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ASSESSMENT OF YIELD LOSSES DUE TO SUCKING PESTS IN BT COTTON

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ABSTRACT

Field experiment was conducted during kharif 2019 to determine the avoidable yield losses due to sucking insect pests on four cotton cultivars BG II (US 81& RCH 776), non Bt F-2228 and Desi LD 949 at two sowing dates (timely-25th April; and late 27th May) at the Punjab Agricultural University, Ludhiana. Significantly higher incidence of whitefly *Bemisia tabaci* (Genn.) (20.61 adults), jassid *Amrasca biguttula biguttula* (Ishida) (12.97 nymphs) and thrips *Thrips tabaci* (Lindeman) (7.32 adults/ 3 leaves) was observed under late sown conditions, compared to the timely sown one with less incidence- *B. tabaci* (14.51 adults), *A. biguttula biguttula* (11.37 nymphs) and *T. tabaci* (6.58 adults)/ 3 leaves. Significantly less *B. tabaci* (16.69 adults), *A. biguttula biguttula* (13.74 nymphs) and *T. tabaci* (5.86 adults) were observed with desi cotton (LD 949) as compared BG II cultivars (RCH 776, US 81) and non Bt F 2228. Significantly less avoidable yield loss (16.41%) was observed with timely sown crop as compared to 18.45% losses under late sown conditions. Significantly less yield loss was observed in desi cotton (16.01%) as compared to US 81 (16.55%), RCH 776 (17.20) and F 2228 (19.98%).

Key words: Bt, desi, non Bt cotton, avoidable yield losses, *Bemisia tabaci*, *Amrasca biguttula biguttula*, *Thrips tabaci*, seed cotton yield

India leads in cotton cultivation and it is the only country where all the four species of *Gossypium arboreum*, *G. herbaceum*, *G. hirsutum* and *G. barbadense* along with intra and interspecific hybrids are cultivated (Rajendran and Jain, 2004; AICCIP 2019). In Punjab cotton occupied an area of 2.63 lakh ha with production of 12.06 lakh bales during 2019-20 (Anonymous, 2020). Cotton has an inventory of >1300 insect pest species in the world and there are about 130 arthropod species recorded from Punjab, out of which 54 belongs to the category of insect pests (Bal and Dhawan, 2008). The sap sucking insects like whitefly, jassid, mealy bug, aphid and mirids are emerging as serious threat and they are inflicting heavy losses to Bt cotton. The insect pest complex of cotton crop is broadly categorized into three categories, viz. sucking pests [leafhopper {*Amrasca biguttula biguttula* (Ishida)}, whitefly {*Bemisia tabaci* (Gennadius)}, thrips {*Thrips tabaci* (Lindemann)}, aphid {*Aphis gossypii* (Glover)} and mealybug {*Phenacoccus solenopsis* (Tinsley)}]; foliage feeder [tobacco caterpillar {*Spodoptera litura* (Fabricius)}] and bollworms [American bollworm {*Helicoverpa armigera* (Hübner)}, spotted bollworm {*Earias vittella* (Fabricius)}, spiny bollworm {*E. insulana* (Boisduval)} and pink bollworm {*Pectinophora gossypiella* (Saunders)}]. These cause damage to various plant parts at different growth stages throughout the cropping season. Since 2005, the adoption of transgenic Bt cotton has not only changed the cultivation profile, but also the pest scenario in Punjab. Owing to the introduction of Bt cotton having gene from Bacillus thuringiensis Berliner expressing delta endotoxin, the pest status of bollworm complex has declined (Dhawan et al., 2011). Though genetically engineered Bt cotton provides effective management of bollworm complex, sucking pests still pose a great threat in cultivation of Bt cotton, and hence the present study.

MATERIALS AND METHODS

The field experiment was conducted using four cotton cultivars under protected and unprotected conditions during kharif 2019 at the Entomology Research Farm, Department of Entomology, Punjab Agricultural University, Ludhiana. The crop was raised in split plot design (SPD) with three replications following the recommendations by PAU, Ludhiana except the date of sowing and crop protection. Each cultivar was sown in individual plots measuring 60.75 m^2 with recommended spacing. Unprotected plots were kept free from insecticides and were subjected to natural infestation, whereas protected plots were kept free from insects by applying the foliar spray of insecticide flonicamid 50WG @ 200 g/ ha and profenophos 50EC @ 1250 ml/ ha. The crop sown at two dates namely 25th April (timely sown) and 27th May (late sown).

Table 1. Effect of dates of sowing on the incidence of sucking pests and yield losses in cotton cultivars

Treatment	Number of whitefly adults*/ 3 leaves			Number of jassid nymphs*/ 3 leaves			Number of thrips adults*/ 3 leaves			Seed cotton yield* (q/ acre)					Avoidable yield losses %		
	Timely sowing (25th April)	Late sowing (27th May)	Mean	Timely sowing (25th April)	Late sowing (27th May)	Mean	Timely sowing (25th April)	Late sowing (27th May)	Mean	Timely sown (25th April)		Late sown (27th May)		Mean	Timely sown (25th April)	Late sown (27th May)	Mean
										Sprayed	Unsprayed	Sprayed	Unsprayed				
BG II cotton hybrid (US 81)	14.51 (3.79)[a]	21.50 (4.61)[e]	18.01 (4.20)	11.30	13.15	12.23 (3.63)[b]	6.52	7.41	6.97 (2.63)[b]	11.32	9.48	10.80	8.98	10.14	16.25	16.85	16.55
BG II cotton hybrid (RCH 776)	14.86 (3.83)[b]	21.10 (4.56)[d]	17.98 (4.20)	11.72	13.31	12.51 (3.67)[c]	7.19	7.80	7.50 (2.73)[c]	10.35	8.62	9.94	8.18	9.27	16.71	17.70	17.20
Non Bt cotton cultivar (F 2228)	14.43 (3.78)[a]	20.71 (4.52)[d]	17.57 (4.15)	12.90	14.57	13.74 (3.83)[d]	7.05	7.89	7.47 (2.72)[c]	6.27	5.15	5.75	4.48	5.41	17.86	22.08	19.98
Desi cotton cultivar (LD 949)	14.24 (3.74)[a]	19.14 (4.35)[c]	16.69 (4.05)	9.58	10.83	10.20 (3.34)[a]	5.55	6.16	5.86 (2.41)[a]	8.36	7.12	7.97	6.60	7.51	14.83	17.18	16.01
Mean	14.51 (3.79)[a]	20.61 (4.51)[b]		11.37 (3.51)	12.97 (3.73)		6.58	7.32		8.33		7.84			16.41	18.45	
LSD (p=0.05)	Date of sowing = 0.72; cultivars = 0.06; date of sowing × cultivars = 0.08			Date of sowing = 0.03; cultivars = 0.07; date of sowing × cultivars = NS			Date of sowing = NS; cultivars = 0.10; date of sowing × cultivars = NS			Date of sowing = 0.37; sprayed & unsprayed = 0.32; cultivars = 0.41					Date of sowing = 0.37; cultivars = 0.39; date of sowing × cultivars = NS		

*Mean of three replications; Figures in parentheses square root transformed values

Table 2. Incidence of sucking insect pests on cotton cultivars under protected and unprotected conditions

Treatment	Number of whitefly adults*/ 3 leaves			Number of jassid nymphs*/ 3 leaves			Number of Thrips adults*/ 3 leaves		
	Sprayed	Unsprayed	Mean	Sprayed	Unsprayed	Mean	Sprayed	Unsprayed	Mean
BG II cotton hybrid (US 81)	15.01	21.00	18.01 (4.20)^{c}	11.81	12.64	12.23 (3.63)^{b}	7.5 (2.73)^{f}	6.44 (2.53)^{c}	6.97 (2.63)^{b}
BG II cotton hybrid (RCH 776)	14.57	21.40	17.98 (4.20)^{c}	12.27	12.76	12.51 (3.67)^{c}	7.22 (2.68)^{e}	7.78 (2.78)^{g}	7.50 (2.73)^{c}
Non Bt cotton cultivar (F 2228)	14.29	20.85	17.57 (4.15)^{b}	13.40	14.07	13.74 (3.83)^{d}	6.61 (2.56)^{d}	8.33 (2.88)^{h}	7.47 (2.72)^{c}
Desi cotton cultivar (LD 949)	13.71	19.66	16.69 (4.05)^{a}	10.34	10.07	10.20 (3.34)^{a}	5.52 (2.34)^{a}	6.19 (2.47)^{b}	5.86 (2.41)^{a}
Mean	14.40 (3.77)	20.73 (4.52)		11.95 (3.59)^{a}	12.39 (3.65)^{b}		6.71 (2.58)	7.18 (2.67)	
LSD (p=0.05)	Sprayed and unsprayed = 0.11; Cultivars = 0.06 Sprayed and unsprayed × cultivars = NS			Sprayed and unsprayed = 0.03; cultivars = 0.07 Sprayed and unsprayed × Cultivars = NS			Sprayed and unsprayed = NS; Cultivars = 0.10 Sprayed and unsprayed × Cultivars = 0.15		

*Mean of three replications; Figures in parentheses square root transformed values

The observations on the incidence of sucking pests namely whitefly, jassid and thrips were recorded from 3 fully formed leaves of 10 randomly selected plants at weekly intervals throughout the cropping system. The seed cotton yield of the protected and unprotected plots was recorded on whole plot basis, and avoidable yield losses was computed as per the formula given by Pradhan (1964). Data was analyzed using ANOVA to test for significance of difference among the treatments.

RESULTS AND DISCUSSION

Effect of date of sowing on the incidence of *B. tabaci* revealed significantly low incidence (14.51 whitefly adults/ 3 leaves) under timely sown conditions vs late sown (20.61 whitefly adults/ 3 leaves); among the cultivars tested, significantly less incidence (16.69 whitefly adults/ 3 leaves) was on Desi cotton (LD 949); population density revealed significantly higher incidence (20.73 whitefly adults/ 3 leaves) under unsprayed as compared to sprayed conditions (14.40 whitefly adults/ 3 leaves). With *A. biguttula biguttula* significantly less incidence was in timely sown crop (11.37 jassid nymph/ 3 leaves) as compared to late sown (12.97 jassid nymphs/ 3 leaves); and significantly less incidence (10.20 jassid nymph/ 3 leaves) was on Desi cotton (LD 949); and significantly high incidence was under unsprayed conditions. The incidence of *T. tabaci* was significantly less in timely sown crop (6.58 thrips adults/ 3 leaves), compared to late sown one (7.32 thrips adults/ 3 leaves); of the cultivars significantly less infested was Desi cotton (LD949) (5.86 thrips adults/ 3 leaves); and significantly high incidence (7.18 thrips adults/ 3 leaves) was under sprayed conditions (Table 1, 2).

The results obtained from the present study on the effect of date of late sowing (with high incidence) are corroborated with those of Devi and Ram (2018). Late sown condition supports higher population of *A. biguttula biguttula* in cotton (Devi et al.,2019). Kumar et al. (2020) also showed the effect of late sown cotton on the incidence of *B. tabaci* in Punjab. The late sown cotton crop is attacked more by sucking pests had been shown with results of Abhilasha and Shekharappa (2017), Magundmder (2013), Karavina et al. (2012) and Butter et al. (1992). Significantly high *B. tabaci* incidence was observed on BG II cultivars (US 81 and RCH 776) and non Bt variety (F 2228) whereas, lowest incidence was on Desi cotton hybrid (LD 949). Pathania et al. (2020) observed that *B. tabaci* incidence was more in BG II cultivars. Several workers have observed that growth, development, survival and reproduction of insects were affected by characteristics of host plant (Liu et al., 2004; Akkopru et al., 2015).

Seed cotton yield illustrating interaction of date of sowing cultivars under sprayed and unsprayed conditions showed that significantly low seed cotton yield was recorded on F 2228 (5.41 q/ acre); maximum yield was in US 81 (10.14 q/ acre). The data on seed cotton yield of different Bt hybrid under sprayed and unsprayed conditions revealed significantly more yield in US 81 (10.14 q/ acre). Avoidable yield losses due

to date of sowing was significantly less (16.41%) in timely sown crop, and with LD 949 (16.01%) (Table 1). These results on avoidable yield losses correspond with those of Shera et al. (2012), Surulivelu et al. (2009) and Dhawan et al. (2008); also those of Satpute et al. (1988).

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