Strategies for management of Pink boll worm through integrated pest management

ABSTRACT

The present study of the frontline demonstration on the Efficacy of integrated pest management (IPM) practices against pink bollworm was carried out to assess the damage incidence caused by the pink bollworm *Pectinophoragossypiella* (Saunders) and its effective management strategies conducted in 30 farmer fields of Nalgonda and yadadribhuvangiridistrits of Telangana during kharif 2018, 2019 and 2020 respectively . Theresultsrevealedthat,dueto the adoptionofIPMpracticesalongwithgoodagriculturalpractices,AveragekapasyieldwashighinIPMdemonstrationplots(1857.0kg/ha)with a percentincreaseof12.0%overthefarmers' practice(1658kg/ha)during three years of study.

The mean percent of rosette flowers, green boll damage, and the number of larvae per 50 flowerswas 11.93%, 9.05%, and 17.87 respectively recorded in the demonstration plot which is significantly lower than the check plots i.e.,15.93%, 13.20%, 21.90 respectively. Pheromone trap catches were recorded at 28.67 in the demonstration plot. The average gross returns of Rs.1,01,007/ha, net returns of Rs.52,027/ha, and Benefit-cost ratio of 2.05 was recorded as higher in the demonstration plot as compared to farmers practice Rs. 90,121/ha, Rs.37,430 and 1.69 respectively during three years of the study period. The additional average net returns of Rs.14,597/ha and reduction in the cost of cultivation of Rs.1912/ha were saved per year.

Keywords:*Cotton,economics, frontline demonstration,pinkbollworm,yield.*

INTRODUCTION

Cotton (*Gossypium hirustum* L.) is one of the most important commercial fiber crops of India and plays a dominant role accounting for 30 % of the agricultural domestic product[1]. In India, cotton crop was cultivated in an area of 13.48 M. hectares with a production of 36.07 Million bales which accounts for 37% of world's area. India is one of the largest producers as wells as consumers of cotton in the world. In India approximately 62% of the cotton area is under rainfed ecosystem and only 38% of area is under irrigation. In the world, India is the only country which cultivates all the four species of cotton. In India, there are nine major cotton growing states, which are grouped into three diverse agro-ecological zones, i.e., Northern zone comprising of Punjab, Haryana and Rajasthan, Central zone includes the States like Gujarat, Maharashtra and Madhya Pradesh and Southern zone comprising of States like Telangana, Andhra Pradesh and Karnataka[2].

Cotton crop isbeing infested by 1326 insect species in the world, and in India, only 166 arthropod pest specieswere recorded. Yield lossesduetoinsectpestsrangedfrom50-60%(Puri*etal*.,1999);andduetoarthropodpestsrangedfrom20-60%.ThemajorpestsofbollwormsincottonareAmericanbollworm,*Helicoverpaarmigera*(Hübner),Tobaccocaterpillar, *Spodoptera litura*(Fabricius)spottedbollworm,*Eriasvittella*(Boisduvel), *E. insulana*(Fab.) and pink bollworm,*Pectinophoragossypiella*(Saunders).

After the introduction of *Bt*Cotton (BG-1, cry1Ac) in 2002 and (BG-II, cry1Ac and cry2Ab) in 2006 the incidence of bollworm complexes on the crop has drastically reduced. Both the production and productivity of cotton in India have improved significantly during the past few decades. In the recent past, *Bt*-cotton technology isunable to protect the cotton crop from pink bollworm dueto the development of resistance against Cry1Ac andCry2Ab toxins in India [3]. The pinkbollworm developed resistance to Cry1Ac in 2009and 2010 and survived on all *Bt*-cotton hybrids inKarnataka, Andhra Pradesh[4]. It became a major and most destructivepestofcottonhavingnationalimportancebycausingsevereyieldlosses[3].The incidence of Pink Bollworm (PBW) was increasing in the recent past. In India, the productivity levels are very low compared to other countries like USA and China.

The pinkboll worm Larvaecausedamagefrom the flowering to harvesting stage by feeding on anthers,pollens, flowers, green bolls, locules, lint, and seed.Thedamagedflowersaretwistedintheformof a rosecalledas"rosetteflowers".Thelarvae

initiallyboreinside the green bolls with making minute hole, burrow into lintandthenpenetrateseeds. Theaffectedbollsrot, shed prematurely. While opening, immaturefibersdeterioratethequalityoflint. The infestation ranged between 40 -95% in *Bt*-cotton[5], early flowerinfestation was 3.09 - 29.26% and late infestationwas 36 - 90% in Telangana, Maharashtra, AndhraPradeshandGujarath [6],greenbolldamage,loculedamage13.58%in*Bt*-cotton.The reduction in seedcottonyieldwas 61.9% and 59.2%bolls were normal in opening nature throughpinkbollwormandinfestationrangedfrom 20-40%[7] and where as it is 20 – 90%.

The pink bollwormincidence was high due cultivation of long-durationhybrids, continuous hosts throughout the year, longterm storage of raw cotton at ginning mills. Further,non-adoption of refugia, less expression of*Bt*-toxinin squares, flowers, and developing seeds in youngbolls,extensionofcropupto April-Mayandearlysowingsofseedproductionplotsofcottoninmayare favourable for the pink bollworm survival.

Themanagementofpinkbollwormwithconventionalinsecticidesisverydifficult;andisnotaviablesolution inlongtermtocontrolthispest.Insectresistancewasdevelopedduetorepeatedsprayingsandnosinglemet hodwouldbecompletelysatisfactoryto manage this pest and integrated pest managementpracticeswill(i.e.,cultural,mechanical,physical,biologicalandchemical)controlthepestbel owETL. Hence, the present studywas undertaken to assess the efficacy of IPM module in thefieldconditionsagainstpinkbollwormincottonin Nalgonda and YadadriBhuvanagiri districts of Telangana.

MATERIALSANDMETHODS

Frontline demonstrationswereconductedtoassessthe efficacy ofIntegratedPestManagementpracticesagainstpinkbollwormincottoninfarmer'sfieldsbythe (District Agricutlrual Advisory and Transfer of Technology) DAATT Centreduring *kharif* 2018, 2019 and 2020. The farmers were sensitized on the relevance of these technologies by organizing pre-Kharif awareness programmes, focused group discussions, conducting method demonstrations, training programmes and sending timely messages through AKPS, and Whats app groups. Based on the response for sensitization programme from farmers total 30demonstrationswereorganizedintwodistricts i.e. Nalgonda and YadadriBhuvanagiriwith10locationsineachseasoneveryyear.Each demonstration was laid out in 0.4 ha selectedas a demonstrationplotandallIPMpracticeswereimposed and an adjacent field of 0.4 ha was treated as a check.

TheimprovedIntegratedPestManagementpracticescomprisedofincorporationofcottoncropstubble sin the field by tractor drawn cotton shredder, deepsummerploughingstoeliminatepupaandlarvaldiapauses stages, adoption of community sowing invillage, installation of pheromone traps at 45 daysafter sowing @ 10/ha to monitor the pest, removaland destruction of rosette flowers from 45 - 70 daysaftersowing,sprayingofAzadirachtin0.15%EC@5ml/lwithsandovit@1ml/lat40-45daysofthecrop,sprayingofEmamectinbenzoate5%SG@0.5g/l,Chlorantraniliprole18.5EC@0.3ml/landspinosad45%SC@0.375ml/lalternativelyatanintervalof7-10daysdependingonpestload, terminate the crop between 180-200 days, erection of bird perches 10/acre.Whereas,farmer'spracticeincludesprayingofAcephate@1.5g/l,synthetic pyrethroids like lambda-cyhalothrin @ 1 ml/l,cypermethrin@1.25ml/l,Chlorantraniliprole + lambda-cyhalothrin @ 0.4 ml/lfromfloweringstagetoendofthecrop.

Datawererecordedonpercentageofrosetteflowers,greenbolldamage,Number of larvae per 50 flowers, pheromone trap catches per week. Atthe end of crop, seed cotton yield and economicparameterswerecomputed.

The FLD was conducted to study the potential yield reduction factors that are mainly due to the pests and yield difference between the farmers practice and demonstration. A random crop cutting experiment was conducted and the yield data of farmer's practice and demonstration trial was recorded. The qualitative data was converted into quantitative form and expressed in terms of per cent increase in yield. Other data parameters like cost of cultivation, gross returns, net returns, and benefit-cost ratio were recorded.

RESULTSANDDISCUSSION

The results of the frontline demonstration on efficacy of IPM in cotton (Table 1). Pooled mean

yield was recorded in demonstration plot recorded 18.57 q/ha which is significantly superior over the farmer's practice plot which was 16.58/ha, which is 12.0% increase in demonstration plot. The year wise cotton yields were 16.20 q/ha, 22.48 q/ha, and 17.04 q/ha recorded in demonstration plot respectively, where as in farmer's practice it was recorded 14.85 q/ha, 19.54 q/ha, and 15.34 q/ha during kharif 2018, 2019 and 2020 respectively. These results clearly indicated that adoption of IPM practices like installation of Pheromone traps from 4/acre for mass trapping, collection and destruction of rosette flowers, erection of bird perches, spraying of azadiractin 1500 ppm@ 5 ml/lit and spray of Emamectin benzoate @0.5 g/l of water. whereas, the yields were low in farmer's practice due to non-adoption of IPM practices. The findings are inline with shankar et al., 2022 [8]

The economics indicators, i.e gross returns, net returns, B:C ratio of frontline demonstration were illustrated in Table 1. The data clearly envisages that gross returns, net returns and BC ratio were substantially higher in the demonstration plots than farmer's practice during all the years of the demonstration. The average gross returns from demonstration practice were Rs.101007/ha compared to Rs.90121/ha. The net returns from demonstration practice were Rs. 52,027/ha compared to Rs.37430/ha in farmers practice the results are tune with Shankar et al., 2022 [8]. The average cost of cultivation was low of Rs. 50,779 in demonstration plot and it was of Rs. 52691 in farmer's practice during the study period.

The Benefit cost ratio of frontline demonstration was illustrated in table 1. The benefit cost ratio of demonstration plot and farmers practice were recorded as 1.81, 2.23 and 2.21 and 1.47, 1.81 and 1.80 during kharif 18, kharif 19 and kharif 20 respectively. The cumulative effect of technological interventions over three years revealed an average benefit cost ratio of 2.05 in demonstration plots compared to 1.69 in farmers practice. The results are in tune with the findings of Narendar et al., (2021) [9]. who observed additional net returns and increase in B:C ratio among FLD farmers.

The incidence of pink bollworm wasminimumindemonstrationsplotsduetoadoptionofIntegrated PestManagementtechnologies*viz*., creatingawarenesson the identification of pest and damage symptoms at the fieldlevel, regularmonitoringofpestthroughfieldvisits,suggestionsgivenbyDAATT Centrescientists from time to time,application of IPM components and strong linkageswithfarmersandscientiststounderstandtheroleofapestmonitoring, the conceptofETLandneed-basedapplicationofpesticides.Theincidencewashighinfarmers'practiceduetonon-adoptionofIPMpracticesandlackofawarenessonnewtechnologies.SimilarresultswerereportedbyKolhe *et al*. (2017) [10] whoobserved that pink bollworm incidence was low indemonstrationplots.

CONCLUSION

The present demonstration conducted during kharif 2018, 2019 and 2020 by the DAATT Centre scientist indicated that with the result of extension activities carried out in the field condition, the demonstration plot recorded high yields, high gross returns, net returns, Benefit cost ratio, low cost of cultivation. The incidence of pink boll worm in rosette flowers, green boll damage and number of larvae per 50 percent flowers were low in demonstration practice compared to farmers practice.

REFERENCES:

1. FayetL.andVermeulenW.J.V.Supportingsmallholderstoaccesssustainablesupplychains:lessons from the Indian cotton supply chain. *Sustain.Dev.* 2014;22:289-310.
2. Anonymous. Ministry of textiles, Cotton Section- 2018. (http;//cotcorp.gov.in)
3. NaikV.C,KumbhareS,KranthiS,SatijaU, andKranthiK.R.Fieldevolvedresistanceofpink bollworm, *Pectinophoragossypiella*(Saunders)(Lepidoptera:Gelechiidae)totransgenic*Bt*-cottonexpressing Cry1Ac and Cry2Ab in India. *Pest Manag.Sci*. 2018; 74:2544-54.
4. KranthiK.R. Pink bollworm strikes *Bt*-cotton. *CottonStatisticsNews*. 2015;**35**:1-6.
5. FandB.B,NagrareV,GawandeS,NagraleD,Naikwadi B, Deshmukh V, Gokte-Narkhedkar N,and Waghmare V. Widespread infestation ofpink bollworm, *Pectinophoragossypiella*(Saunders)(Lepidoptera:Gelechiidae)on*Bt*-cottoninCentralIndia:Anewthreatandconcernsforcottonproduction.*Phytopara*. 2019;**47**:313-25.
6. NaikVC,SubbireddyKB,KranthiS,NagrareV.S,KumbhareSujit,GokteNarkhedkarNandWaghmareV.Pinkbollworm,*Pectinophoragossypiella*(Saunders)(Lepidoptera:Gelechiidae)survivalontra

nsgeniccottoninIndia. *Egy.J.Bio.PestCont*. 2021;**31**:40.
7. Amin AA and Gergis MF. Integrated managementstrategies for control of cotton key pests in middleEgypt.*Agro.Res*.2006;**4**:121-28.
8. Shankar M, BharathT, Pallavi S, HimabinduT, Shankaraih M, Sumalini K. Adoption and efficacy of integrated pest management practices against pink bollworm,pectinophoragossypiella (saunders) in Bt-cotton. Journal of entomological research. 2022;46(3):529-533.
9. Narendar G, Madhushekar BR, Avilkmar K, and Goverdhan M. Management of Brown plant hopper (Nilaparvatalugens) in rice in Nalgonda and yadadriBhuvanagiri districts of Telangana. The Pharma Innovation.2021;11(6): 1587-1591.
10. KolheAV,JayashriU,andUndirwadeDB.Performanceof*Bt*-cottonhybridsandtheircounterpartsunderIPMinrainfedconditionofVidarbharegion.*J.Cot.Res.Dev*. 2017; **31**:108-15.

Table.1: Yield and economics of cotton between farmers practice and demo practice during kharif 2018-2020.

S. No	Year	Area (Acres)	Yield q/ha			Gross returns Rs./ha		Cost of cultivation Rs./ha		Net returns Rs./ha		B:C	
			Farmer practice	Demo	% Increase	Farmer practice	Demo	Farmer practice	Demo	Farmer practice	Demo	Farmer practice	Demo
1.	2018-19	10	14.85	16.20	9.09	77220	84240	52500	46500	24720	37740	1.47	1.81
2.	2019-20	10	19.54	22.48	15.04	106471	122505	57500	55000	48971	67505	1.81	2.23
3.	2020-21	10	15.34	17.04	11.08	86671	96276	48073	50836	38598	50836	1.80	2.12
4.	Average	30	16.58	18.57	12.00	90121	101007	52691	50779	37430	52027	1.69	2.05