

Losses Caused by Major Insect Pests of Transgenic Cotton with Special Reference to Pink Bollworm

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ABSTRACT

The experiments were conducted for the estimation of yield losses due to major insect pests of transgenic cotton with special reference to pink bollworm, *Pectinophora gossypiella*, at the research farm, Department of Agricultural Entomology, College of Agriculture, VNMKV, Parbhani during the years 2019-20 and 2020-21. The newly introduced transgenic cotton hybrid NHH-44 was grown on the plot size of 3.6 m x 3.00 m with a spacing of 90 cm x 60 cm in Paired Plot Design with two treatments and fourteen replications. The studies on avoidable losses due to major insect pests of the transgenic cotton indicated that significant differences were observed in percent damage infestation due to pink, American bollworm, and sucking pest population under protected and unprotected conditions. The data revealed that a significantly higher seed cotton yield of 17.85q/ha was recorded from protected plots however, a yield of 9.25q/ha was recorded from unprotected plots. This showed that 51.85 per cent increase in yield and 48.15 per cent avoidable loss. The results indicated that by providing protection with effective insecticides against bollworm and sucking pests complex of transgenic cotton the yield loss can be saved up to 8.60q/ha. The effects of different treatments on transgenic cotton hybrid NHH-44 indicated that all the lint quality parameters, as well as oil percentage, were significantly superior in protected conditions over the unprotected condition.

Keywords- Transgenic cotton, avoidable yield losses, bollworm, sucking pests, quality parameters

INTRODUCTION

Cotton the “white gold” occupies an enviable place amongst commercial crops of our country. Area wise India ranks first scenario contributing about 26% of the world cotton area with a production of 40.00 million bales and an average lint yield of 537 kg ha⁻¹ in 2020-21 [2]. Cotton crop is subjected to damage by 162 species of pests right from germination to the final picking [3]. In Maharashtra about 25 pests are reported to cause damage to cotton crops at different growth stages [12]. The important sucking pests are aphids *Aphis gossypii* (Glover), Jassids *Amrasca biguttula biguttula* (Ishida), Whiteflies *Bemisia tabaci* (Gennadius), Thrips *Thrips tabaci*, Mealy bugs *Phenacoccus solenopsis* (Tinsley). The bollworms include spotted bollworm *Earias vitella* (Fab.), American bollworm *Helicoverpa armigera* (Hubner) and Pink bollworm *Pectinophora gossypiella* (Saund.). The important sucking pests are aphids *Aphis gossypii* (Glover), Jassids *Amrasca biguttula biguttula* (Ishida), Whiteflies *Bemisia tabaci* (Gennadius) and Thrips *Thrips tabaci*.

The losses in cotton due to sucking pests, bollworms, and both together have been reported as 11.60%, 44.50%, and 52.10%, respectively [4]. There are various causes for the low yield, but pest losses are a major one because the cotton crop is heaven for insects. On cotton, a total of 1326 bug species have been identified [6]. Cotton's pest spectrum is highly diverse

encompassing a variety of insect species. Aphids (*Aphis gossypii* Glover), Jassids (*Amrasca biguttula biguttula* Ishida), thrips (*Thrips tabaci* Lind.), and whiteflies (*Bemisia tabaci* Gennadius) are sucking pests that have reached epidemic proportions. The bollworm complex which includes the American bollworm (and the spotted bollworm and the pink bollworm is responsible for 36.2 per cent of the yield loss [7].

The pink bollworm had first shown up sporadically on Bt cotton in 2010, but by the 2015-16 season, large areas of cotton crop were affected by the pests reducing the yields. The pink bollworm infestation was wide spread in Maharashtra, Madhya Pradesh, Gujarat and Telangana state during 2017 season [1]. Hence, the studies were conducted for the estimation of yield and economic trait losses due to major insect pests with special reference to pink bollworm in newly introduced public sector transgenic cotton hybrid NHH-44.

MATERIALS AND METHODS

The field experiments were conducted during Kharif 2019-20 and Kharif 2020-21 seasons at the Department of Agricultural Entomology, college of Agriculture, Vasantnao Naik Marathwada

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Krishi Vidyapeeth, Parbhani (M.S.). Transgenic cotton NHH-44 was sown on the plot size of 3.6 m x 3.00 m with the spacing of 90 cm x 60 cm in Paired Plot Design with two treatments and fourteen replications and the crop was raised as per recommended package of practices.

The observations of sucking pests viz., aphids, leafhoppers, whiteflies, thrips and observations were also recorded percent rosette flower, per cent green boll damage, fruiting bodies damage, per cent locule damage, per cent opened boll damage, percent shed material.

Treatments Details

T1 (Protected)

1. Seed treatment with Thiamethoxam 70 WS@4.5g/kg
2. One spray of Flonicamid 50% WG @ 3.0 g/10 lit. water at 45DAS
3. One spray of Lamdacyhalothrin 5 % EC 10 ml/ 10 lit.water at 75 DAS
4. One spray of Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC@ 10ml/10 lit. water at 90 DAS
5. One spray of Thiamethoxam 12.6% + Lambda cyhalothrin 9.5 % ZC10 ml/10 lit. water at 105 DAS

T2 (Unprotected)

Loss assessment:

A paired plot technique was used in which yields of protected and unprotected plots were compared. The plants in protected plots were sprayed against insect pests following spray of insecticides as per in treatment details. Total seed cotton yield obtained from different plots were recorded. Losses of seed cotton due to insect pests were worked out by using the formula given by (Pradhan, 1964)

$$\text{Avoidable loss in yield (\%)} = \frac{T - C}{T} \times 100$$

Where T = Yield from treated plot

C = Yield from control plot

RESULTS AND DISCUSSION

The population of sucking pest on Bt cotton under protected and unprotected conditions

The data on sucking pests aphids, leafhoppers, thrips and whiteflies in Bt cotton during Kharif 2019 and Kharif 2020 are presented in (Table 1 and Fig.1).

Table 1: Population of sucking pests on Bt cotton under protected and unprotected conditions during the years Kharif 2019-20 and Kharif 2020-21

Sr. No.	Treatments	Population of Sucking pests /three leaves											
		Aphids			Leaf hopper			Thrips			Whiteflies		
		2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
1	Protected condition (T1)	3.69	3.54	3.61	2.77	2.37	2.57	3.22	2.94	3.08	3.04	2.75	2.89
2	Unprotected condition (T2)	36.69	28.88	32.78	7.51	5.62	6.56	15.54	13.44	14.49	16.73	15.02	15.88
	't' Value	4.57*	7.16*	5.87*	10.49*	9.23*	9.86*	10.38*	8.54*	9.46*	11.81*	6.24*	9.02*

*Significant at 5% Level

*Average of 28 weeks

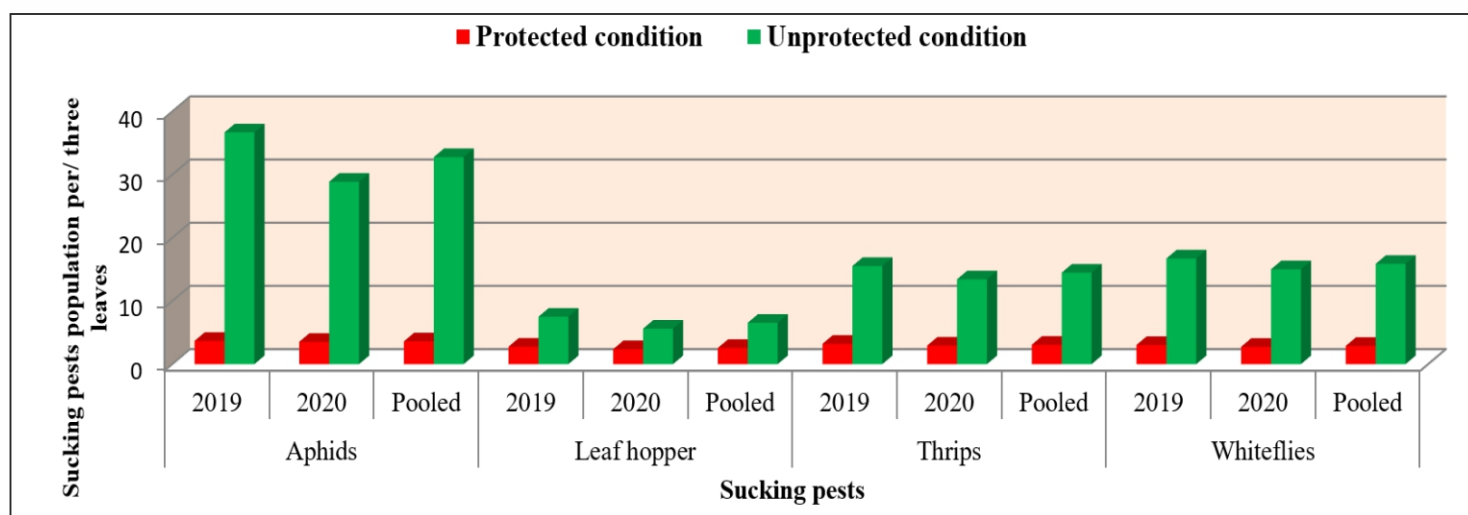


Fig. 1. Mean incidence of sucking pests on Bt cotton in protected and unprotected conditions

The pooled results indicated that significantly the lowest population of sucking pests viz., aphids (3.61), leafhoppers (2.57), thrips (3.08) and whiteflies (2.89) per three leaves were recorded under protected condition during both years. However, under unprotected conditions, the population of sucking pests was maximum during both years.

Incidence of bollworm complex

The data on per cent rosette flower, per cent fruiting bodies damage and per cent shed materials damage due to bollworm during Kharif 2019 and Kharif 2020 are presented in (Table 2 and Fig. 2).

The results based on pooled data indicated significant differences under protected and unprotected conditions. Under protected condition rosette flowers, fruiting bodies damage and shed materials were 4.07, 4.98 and 3.85 per cent and those were 33.71, 34.77, and 28.53 per cent respectively, under unprotected condition.

Table 2: Infestation of rosette flower damage, fruiting bodies damage, per cent shed materials in Bt cotton condition during the years Kharif 2019-20 and Kharif 2020-21

Sr. No	Treatments	Rosette flowers (%)			Fruiting bodies damage (%)			Shed materials (%)		
		2019	2019	Pooled	2019	2020	Pooled	2019	2020	Pooled
1	Protected condition (T1)	3.99	4.15	4.07	4.80	5.16	4.98	3.41	4.29	3.85
2	Unprotected condition (T2)	28.60	38.82	33.71	28.72	40.82	34.77	23.01	34.04	28.53
	't' Value	11.95*	17.27*	14.61*	5.43*	5.36*	5.40*	4.01*	4.17*	4.09*

*Significant at 5% Level

Average of 21 SMW

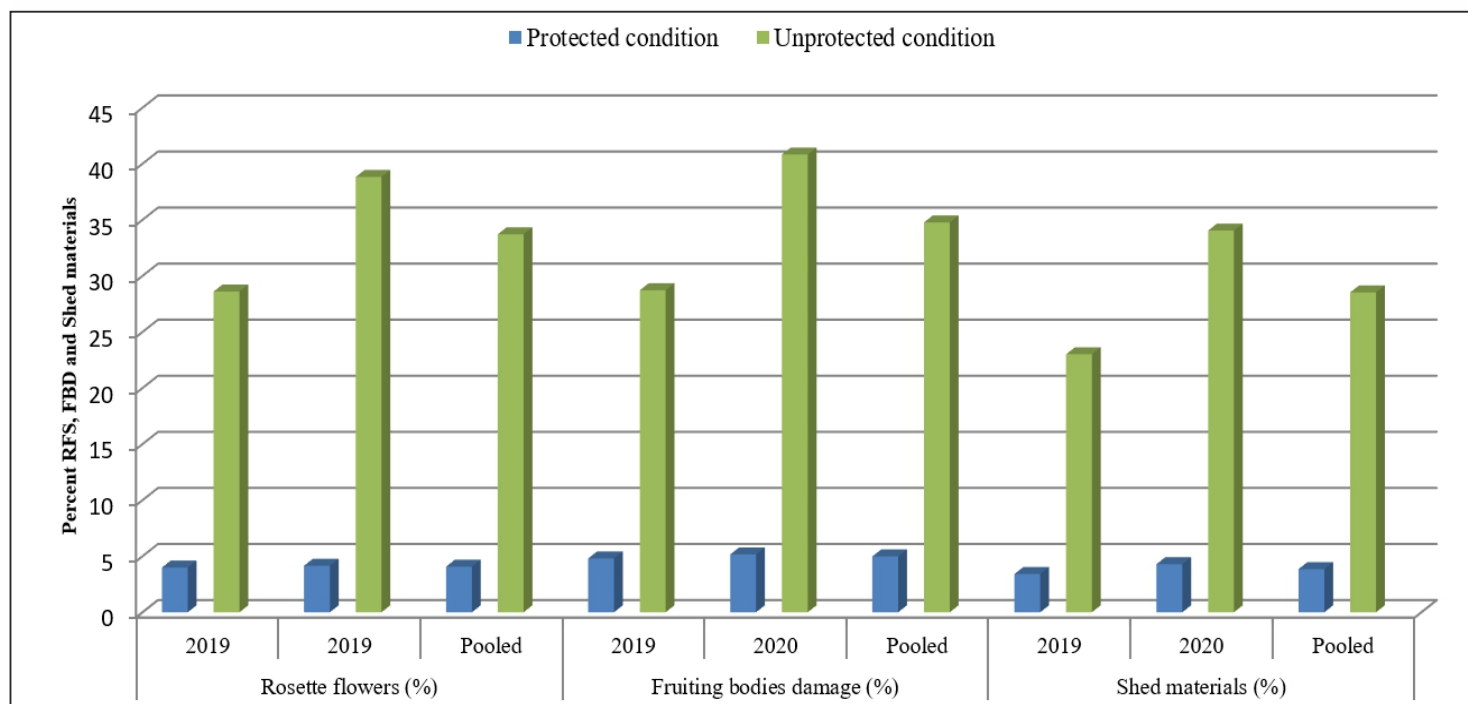


Fig. 2. Infestation of Per cent rosette flower damage, fruiting bodies damage and percent shed materials P.gossypiella and H.armigera on Bt cotton

The data on green boll damage, open boll damage and locule damage in Bt cotton during Kharif 2019 and Kharif 2020 are presented in (Table 3 and fig. 3).

Table 3: Infestation in green boll damage, open boll damage and locule damage Bt cotton in protected and unprotected condition during the years Kharif 2019-20 and Kharif 2020-21

Sr. No	Treatments	Green boll damage (%)			Open boll damage (%)			Locule damage (%)		
		2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
1	Protected condition (T1)	4.06	4.18	4.12	3.88	4.42	4.15	3.70	4.06	3.88
2	Unprotected condition (T2)	41.91	46.48	44.16	43.52	48.57	46.04	39.54	52.71	46.12
	't' Value	17.10*	26.75*	21.93*	16.72*	28.57*	22.65*	13.81*	18.65*	16.23*

*Significant at 5% Level

Average of 3 picking weeks

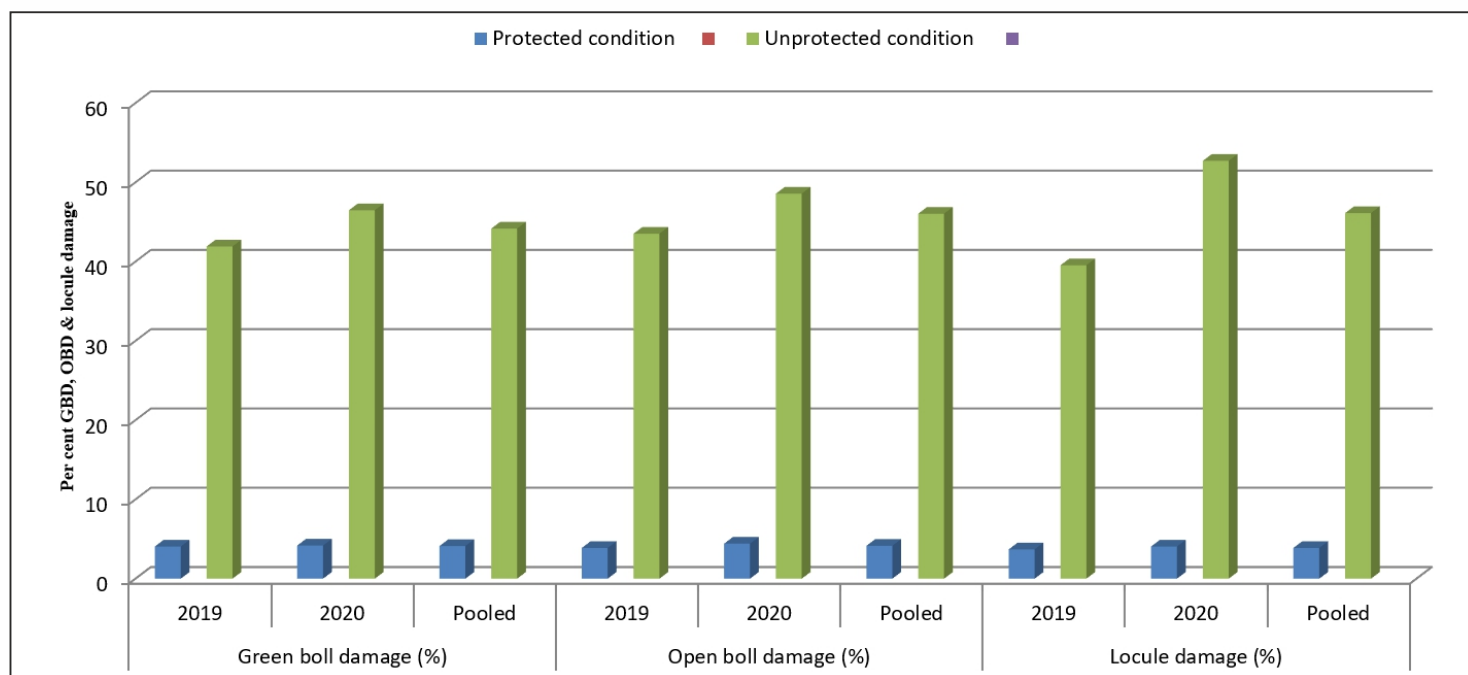


Fig. 3. Infestation of green boll damage, open boll damage, and locule damage in Bt cotton

Similarly two years of pooled data on green boll damage, open boll damage, and locule damage significant differences under protected and unprotected conditions. The infestation on green boll damage, open boll damage and locule damage was 4.12, 4.15, and 3.88 per cent respectively, under protected condition, while those were 44.16, 46.04 and 46.12 per cent respectively, under unprotected condition.

Estimation of loss in Seed Cotton Yields

The two years pooled results (Table 4) showed that a significantly higher yield (17.85 q/ha) was obtained under protected conditions as compared to unprotected conditions (9.25 q/ha). The result indicated that it is possible to avoid 48.15 per cent loss if the crop is protected for major pests.

Table 4: Losses in yield of seed cotton due to infestation by major insect pests of Bt cotton during the years Kharif 2019-20 and Kharif 2020-21

Sr. No	Treatments	Seed cotton yield q /ha			Avoidable losses (%)		
		2019	2020	Pooled	2019	2020	pooled
1	Protected condition (T1)	18.57	17.13	17.85	48.84	47.46	48.15
2	Unprotected condition (T2)	9.50	9.00	9.25			
	't' Value	6.69*	5.90*	6.30*			

*Significant at 5% Level

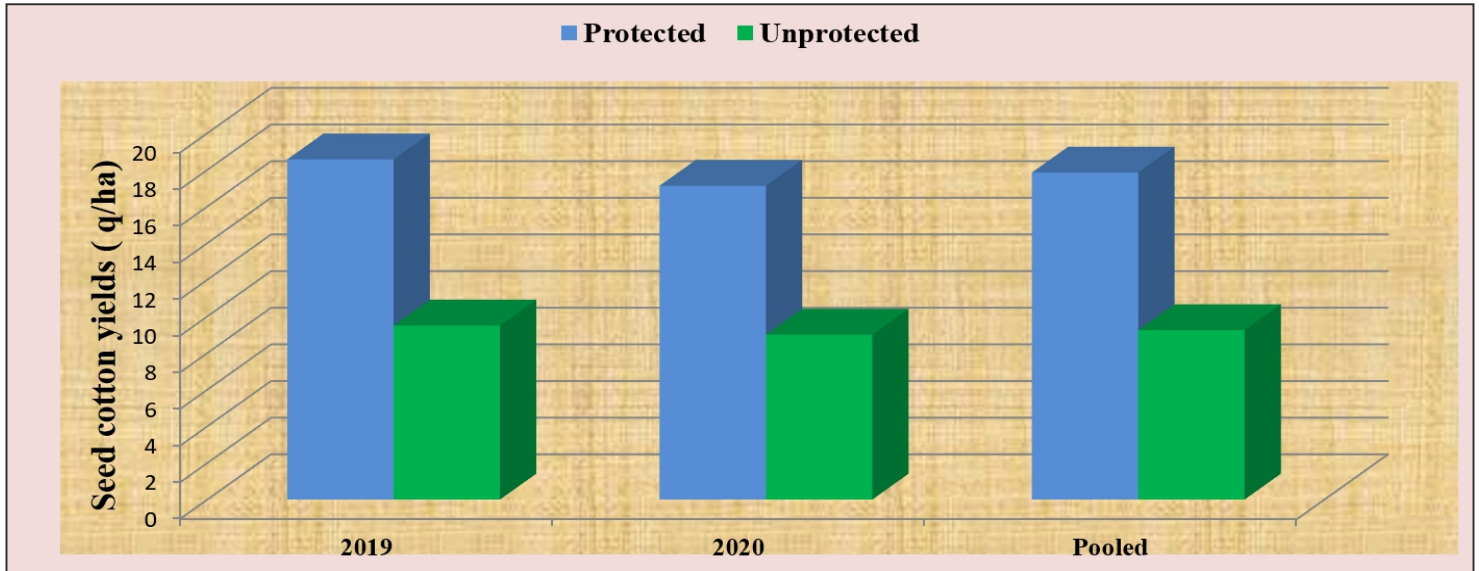


Fig. Losses in yield of seed cotton due to infestation by major insect pests of Bt cotton in protected and unprotected conditions Effects of different treatments on lint quality characters on Bt cotton hybrid NHH-44

The data on lint quality parameters as influenced by protection irrespective of protected and unprotected conditions are presented in (Table 5).The unprotected treatments recorded significantly lower seed germination percentage over protected ones with 63.42 and 69.50 seed germination percentages, respectively. The maximum seed index 6.80 grams per 100 seed was recorded in protected condition over the unprotected condition 5.70 grams per 100 seed weights.

The unprotected treatments recorded 13.84 per cent oil over the protected treatments 21.66 per cent.

The highest positively significant Upper Half Mean Length (mm) among treatments for improving fiber UHML was observed in protected condition 25.40 mm over the unprotected condition 25.10 mm, respectively.

Table 5. Effects of different treatments on lint quality characters on Bt cotton hybrid NHH-44

Sr. No	Name of variety	Treatments	Seed Germination (%)	Oil percentage (%)	Seed Index (gm)	UHML (mm)	Uniformity index (%)	MIC (µg/ inch)	Tenacity 3.2 mm (g/tex)	EL %
1.	NHH-44 Bt	Protected condition (T1)	69.50	21.66	6.80	25.40	82.00	4.40	25.00	6.40
2.	NHH-44 Bt	Unprotected condition (T2)	63.42	13.84	5.70	25.10	81.00	4.60	24.00	5.70

The highest positively significant uniformity index was recorded in protected condition (25.40) over unprotected condition (25.10%), respectively. The unprotected treatments recorded significantly higher micronaire (µg/inch) over protected ones with 4.60 and 4.40 micronaire (µg/inch), respectively. The protected treatments recorded significantly higher tenacity 3.2 mm and EL over unprotected ones with 25.00, 24.00 (g/tex) and 6.40 and 5.70 percent EL, respectively.

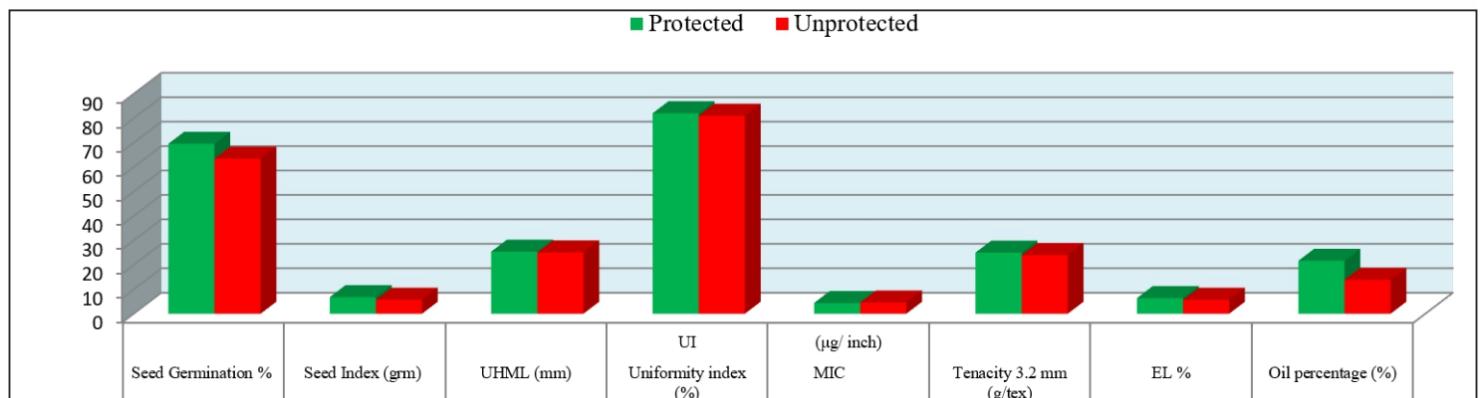
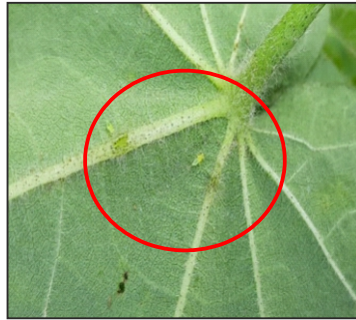


Fig. Effect of different treatments on lint quality parameters on Bt cotton hybrid NHH-44

The results obtained during the present experiment are more or less in conformity with earlier researcher like [9] reported that the unprotected treatments recorded significantly higher aphid, leafhopper, thrips and whitefly population over protected ones. [5] reported that results showed that there was no significant effect of insecticides on lint quality characteristics such as micronair, fibre maturity, staple length fibre strength, seed index GOT and seed germination. First picking seeds had the overall germination percentage of 63.44 followed by second and third as 35.2 and 34.7%, respectively. [8] reported that significantly higher seed cotton yield 2038.82 kg/ha was recorded from protected plots, while the yield of 1312.70 kg/ha was recorded from unprotected plots. [11] was reported that the mean incidence in unprotected plot recorded significantly higher sucking pests population over protected ones with per cent overall increase in population in the unprotected plot over protected ones.



Picture:1. Aphids infestation



Picture: 2. leafhopper infestation



Picture: 3. Thrips infestation



Picture: 4 whitefly infestation on Bt cotton



Rosette flower and their infestation



Locule damage due to pink bollworm



Infestation in green boll due to pink bollworm



yield loss can be saved. The effect of different treatments on lint quality characters on Bt cotton hybrid NHH-44 were significantly superior in protected condition over unprotected conditions.

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Declaration: The author declares that they have no conflict of interest

CONCLUSION

The studies indicated that significantly higher seed cotton yield 17.85q/ha were recorded from protected plots, while the yield of 9.25q/ha were recorded from unprotected plots. The yield increased in protected plots over unprotected plots was 8.60q/ha. This showed 51.85 per cent increase in yield and 48.15 per cent per cent avoidable loss. The results clearly indicated that by protecting with effective insecticides against sucking pests and bollworm complex of Bt cotton, 8.60q/ha

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