25.84)**	31.74	38.57	32.07	**34.13**	833	1687	1312	**1277**	11.57	12.95	17.33	**14.24**
T_8	16.7 (24.12)	22.2 (28.11)	19.7 (26.35)	**19.5 (26.21)**	27.39	36.57	32.07	**32.01**	746	1673	1302	**1240**	20.81	13.67	17.96	**16.72**
T_9	18.3 (25.33)	27.3 (31.5)	21.8 (27.83)	**22.5 (28.32)**	**20.43**	22.0	24.83	**22.42**	704	1462	1164	**1110**	25.27	24.56	26.65	**25.45**
T_{10}	23.0 (28.56)	35.0 (36.27)	29.0 (32.58)	**29.0 (32.58)**					561	1349	1037	982	40.45	30.39	34.66	**34.05**
P=0.05	2.66	3.899	3.075	**2.208**					125	99.6	102	72.3				
CV (%)	10.0	11.4	9.5	**7.1**					9.1	3.5	4.5	3.3				

*Figures in parentheses are transformed values.

Table 2. Economics of protection from rust disease in *Bt* cotton hybrid RCH 2

Treatment	Spray cost (Rs)	Gross expenditure (Rs)	Yield (kg/ha)	Additional yield (kg/ha)	Gross returns (Rs)	Net profit (Rs)	Benefit cost ratio
T_1	350	38349	1227	245	59551	21202	1.55
T_2	700	38699	1287	305	62302	23603	1.61
T_3	1050	39049	1328	346	63890	24841	1.64
T_4	1400	39399	1489	507	71804	32405	1.82
T_5	1750	39749	1387	405	66978	27229	1.69
T_6	1400	39399	1329	347	64477	25078	1.64
T_7	1050	39049	1277	295	61809	22760	1.58
T_8	700	38699	1240	258	60239	21540	1.56
T_9	350	38349	1110	128	53664	14315	1.40
T_{10}	0	37999	982		47872	9873	1.26

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