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Management of Pink Bollworm, *Pectinophora gossypiella* (Saunders) through Agronomic Interventions in Cotton

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***Abstract*:** An experiment to investigate the effect of agronomic interventions in the management of pink bollworm, *Pectinophora gossypiella* in *Bt* cotton (hybrid Platinum) under closer spacing (90 x 30 cm) was conducted at RARS, Lam, ANGRAU, Guntur during *kharif* ,2024-25. Eight treatments in combination with mepiquat chloride application at 45 and 60 days after sowing detopping at 60 DAS, with recommended chemical pink bollworm management compared with conventional method of spacing (105 x 60 cm) , were evaluated. Infestation levels of PBW measured in terms of green boll damage (%), green locule damage (%), number of larvae per 10 bolls, and rosette flowers (%). The lowest green boll damage, green locule damage, no. of larvae/ 10 bolls and rosette flowers due to pink bollworm were recorded in the treatment closer spacing + detopping + recommended PBW chemical management (17.33, 12.5, 4.33 and 11.00 respectively), next best treatment was closer spacing + MPC @ 45 ppm at 45–60 DAS + recommended PBW chemical management (18, 18, 4.33 and 12 respectively) and highest infestation was recorded in Conventional method of spacing (36.67, 36, 4.93 and 24.67 respectively). Closer spacing + recommended PBW chemical management alone recorded 22.67 green boll damage, 14.89 green locule damage, 4.33, and 16.33 rosette flowers. Integrating closer spacing, growth regulation, and recommended PBW chemical management effectively reduced PBW infestation in *Bt* cotton.

Keywords: *Bt* cotton, Closer spacing, Detopping, Mepiquat chloride, Rosette flowers, Pink bollworm

India is a leading cotton producer, with approximately 112.95 lakh hectares of area during the 2024-25 season and an estimated production of around 301 lakh bales of 170 kg each (Cotton Association of India 2024). The introduction of genetically modified *Bt* cotton in the early 2000s significantly reduced bollworm infestations and reliance on chemical insecticides with enhanced yields. Despite its vital contribution to the global economy, cotton production is consistently challenged by a wide spectrum of insect pests. Among these pests, the pink bollworm (*Pectinophora gossypiella* Saunders) is particularly destructive, feeding internally on floral parts and developing bolls, causing substantial yield losses and reducing fibre quality. The field populations of pink bollworm have developed resistance to both Cry1Ac and Cry2Ab proteins in dual-gene *Bt* cotton varieties, resulting in pest resurgence in key cotton-growing regions (Dhurua et al., 2011, Mukhtar et al., 2023). This highlights the need for integrated management strategies. The IPM strategies include refugia strategy, short statured high density planting systems with agronomic interventions, off-season management of the pest etc

Agronomic interventions such as detopping, foliar application of the growth regulator mepiquat chloride (MPC), and optimized plant spacing have been explored to complement *Bt* cotton and improve crop resilience. Detopping redistributes the assimilates to reproductive organs, promoting flowering and boll formation (Maiga et al., 2024). MPC regulates excessive vegetative growth, maintains optimal canopy architecture, and improves light interception (Abbas et al., 2022). MPC, limits vegetative growth by reducing gibberellic acid, shortening internodes, and producing a compact canopy that promotes early and uniform fruiting Optimized spacing ensures uniform crop growth and modifies the microclimate within the canopy, indirectly reducing pest incidence (Bhanderi et al., 2024).

The present study was undertaken to evaluate the effects of detopping, MPC application, and closer spacing, along with recommended pink bollworm management strategies on the incidence of pink bollworm and its damage.

MATERIAL AND METHODS

A field experiment was conducted at the Regional Agricultural Research Station (RARS), Lam, Guntur during *kharif* 2024-25 with Bt hybrid, Platinum under closer spacing. The study comprised eight treatments: conventional spacing of 105 × 60 cm under unprotected conditions, conventional spacing (105 x 60 cm) with recommended PBW chemical management; closer spacing (90 × 30 cm) as untreated control; closer spacing with recommended PBW chemical management; closer spacing with detopping; closer spacing with detopping along with recommended PBW chemical management; closer spacing with foliar application of MPC @ 45 ppm at 40–60 DAS during square initiation and closer spacing with MPC @ 45 ppm along with recommended PBW chemical management. Detopping was carried out by removing the apical shoot tip when plants attained 15 nodes to restrict vertical growth and encourage early boll formation. Foliar application of MPC @ 45 ppm was imposed between

40–60 DAS during square initiation. Recommended PBW management involved rotation of insecticides starting from 75 DAS at 15-day intervals, including chlorpyriphos 20% EC @1250 ml/ ha, quinalphos 25% EC@1000 ml/ ha, cypermethrin 25% EC @500 ml/ ha, lambda-cyhalothrin 5 EC @500 ml/ ha and profenophos 50 EC @ 1000 ml/ha.

Observations on pink bollworm (*P. gossypiella*) incidence were recorded at 75, 90, 105, 120, 135, and 150 days after sowing (DAS) across all treatments. The infestation levels were measured in terms of per cent rosette flowers (50 flowers/ plot), per cent green boll damage (GBD), green locule damage (GLD), no.of larvae (10 bolls/ plot by destructive sampling), open boll and locule damage at the time of harvest by collecting data from open bolls from 5 plants/ plot. Per cent GBD and GLD were calculated by destructive sampling of 10 bolls per treatment. The original per cent mean values were transformed into arc sine values and no. of PBW larvae converted into square root values. The transformed data is subjected to ANNOVA

RESULTS AND DISCUSSION

The mean green boll damage (%) during the *kharif* 2024-25 season ranged from 17.33 to 36.67. The lowest damage was recorded in the treatment combining closer spacing with detopping at 60 DAS and recommended PBW management (17.33%), which was statistically superior to both conventional and closer spacing untreated plots (Table 1). Similarly, the mean green locule damage (%) ranged from 12.53 to 25.35, with the lowest damage (12.53%) also observed in the treatment combining closer spacing and detopping with recommended PBW management. This combination of agronomic interventions resulted in a significant reduction in both GBD and GLD. These findings are in accordance with earlier reports where terminal shoot removal reduced fruiting body damage (bolls and squares) by *Helicoverpa armigera* (Vennila et al., 2000) Reddy and Rabindrababu (1999) also confirmed the reduction of *H. armigera* eggs by nipping at 18-20 nodes.

The lowest mean larval incidence (2.13 per 10 green bolls) and lowest mean rosette flowers (%) damage (11.00) were both recorded in treatments that combined closer spacing with MPC application and recommended PBW chemical management. Zummo et al. (1984), also confirmed that MPC not only controls excessive vegetative growth but also contributes to increased resistance against bollworms. The MPC application led to a reduction in bollworm survival and growth, suggesting enhanced antibiosis and feeding deterrence. This effect was partially attributed to the increased synthesis of secondary metabolites such as tannins and terpenoids, which are known to reduce pest feeding and improve plant resistance. Therefore, the use of MPC not only improves canopy structure but also plays an important role in integrated pest management (IPM) by enhancing the plant's natural defence mechanisms against bollworm infestation.

Table 1. Effect of agronomic practices on the incidence of pink bollworm and damage in cotton during *kharif,* 2024–25 at RARS Lam

Treatment Details	Green boll damage (%)	Green locule damage (%)	Rosette flowers (%)	No. of larvae	Open boll damage (%)	Open locule damage (%)	Seed cotton yield (q/ha)
T_1: Conventional method of spacing (105 x 60 cm)	32.00 (34.32)*	21.77 (27.80)*	23.33 (28.87)*	4.40 (2.31)**	49.83 (44.88)*	39.20 (38.71)*	11.62
T_2: Conventional method of spacing (105 x 60 cm) + recommended PBW management	20.67 (27.02)	13.91 (21.86)	15.33 (23.03)	2.53 (1.85)	36.58 (37.09)	21.09 (27.33)	17.87
T_3: Closer spacing (90 x 30 cm) (untreated control)	36.67 (37.22)	25.35 (30.20)	24.67 (29.75)	4.93 (2.43)	50.63 (45.35)	41.41 (39.99)	12.67
T_4: Closer spacing + recommended PBW management	22.67 (28.35)	14.89 (22.62)	16.33 (23.81)	2.80 (1.95)	38.35 (38.24)	22.39 (28.23)	18.64
T_5: Closer spacing + detopping	30.00 (33.17)	19.50 (26.17)	19.00 (25.79)	3.80 (2.19)	42.57 (40.68)	27.81 (31.81)	12.12
T_6: Closer spacing + detopping + recommended PBW management	17.33 (24.50)	12.53 (20.66)	12.00 (20.21)	2.33 (1.83)	30.40 (33.38)	19.65 (26.3)	20.19
T_7: Closer spacing + mapiquat chloride @ 45ppm at 30 DAS or square initiation stage	30.66 (33.60)	19.01 (25.81)	17.33 (24.59)	4.47 (2.34)	42.67 (40.76)	24.94 (29.95)	11.4
T_8: Closer spacing + MPC @ 45ppm at 30 -45 DAS or square initiation + recommended pbw management	18.00 (25.07)	13.44 (21.32)	11.00 (19.35)	2.13 (1.77)	29.48 (32.79)	18.83 (25.67)	20.87
CD (p=0.05)	3.95	4.03	2.22	0.38	4.16	3.53	3.89
CV (%)	7.33	9.29	5.14	10.44	6.00	6.44	14.03

·ARC SINE transformed values, **SQRT x +1 transformed values

At harvest, this integrated approach continued to show its effectiveness. The lowest open boll damage (OBD) of 29.48% and open locule damage (OLD) of 18.83% were recorded in the closer spacing treatment with MPC and recommended PBW chemical management (Table 1). The damage in close spacing without protection was maximum, with 50.63% OBD and 41.41% OLD. This highlights that through closer spacing favours pest build-up, an integrated approach with detopping, MPC application, and insecticide management could control PBW effectively. These results are supported by Udikeri et al. (2004), who reported that shoot nipping effectively reduced bollworm populations and minimized fruiting body damage. Renou et al. (2011) also confirmed that manual topping significantly reduced the incidence of *Helicoverpa armigera* and *Earias* species. Similarly, Surilivelu *et al.* (1998) demonstrated that topping, when integrated with insecticide applications guided by economic thresholds, significantly reduced bollworm infestation. Collectively, these studies indicate that although closer plant spacing may promote pest proliferation, the combined implementation of detopping, MPC application and insecticide management constitutes an essential and effective approach within the framework of Integrated Pest Management.

The highest seed cotton yield (20.87 q/ha) was achieved under closer spacing (90 × 30 cm) with mepiquat chloride (45 ppm at 45 DAS) and recommended PBW chemical management, comparable to treatments combining closer spacing with PBW management or detopping, whereas MPC alone produced the lowest yield (11.40 q/ha) (Table 1). These findings align with Alam et al. (2024), who reported significant yield and fiber quality improvements from detopping at 80-95 DAS. Grundy et al. (2012) stated that Integrating canopy management, MPC application and PBW control optimizes plant architecture and maximizes yield potential.

CONCLUSION

The present study demonstrated that by integrating closer spacing with detopping and recommended PBW management proved most effective, recording the lowest green boll ,locule damage. Similarly, closer spacing with mepiquat chloride (MPC) application and PBW chemical management significantly reduced larval incidence and rosette flowers, open boll and open locule damage, while achieving the highest seed cotton yield . These findings highlight those cultural practices such as detopping and canopy regulation through MPC, when combined with recommended chemical management, can substantially suppress PBW infestation while improving productivity. The results reinforce the importance of adopting integrated agronomic and chemical interventions for sustainable management of pink bollworm in cotton.

AUTHORS CONTRIBUTION

Conceptualization and experiment design: Annie Diana Grace, Trial execution and data collection: Ms. Hima Bindu; Data curation, statistical analysis and draft preparation**:** V. Hima Bindu**,** G. Annie Diana Grace, B. Ratna Kumari, Rani Chapara. Final draft revision and approval: V. Hima Bindu**,** G. Annie Diana Grace, B. Ratna Kumari, Rani Chapara.

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