

Impact of Altering Sowing Dates on the Incidence of Bollworms

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Abstract: - The influence of different planting dates was studied on major bollworms (*Earias spp.* & *Pectinophora gossypiella*) attacking valuable commercial cotton crop. Susceptible *Gossypium arboreum* variety HD 432 was planted on three different date of sowing at fortnight intervals starting from April to May. Incidence of Spotted bollworm in green bolls was observed least (12.07 & 13.08%) in first fortnight of April sown crop as compared to May sown crop (19.52 & 21.91%) during 2018 and 2019, respectively. Pink bollworm also showed a similar trend and damage (bolls and locules) was minimal in the crop sown in April compared to the crop sown in May during both cropping seasons. This study highlights the importance of sowing date in the pest management scenario by defining the final level.

Key-Words: - Incidence, spotted bollworm, pink bollworm, sowing dates

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1 Introduction

Cotton is the most widespread, profitable non-food crop in the world. Being cash crop, it furnish livelihood to millions of people associated with its cultivation, textile and apparel industries (Sahito *et al.*, 2011). Presently, 50 to 60 million people depend on cotton cultivation, marketing, processing and exports for their livelihood across India (Anonymous, 2021). Globally, cotton grown area is 33.19 million hectares with the production of 25.73 million tons (Anonymous, 2022a). Cotton production in India was 362.18 lakh bales of 170 kg from 120.69 lakh hectares with a productivity of 510 kg lint/ha. Haryana is one of the major cotton growing states in India. In Haryana, area under cotton cultivation is 6.95 lakh hectares with production of 20.30 lakh bales of 170 kg and productivity of 500 kg/ha (Anonymous, 2022b). Cotton productivity is limited by many factors but the major concern in getting maximum production per unit area is due to the infestation of various insect pests, particularly bollworms. Bollworms *viz.* pink bollworm, *Pectinophora gossypiella* (Saunders) and spotted bollworms, *Earias vittella* (Fabricius), *Earias insulana* (Boisduval) are major cause for heavy damage in Haryana. Bollworms reduce the yield and quality of cotton (Vonzun *et al.* 2019).

Today, *Bt* hybrids dominate the cotton seed market in India and have displaced other traditional cotton species such as *G. arboreum* and non-GM *G. hirsutum* cotton cultivars. In recent years farmers experienced severe bollworm attacks due to irregular monsoon rains, unusually warm growing

conditions, presence on other alternative host crops and development of resistance against GM cotton (Vonzun *et al.*, 2019). Therefore, *G. arboreum* might be a better choice in present scenario as it is known for higher genetic diversity than *G. hirsutum*. (Sethi *et al.*, 2015). *G. arboreum* has certain inherent qualities and remarkable tolerance to several pests and disease (Nibouche *et al.*, 2008). Recently, Pink bollworm *P. gossypiella* (Saunders) has developed resistance to *Bt* technology and now it is considered as one of the most serious insect pests of cotton crop attacking on fruiting bodies (Prasad and Ashwini, 2021). During 2017-18, epidemic level pink bollworm infestation was recorded in major cotton growing states of India that ranged between 8-92 per cent with corresponding yield losses of 10-30 per cent (Anonymous, 2019). *E. vittella* is the predominant species on cotton in India (Shera *et al.*, 2015). The yield losses caused by *E. vittella* and *E. insulana*, estimated by chemical control method, were 44 per cent in *G. hirsutum* and 48.2 per cent in *G. arboreum* varieties (Shera, 2009). Cultural practice like time of sowing has significant effect in pest population build-up (Mohamed, 2012). Bollworm population usually increasing as the season progresses (Parajulee *et al.*, 1998). Early planted cotton had lower population of aphids, jassids and American bollworm than later-planted cotton (Karavina *et al.* 2012). Khan *et al.* (2019) studied the effect of different sowing dates of transgenic cotton genotypes against bollworms. Late sown genotypes of cotton showed the highest per cent damage (1.27 ± 0.27 and 2.27 ± 1.04) compared to early sown (0.01 ± 0.00 and 0.73 ± 0.11) and

median sown (0.37 ± 0.08 and 0.95 ± 0.22) for pink and spotted bollworm, respectively. Attia *et al.* (2021) reported that insect infestation increased significantly by delaying planting date. So in present study we aimed to study effect of planting dated on bollworms incidence.

2 Material and Methods

The experiment was conducted at Chaudhary Charan Singh Haryana Agricultural University, Hisar ($29^{\circ}05'N$ $75^{\circ}26'E$ / $29.09^{\circ}N$ $75.43^{\circ}E$ / 29.09 ; 75.43). Hisar is above 215 m (705 ft) above mean sea level and located in western Haryana (India). *Desi* cotton variety HD 432 (recommended for Haryana state) was selected and experimented in randomized block design with seven replications. There were three sowing dates at fortnight interval *viz.* first fortnight of April (12th April), second fortnight of April (27th April) and first fortnight of May (14th May) during 2018, and 2019. The experimental plots were of dimensions 5m long and 4m wide (20 m²). Before sowing, the seeds were soaked in water for two hours for better germination. Sowing was done with hand plough by *pura* method by keeping row to row distance of 67.5 cm and plant to plant 30 cm. Thinning was done after one month of sowing living the healthy ones and to maintain the proper space. The recommended package of practices for cultivation of cotton was followed except the recommended date of sowing (*i.e.*, first fortnight of April) and the insecticide treatments.

2.1 Observations for insect incidence

Incidence of both the bollworms (pink and spotted bollworm) was recorded in bolls and shed materials (squares, flowers and bolls). Forty five days after sowing five plants were selected from each plot at random excluding two rows on either side to observe the incidence and population of bollworms at fifteen days interval during the entire crop growth period. The spotted bollworm incidence was recorded by visually observing the intact green bolls. Total bolls and damaged bolls of the plant were counted to calculate the percentage of damage using formula given below.

Pink bollworm damage in open bolls and locules was observed at the time of harvesting by counting the total bolls/locules and damaged bolls/locules in five randomly selected plants. Per cent boll and locule damage was calculated using the same formula.

No. of bolls damaged

$$\text{Per cent boll damage} = \frac{\text{No. of bolls damaged}}{\text{Total number of bolls observed}} \times 100$$

2.1.1 Statistical analysis

Data of population dynamics was analyzed for variance by adopting square root ($\sqrt{n + 1}$) and angular transformation by using OPSTAT (Sheoran *et al.*, 1998) at 5 per cent level of significance.

3 Results

In our experiment date of sowing showed significant effect on bollworms incidence. First fortnight of May sown crop was observed with severe infestation of spotted and pink bollworms in comparison to April sown crops (First and second fortnight)

Incidence of spotted bollworms in green bolls

The sowing date exhibited significant effect on incidence of spotted bollworm on cotton crop during both years. Green boll damage during *kharif*, 2018 started at 90 days after sowing (DAS) in first fortnight of April sown crop (2.02%) while at 75 DAS in second fortnight of April (0.76%) and first fortnight of May sown crops (5.03%) (Table 1). Peak damage (25.87, 27.10 and 36.57%) was noticed at 165 DAS (October to November) in all three sowing dates, respectively. During *kharif* 2019 damage (0.19, 1.84 and 6.44%) started at 75 DAS (July to August) and reached to peak (29.83, 30.92 and 35.77%) at 165 DAS in all three sowing dates (Table 2). Therefore, in present study, final mean of green boll damage was lowest (12.07 & 13.08 %) in case of first fortnight of April sown crop and highest (19.52 & 23.71 %) in first fortnight of May sown crop in 2018 and 2019, respectively (Table 6).

Incidence of Pink bollworm in open bolls and locules

Open boll damage fluctuated from 29.72 and 35.75 to 40.27 and 46.03 per cent, respectively in three sowing dates during *kharif* 2018 and 2019 (Table 3). In present study, the lowest (29.72%) open boll damage was recorded in second fortnight of April sown crop that was statistically on par (31.05%) with first fortnight of April sown crop during 2018. Irrespective to this open boll damage was lowest (35.75%) in first fortnight of April sown crop during *kharif* 2019 that was statistically on par (37.38%) with second fortnight of April sown crop damage. Highest damage (40.27 and 46.03%) was recorded in first fortnight of May sown crop during *kharif* 2018 and 2019, respectively.

The locule damage varied from 13.03 to 22.86 per cent during 2018 and 13.14 to 22.06 per cent during 2019. In present study, locule damage was minimum (13.03%) in second fortnight of April

sown crop that was at par with first fortnight of April sown crop (14.83%) while maximum (22.86%) in first fortnight of May sown crop during *kharif*, 2018. Whereas during *kharif*, 2019 minimum (13.14%) locule damage was recorded in first fortnight of April sown crop and maximum (22.06) in first fortnight of May sown crop (Table 3).

Incidence of bollworms in Shed materials (Squares, flowers and bolls)

During 2018, bollworms damage in shed materials was noticed at 60 DAS in first fortnight of April sown crop (0.96%) that reached to peak (34.22%) at 165 DAS. sown crop. The damage in shed material appeared early at 45 DAS (0.55 & 1.38%) with peak damage (33.31 & 42.99%) at 165 DAS in second fortnight of April and first fortnight of May sown crops, respectively (Table 4). Incidence of bollworms was noticed at 45 DAS in all three sowing dates during 2019, that increased onwards and reached to peak at 165 DAS (Table 5).

On the basis of shed materials incidence of both the bollworms was recorded minimum in April sown crops as compared to May sown crop (Table 6). First fortnight of April sown crop showed significant least (14.88 & 16.36%) incidence of bollworms during 2018 and 2019 respectively (Table 6).

4 Conclusion

Planting dates significantly effecting the incidence of bollworms in present study. Alteration in sowing time can be an efficient, economical as well as eco-friendly solution to a particular pest problem in a particular region. Delayed sowing *i.e.* first fortnight of May, significantly increase the incidence of both the bollworms in cotton crop. As per our studies sowing done in April (first and second fortnight) was found most suitable to minimize the incidence of spotted and pink bollworms.

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Table 1. Effect of date of sowing on incidence of spotted bollworm in bolls during 2018

Sowing time	Per cent damage at different days after sowing							
	75	90	105	120	135	150	165	Mean
1 st fortnight of April (12 th April)	0 (1.15)	2.02 (8.10)	6.23 (14.41)	11.50 (19.78)	15.79 (23.37)	23.06 (28.67)	25.87 (30.54)	12.07 (20.31)
2 nd fortnight of April (27 th April)	0.76 (4.56)	3.62 (10.91)	8.55 (16.94)	11.75 (19.95)	15.93 (23.48)	23.41 (28.91)	27.10 (31.33)	13.02 (21.13)
1 st fortnight of May (14 th May)	5.03 (12.89)	10.03 (18.43)	14.55 (22.41)	20.08 (26.59)	23.65 (29.08)	26.72 (31.08)	36.57 (37.17)	19.52 (26.20)
SE±(m)	0.61	0.28	0.38	0.62	0.60	0.57	0.69	0.28
CD at 5%	(1.89)	(0.86)	(1.17)	(1.92)	(1.87)	(1.77)	(2.14)	(0.87)

Figures in parentheses are angular transformed values, mean of 7 replications

Table 2. Effect of date of sowing on incidence of spotted bollworm in bolls during 2019

Sowing time	Per cent damage at different days after sowing							
	75	90	105	120	135	150	165	Mean
1 st fortnight of April (12 th April)	0.19 (1.32)	2.51 (8.98)	5.91 (14.02)	10.89 (19.23)	17.81 (24.94)	24.39 (29.54)	29.83 (33.07)	13.08 (20.32)
2 nd fortnight of April (27 th April)	1.84 (7.65)	3.43 (10.59)	6.60 (14.79)	12.77 (20.90)	19.26 (25.98)	26.85 (31.18)	30.92 (33.74)	14.52 (22.60)
1 st fortnight of May (14 th May)	6.44 (14.61)	15.55 (23.17)	15.79 (23.37)	22.81 (28.49)	26.43 (30.87)	30.60 (33.56)	35.77 (36.77)	21.91 (29.12)
SE±(m)	0.64	0.61	0.53	0.52	0.80	0.73	0.80	0.31
CD at 5%	(1.99)	(1.90)	(1.65)	(1.63)	(2.48)	(2.28)	(2.50)	(0.95)

Figures in parentheses are angular transformed values; mean of 7 replications

Table 3. Effect of date of sowing on incidence of pink bollworm in open bolls and locules

Sowing time	Per cent Damage					
	Open bolls			Locules		
	2018	2019	pooled	2018	2019	pooled
1 st fortnight of April (12 th April)	31.05 (33.82)	35.75 (36.69)	33.40 (35.28)	14.83 (22.60)	13.14 (21.20)	13.99 (21.93)
2 nd fortnight of April (27 th April)	29.72 (33.00)	37.38 (37.66)	33.55 (35.37)	13.03 (21.13)	16.09 (23.55)	14.56 (22.38)
1 st fortnight of May (14 th May)	40.27 (39.37)	46.03 (42.70)	43.15 (41.04)	22.86 (28.49)	22.06 (27.93)	23.46 (28.21)
SE±(m)	0.66	0.89	0.62	0.77	0.73	0.66
CD at 5%	(2.06)	(2.79)	(1.94)	(2.41)	(2.28)	(2.07)

Figures in parentheses are angular transformed values; Mean of 7 replications

Table 4. Effect of date of sowing on incidence of bollworms in shed fruiting bodies (flowers, squares and bolls) during 2018

Sowing time	Per cent damage at different days after sowing									
	45	60	75	90	105	120	135	150	165	Mean
1 st fortnight of April (12 th April)	0 (1.15)	0.96 (4.71)	2.96 (9.73)	7.67 (15.99)	16.48 (23.88)	21.79 (27.76)	23.09 (28.64)	26.74 (31.08)	34.22 (35.76)	14.88 (22.65)
2 nd fortnight of April (27 th April)	0.55 (2.77)	2.03 (8.00)	3.77 (10.96)	8.90 (17.29)	15.27 (22.94)	19.43 (26.07)	21.53 (27.53)	27.33 (31.49)	33.31 (35.22)	14.68 (22.50)
1 st fortnight of May (14 th May)	1.38 (6.56)	5.25 (13.09)	9.08 (17.40)	14.75 (22.51)	22.65 (28.35)	28.49 (32.23)	30.10 (33.21)	36.25 (36.97)	42.99 (40.94)	21.22 (27.40)
SE±(m)	0.81	0.97	0.99	0.69	0.89	0.96	0.96	0.78	0.90	0.52
CD at 5%	(2.52)	(3.03)	(3.08)	(2.14)	(2.76)	(2.98)	(2.98)	(2.42)	(2.79)	(1.60)

Figures in parentheses are angular transformed values; Mean of 7 replications

Table 5. Effect of date of sowing on incidence of bollworms in shed fruiting bodies (flowers, squares and bolls) during 2019

Sowing time	Per cent damage at different days after sowing									
	45	60	75	90	105	120	135	150	165	Mean
1 st fortnight of April (12 th April)	0.38 (2.29)	2.40 (8.18)	5.29 (13.13)	12.46 (20.50)	18.16 (25.13)	21.90 (27.82)	24.77 (29.80)	28.24 (32.00)	32.62 (35.35)	16.36 (23.80)
2 nd fortnight of April (27 th April)	0.55 (2.77)	3.45 (10.48)	7.81 (16.07)	15.21 (22.73)	21.28 (27.37)	24.16 (29.37)	27.89 (31.83)	31.04 (33.81)	37.38 (37.62)	18.75 (25.64)
1 st fortnight of May (14 th May)	1.78 (7.54)	7.37 (15.67)	13.87 (23.44)	18.87 (25.60)	29.31 (32.71)	33.84 (35.51)	37.45 (37.70)	42.26 (40.52)	46.20 (42.79)	25.66 (30.41)
SE±(m)	0.97	0.85	0.76	0.99	1.25	0.68	0.62	0.87	0.96	0.41
CD at 5%	(3.02)	(2.65)	(2.36)	(3.09)	(3.89)	(2.12)	(1.94)	(2.72)	(2.98)	(1.26)

Figures in parentheses are angular transformed values; Mean of 7 replications

Table 6. Incidence of spotted and pink bollworms during *Kharif* 2018 and 2019

Sowing time	Spotted bollworm incidence in green bolls (%)		Pink bollworm incidence in open bolls (%)		Pink bollworm incidence in locules (%)		Incidence of bollworms in shed materials (%)	
	2018	2019	2018	2019	2018	2019	2018	2019
1 st fortnight of April	12.07 (20.31)	13.08 (20.32)	31.05 (33.82)	35.75 (36.69)	14.83 (22.60)	13.14 (21.20)	14.88 (22.65)	16.36 (23.80)
2 nd fortnight of April	13.02 (21.13)	14.52 (22.60)	29.72 (33.00)	37.38 (37.66)	13.03 (21.13)	16.09 (23.55)	14.68 (22.50)	18.75 (25.64)
1 st fortnight of May	19.52 (26.20)	21.91 (29.12)	40.27 (39.37)	46.03 (42.70)	22.86 (28.49)	22.06 (27.93)	21.22 (27.40)	25.66 (30.41)
SE±(m)	0.28	0.31	0.66	0.89	0.77	0.73	0.52	0.41
CD at 5%	(0.87)	(0.95)	(2.06)	(2.79)	(2.41)	(2.28)	(1.60)	(1.26)

Figures in parentheses are angular transformed values