J. Farm Sci., 36(3): (266-269) 2023

RESEARCH PAPER

Incidence of pink bollworm, *Pectinophora gossypiella* (Saunders) on various malvaceous plants in North Eastern region of Karnataka, India

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(Received: July, 2023 ; Accepted: August, 2023)

DOI: 10.61475/JFS.2023.v36i3.06

Abstract: Pink bollworm roving survey on *Bt*-cotton and some malvaceous plants, in and around the cotton field across the major cotton growing districts of North Eastern region of Karnataka recorded the highest green boll damage in Raichur district (70.79%) followed by Ballari (63.46%) and Yadgir (55.80%) district. Whereas, no incidence of pink bollworm was recorded on the malvaceous plants *viz*., *Abutilon indicum* (L.), *Abutilon hirtum* (Lam.) and *Abelmoschus ficulneus* (L.).

Key words: Abelmoschus, Abutilon, Malvaceae, Pectinophora, Pink bollworm

Introduction

Cotton (*Gossypium* spp.), the king of natural fibres referred as white gold, grown in more than 111 countries of tropical and sub-tropical regions as a commercial crop. The cotton seed, which accounts for nearly 65 per cent of the boll weight, is utilized for oil extraction and as a valuable concentrate for the cattle (Rakesh and Kathane, 1989). Cotton belongs to the family Malvaceae with four cultivated Gossypium species, two tetraploids *viz., Gossypium hirsutum* and *Gossypium barbadense* and two diploids namely *Gossypium arboreum* and *Gossypium herbaceum.* Globally, 90 per cent area is covered by *G. hirsutum*, followed by *G. barbadense* (8%); *G. arboreum* and *G. herbaceum* occupy rest of the area. In India, all the four cultivated species were grown but 95 per cent of all cotton is derived from *G. hirsutum* (Trapero *et al*., 2016).

Global cotton area and production is 32.6 million ha and 116.10 million bales (Anonymous, 2020). India is an important cotton grower among all the cotton producing countries in the world and ranks first in area (129.57 lakh ha) with production of 371 lakh bales of 170 kg each with productivity of 487 kg lint/ ha (Anonymous 2021). In Karnataka, it is cultivated in 5.50 lakh ha with production of 18.00 lakh bales of 170 kg and with the productivity of 556 kg/ ha (Anonymous, 2019).

The insect pest spectrum of cotton is quite complex, more than 1326 species of insect pests have been reported on this crop across the world (Hargreaves, 1948). However, 130 species of insects and mites pests are reported to cause damage to cotton crop in India. Among these, the bollworms *viz.,* American bollworm, *Helicoverpa armigera* (Hubner); spiny bollworm, *Earias insulana* (Boisdual); spotted bollworm, *Earias vitella* (Fabricius) and pink bollworm, *Pectinophora gossypiella* (Saunders) pose greater threat to cotton production (Parmar and Patel, 2016).

Even after the introduction of *Bt*-cotton in India, Pink bollworm (PBW) showed multifold resistance to Bollgard I event (Cry1Ac) in Gujarat during 2010 with a resistance ratio of 44 (Dhurua and Gujar, 2011) and subsequently to Bollgard II (Cry1Ac + Cry2Ab) with 40-80 per cent of the bolls harboured surviving larvae as recorded from Amreli and Bhavnagar districts of Gujarat during 2014 From 2014 onwards, reports have highlighted the outbreak of pink bollworm on Bollgard I and Bollgard II in states namely, Gujarat, Madhya Pradesh, Maharashtra, Karnataka, and Andhra Pradesh with a resistance ratio of 1387 to Cry1Ac and 4196 to Cry2Ab in 2017 from central and southern India (Naik *et al*., 2018). Notably, there was no significant difference in PBW damage on Bt cotton between both rainfed and irrigated conditions at Raichur, indicating consistently high damage levels unaffected by cultural practices or hybrid selection (Mahesh and Mohan, 2020). The fruit/ seed pods of alternate host plants provide continuous food supply for breeding, during the dead season of cotton production in other countries (Rude, 1932 and Fife, 1938). Still no alternate (malvaceous/weed) host has been reported in India for PBW. Hence, the present investigation framed to conduct a roving survey on different malvaceous plants, to know about the incidence of pink bollworm on any alternate hosts, across major cotton growing districts of North Eastern Region of Karnataka.

Material and methods

Roving survey was conducted to know about the malvaceous plants present in and around the cotton growing fields of North Eastern districts of Karnataka during the cotton growing season 2020-21. Three different plants *viz.*, *Abutilon indicum* (L.), *Abutilon hirtum* (Lam.) and *Abelmoschus ficulneus* (L.) belongs to the family Malvaceae were observed. Then roving survey was undertaken to know the incidence of PBW on *Bt*-cotton and the malvaceous plants in North-Eastern region of Karnataka. Roving survey was carried out in major cotton growing districts *viz.*, Raichur (Devadurga, Manvi, Raichur and Sindhanur), Yadgiri (Shahapur and Yadgiri) and Ballari (Ballari and Siraguppa) at fortnight interval. In each taluk 50 to 100 number of bolls of cotton and fruiting pods of malvaceous host *viz.*, *A. indicum*, *A. hirtum* and *A. ficulneus* were collected at 10 to 20 km distance. The collected cotton bolls and fruiting pods (*A. indicum*, *A. hirtum* and *A. ficulneus*) were examined

for number of PBW larvae and pupae as well as damaged number of bolls and fruiting pods were recorded.

Results and discussion

The roving survey of PBW on cotton bolls indicated a progressive increase in the larval incidence and green boll damage from October to February. Peak PBW incidence and green boll damage was in February in all the taluks of major cotton growing areas of north eastern region of Karnataka (Table 1). Taluk wise pooled mean indicates that, Raichur taluk recorded the highest larval incidence (15.95 larvae per 20 green boll) and green boll damage (76.83%), followed by Devadurga taluk with the larval incidence and green boll damage of 15.20 larvae per 20 green boll and 71.33%, respectively. However, Lowest green boll damage was noticed in the Yadgir taluk with 12.16 of larvae per 20 green boll and 54.10% of green boll damage during cotton growing season of 2020-21 (Fig1).

District wise pooled mean revealed highest PBW incidence (14.78 larvae/20 bolls) and green boll damage (70.79%) with 0.39 pupae per 20 bolls in Raichur district, followed by Ballari district. The lowest larval incidence (12.38 larvae / 20 bolls) and green boll damage (55.80%) with 0.36 pupae per 20 bolls in Yadgir district. In Raichur district, average green boll damage ranged from 65.75-76.83 per cent with an average of 13.72-15.59 larvae per 20 bolls. However, in Yadgiri and Ballari district average green boll damage was ranged from 54.10-57.50 and 61.33-65.58 per cent with an average of 12.16-12.60 and 12.68-13.80 larvae per 20 bolls, respectively (Table 1). This lower incidence might be due to less field-evolved resistance in PBW against *Bt* at that time. However, infestation and green boll damage was more after December during the period of cotton season of the year 2020-21. This might be due to, most of the farmers were harvested two pickings before December and stopped plant protection measures after December that lead to higher green boll damage. This increased boll damage during January and February might be due to the decreased Cry toxin expression (after 90 DAS) and decreased minimum temperature.

We conducted survey to know the off seasonal survival of PBW on malvaceous plants till first fortnight of March, wherever we conducted survey for the offseason survival, we also collected the green bolls of cotton from irrigated/ rainfed fields and the increased PBW incidence after January has contributed to the higher average green boll damage of different districts. The present findings are in concurrence with Mahesh and Mohan (2020) where they reported the average green boll damage 55.42-94.90 per cent in Raichur district. Likewise, Naik *et al*. (2020) recorded 28.85 to 72.49 per cent of pink bollworm larval recovery from BG-II cotton bolls from central and south India, during 2014 to 2017. However, Shrilakshmi and Udikeri (2021) noticed incidence of PBW on Bt cotton across Karnataka in the range of 20 to 85 per cent, in that Raichur recorded the highest green boll damage (72.74%), larval incidence (58.50 larvae per 50 bolls) and Ballari recorded with 50.36 per cent green boll damage, 50.50 larvae per 50 bolls during 2017-18.

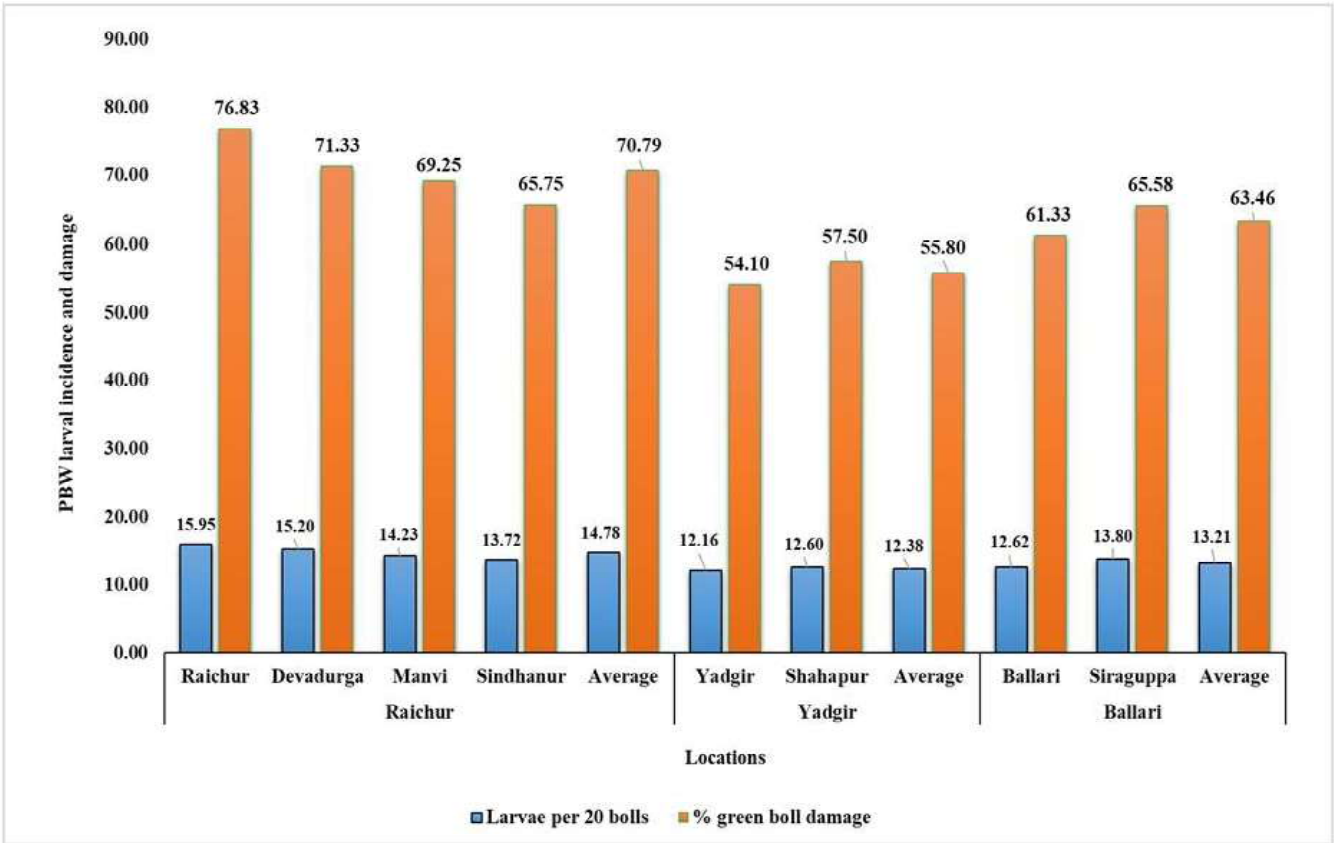

Fig1. Pink bollworm incidence on *Bt* cotton in major cotton growing taluks of North Eastern region of Karnataka

Table 1. Incidence of pink bollworm on *Bt* cotton fields in North-Eastern region of Karnataka

District	Taluk	Month	Larvae Per 20 bolls	Pupae Per 20 bolls	% Green boll damage
Raichur	Raichur	October	10.8	0.2	46.5
		November	14.5	0.3	75
		December	17.9	0.4	85.5
		January	19	0.6	88.5
		February	19.1	0.9	91.5
		March	14.4	0.4	74
	Devadurga	October	8.7	0.2	41
		November	13.9	0.2	63
		December	17.4	0.3	81
		January	18.1	0.6	83.5
		February	18.9	0.7	86.5
		March	14.2	0.4	73
	Manvi	October	8	0.1	36
		November	12.6	0.2	61.5
		December	16.6	0.4	80
		January	17	0.7	82.5
		February	17.4	0.3	84.5
		March	13.8	0.2	71
	Sindhanur	October	7.2	0.2	34
		November	11.8	0.3	58.5
		December	15.7	0.5	75
		January	17	0.6	79.5
		February	17.2	0.5	81.5
		March	13.4	0.2	66
Yadgir	Yadgir	October	7	0.2	31.5
		November	11.6	0.3	49.5
		December	13.3	0.3	60.5
		January	13.9	0.5	62
		February	15	0.7	67
		March	12.16	0.3	54.1
	Shahapur	October	7.3	0.2	34
		November	11.8	0.2	54.5
		December	14.4	0.2	63.5
		January	14.1	0.6	67.5
		February	14.4	0.6	69.5
		March	13.6	0.2	56
Ballari	Ballari	October	6.7	0.1	31.5
		November	10.6	0.4	52
		December	14.8	0.4	70.5
		January	15.3	0.5	75.5
		February	15.9	0.6	78.5
		March	12.4	0.2	60
	Siruguppa	October	7.9	0.2	35
		November	12.2	0.4	59
		December	15.8	0.7	76
		January	16.7	0.7	80
		February	17	0.3	81.5
		March	13.2	0.2	62

On malvaceous host plants *viz.*, *A. indicum*, *A. hirtum* and *A. ficulneus* at fortnight interval indicated that PBW incidence was not observed in any of these plants during October 2020 to March 2021.

Till now there is no report on occurrence of pink bollworm on weed hosts in India. But, Rajpalsingh and Joshi (2003) and Murthy *et al.* (2018), observed the incidence of *P. gossypiella* on okra in India and Murthy *et al.* (2018), taxonomically confirmed with the collected specimen on okra. Mushtaq *et al.* (2021) from Pakistan as they recorded pink bollworm on okra and other weed as well as tree species but they were not taxonomically confirmed during research work. In present study no such host reaching beyond cotton was noticed. However, Sahoo *et al.* (2020) noticed PBW trap catches in non-cropped area and suspected that the pest can complete its life cycle on an alternate host (*Abutilon indicum*), which is a malvaceous

weed present in the study area. But a fact that, PBW activity noticed throughout the year because adults keep emerging throughout the year from the diapause larvae.

Even though other malvaceous plants found to have incidence of PBW in other countries, present study could not show any incidence on these plants in north eastern region of the state. This might be due to non-preference of the hosts or availability of cotton during the season or cotton and other malvaceous weeds dry at the same time or volatiles released either by the insect already feeding on these hosts or by the plants or the PBW mainly depends on diapause for their off seasonal survival rather than alternate hosts.

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