# *Original Research Article*

## A Study on Farmer Perception on the Incorporation of Cotton Stubbles to Control the Pink Boll Worm Incidence


**ABSTRACT**

Incorporation of cotton stubbles into the soil after harvesting will help in reducing the pink boll worm incidence. The present study was conducted with an aim to determine the effectiveness and usefulness of incorporation of cotton stubbles into the soil by the farmers. A total of 120 respondents were randomly selected in Khammam district and interviewed using a structured questionnaire during the year 2020-21. Ex-post facto research design was employed for the present study. The study revealed that, among the different age groups of the respondent's i.e. 44.17 % of the respondents were under Middle (38-53) age group followed by 31.66% of the respondents belonging to Old (54-69) age group with 65.83% under medium extension contacts category. 38.33% of the farmers had high knowledge on incorporation of cotton stubbles as more than 75 percent of the respondents had more than two trainings in Cotton cultivation. 40.83 % of the farmers felt use of Pheromone traps, 34.17% of them sowing of non-bt as refugee, 39.17% avoided stalking of cotton stubbles for fuel purpose, 67.50% of them felt use of need based insecticides as the best management practices for control of PBW in cotton. 59.17 % of the farmers had low perception on incorporation of cotton stubbles. The study also revealed that 56.67% of the respondents expressed that their yields were improved after adopting the cotton shredder technology. Constraints elicited by the respondents were 75.83% envisaged non-availability of the implement as the major constraint, followed by 72.50 % of them that cotton shredder was utilized for only single purpose and remaining idle for most part of the year. 72.50% of the cotton farmers suggested that implement should be brought under Custom hiring centres by Agril dept followed by 67.50% of them suggested that Govt support/ subsidy should be given on the implement.



***Keywords:*** *Pink boll worm, Adoption, Knowledge, Cotton Stubbles incorporation, Shredder*


**1. INTRODUCTION:**

Cotton (*Gossypium* spp.) is the most prominent fibre crop of India, producing natural fibre, fuel and edible oil, is playing an important role in Indian economy (Patil 2003; Prasad et al., 2018). It is a perennial semi-shrub grown as an annual crop in both tropical and warm temperate regions (Rahman et al., 2012; Chakravarthy et al., 2012; Syed et al., 2015) which has been under commercial cultivation for domestic consumption and export needs of 111 countries in the world (Anonymous, 2015; Srinivas, 2018) and hence it is called "King of Fibres" or "White Gold". In addition to textile manufacturing, it provides seeds with a potential multi-product base such as hulls, oil, lint and food for animals (Ozyigit et al., 2007). Cotton is grown on 134.77 lakh hectares in India, with an output of 365 lakh bales (170 kg per bale) and productivity of 460

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kg/ha (lint). India is an important producer of cotton on a global scale. India is the second-largest country to produce cotton after China (Sandhyarani, 2010). Telangana is the country's second state in terms of area (23.58 lakh ha), third in terms of production of 57.97 lakh bales and seventh in terms of productivity of 418 kg/ha) during 2020-21 (Cotton Corporation of India, 2022). The lower productivity of cotton in India corresponded to the world average (786 kg ha-1) is due to the spectrum of insects pests on cotton. Worldwide, about 1326 insect species are enlisted in cotton (Hargreaves, 1948; Atwal, 2004) of which about 162 species of insects infest at various stages of crop growth, of which around 15 are key pests (Kannan *et al.,* 2004). Among the array of insects, especially the bollworms (Dhurua & Gujar 2011) viz., American bollworm, *Helicoverpa armigera* (Hubner), Spiny bollworm, *Earias insulana* (Boiusduval), Spotted bollworm, *Earias vittella* (Fabricius) and Pink bollworm, *Pectinophora gossypiella (*Saunders) normally referred as bollworm complex, pose greater threat to cotton production (Ghosh, 2001; Kranthi, 2015).

Among the boll worms, the pink bollworm *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) has recently emerged as a severe concern to cotton production in India. The insect is native to the Indo- Pak region (Saunders, 1843) and can be found in Tropical America, Africa, Asia, Australia, Egypt, the United States, and Mexico where cotton is cultivated. The pink bollworm (abbreviated as PBW) is a stenophagous insect that has co-evolved with Malvaceous food plants such as cotton, okra, Deccan hemp, and Roselle (CABI, 2017). PBW larvae feed on cotton plant flowers, buds, bolls, and seeds, causing malformed flowers, premature opening and heavy shedding of infested bolls, decreased fiber length, and poor lint quality due to staining (Singh et al., 1988). Synthetic pyrethroids, which were first introduced in India in the 1980s, were crucial in combating this notorious and difficult-to-control cotton pest. On the other hand, the intensive use of chemical insecticides caused widespread ecological harm in the cotton climate, resulting in bollworm exacerbation and secondary pest problems (Kranthi et al., 2002; Kranthi and Russell, 2009; ICAC, 2010). Following that, the development of genetically engineered transgenic cotton containing genes encoding delta-endotoxin proteins from the entomo pathogenic soil bacterium *Bacillus thuringiensis* opened up new avenues for the management of the dreaded cotton bollworm. Since then, the Indian cotton ecosystem has seen remarkable changes in its pest status. In 2002 and 2006, a single gene (Cry 1Ac) and dual gene (Cry 1Ac + Cry 2Ab) Bt cotton hybrids were commercially released in India [9], targeting the dreaded bollworm complex, which included the American bollworm *Helicoverpa armigera* (Hub.), spotted bollworm *Earias vitelli* (Fab.) and Pink boll worm (Choudhary et al., 2010).

Bt cotton technology performed well and offered promising boll-worm complex control. As a result, PBW infestations were very low in the first decade after Bt cotton was released. *H. armigera* and *E. vitelli* still susceptible even after 15 years of continuous Bt cotton cultivation in India. However, PBW reappeared as a major pest problem in India's central and southern cotton growing belt. PBW populations were reported to have developed resistance to Cry1Ac and were found to survive on Bt-I cotton fields in 2009 in Gujarat State in India, but were being effectively controlled by the dual-gene Bt-II cotton (Dhurua & Gujar 2011). However, Surveys conducted across India showed progressive increases in the survival rate of PBW larvae in green bolls of Bt-II cotton F1 hybrid varieties (Vakudavath, 2018).

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Pink bollworm incidence goes unnoticed to the farmers since young larvae enter the cotton boll in the developing stage and remains inside by feeding on seeds. Its damage will be seen only when bad opened bolls with damaged seeds were found at harvesting stage. Non removal of stubbles and discarded damaged bolls left over in the cotton fields for larger period narrowed the interval between two seasons and it could support pest survival in off season and form an important link in the carryover of the pest (Jayaswal, 1971; Simwat and Sidhu, 1982). Moth activity seen throughout the year may be due to cotton stubbles and damaged bolls left over in the field even after harvesting which narrowed the interval between two cropping seasons and incidence carried to next season. Similar observation was made by Simwat and Sidhu (1982) in Punjab that stalks of cotton stubbles were the major source for carryover of pink bollworm. Further, Burning any crop residue in general and cotton in stalks in particular is laborious, time consuming and costly (Rs.4375 ha-1 for cotton). It also leads to environmental pollution. Burning emits a large number of hazardous pollutants (Krishna et al., 2011).Burning leads to emissions of greenhouse gases like CO2 , NOx, SOx, NH3 and volatile organic compounds (VOCs). It affects air quality and visibility in the urban areas because of already existing pollutants due to vehicular and industrial pollution. Finally, it leads to global warming and climate change (IARI, 2012). Heat generated due to burning kills soil microorganisms and eco-friendly insects too. Cotton stalks contain about 67.3-70% holocellulose, 24.3-28.2% lignin and 5.9-8.3% ash. They are rich in nutrients with 51.0% C, 4.9% H, 0.62-1.0% N, 0.61-0.68% K, 0.08-0.1% P, 0.43% Ca, 0.15% S and 0.12% Mg, 324 ppm Fe, 147 ppm Mn, 27 ppm Zn, 9 ppm Cu and 1.6 ppm Mo (Dubey et al., 2004; Sutaria et al., 2016). So, burning leads to loss of valuable soil organic matter and nutrients. Under the circumstances considering the emergence pattern of this pest, the present study was conducted to determine the effectiveness and usefulness of incorporation of cotton stubbles into the soil by the farmers.

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## 2. MATERIAL AND METHODS:

Ex-post facto research design was followed for the study and Random sampling method was used for selecting the respondents. The present study was conducted in Khammam district of Telangana State during 2020-21. Survey for this purpose was conducted in Khammam district. This study is based on primary data collected from cotton farmers. Random sampling technique was adopted in designing sampling frame for the study. Telangana state is selected purposively. In the second stage, Khammam district was selected. Accordingly, in third stage six villages were selected randomly based on potentiality. From each of the selected villages, twenty number of cotton growers were selected randomly i.e. 120 cotton farmers were considered for the present study who incorporated cotton stubbles into the soil. The Primary data was collected from the farmers through personal interview with the help of well-prepared pre-tested schedules and questionnaire. The farmers were classified based on their socio demographic profile. The profile of trainees ranged from illiterates to post graduates, with age ranging from 22 years and more, farm size ranging from less than 2.5 acres to more than 2.5 acres. The data obtained were analyzed simply by frequency and percentage in order to assess the usefulness of incorporation of cotton stubbles into the soil by the farmers. The standard formula by Ansari and Chandargi (2000) was used to calculate the knowledge gain frequency and percentage.

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## 3. RESULTS AND DISCUSSION:

The results from the study conducted on the effectiveness and usefulness of incorporation of cotton stubbles into the soil by the farmers are given below

**Table 1. Profile Characteristics of respondents (n=120)**

| S. no | Variables | Category | Frequency | Percentage |
|---|---|---|---|---|
| 1 | Age | Young (22-37) | 29 | 24.17 |
| | | Middle (38-53) | 53 | 44.17 |
| | | Old (54-69) | 38 | 31.66 |
| 2 | Education | Illiterate | 09 | 7.50 |
| | | Primary school | 13 | 10.83 |
| | | Upper school | 19 | 15.83 |
| | | High school | 28 | 23.33 |
| | | Intermediate | 37 | 30.84 |
| | | Degree | 09 | 7.50 |
| | | Post graduation | 05 | 4.17 |
| 3 | Farm Size | Marginal (0-2.5) | 29 | 24.16 |
| | | Small (2.5-5) | 58 | 48.34 |
| | | Large (5 & above) | 33 | 27.50 |
| 4 | Farming experience | < 5 year (less than 5 year) | 16 | 13.33 |
| | | 5–10 year | 65 | 54.17 |
| | | >10 year (more than 10 year) | 39 | 32.50 |
| 5 | Area under Cotton | Low (less than 2.5 acres) | 33 | 27.50 |
| | | Medium (2.5 – 5.0 acres) | 56 | 46.67 |
| | | High ( more than 5 acres) | 31 | 25.83 |
| 6 | Social participation | No participation | 21 | 17.50 |
| | | Membership in one organization | 54 | 45.00 |
| | | Membership in more than one organization | 31 | 25.83 |
| | | Membership with office bearer | 14 | 11.67 |

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3. **RESULTS AND DISCUSSION**
**3.1- Characteristics of respondents**

**3.2- Knowledge levels of cotton farmers on package of practices on cotton stubble incorporation**
**….etc.**

| | | | | |
|---|---|---|---|---|
| 7 | Trainings received/ participated | One training | 29 | 24.17 |
| | | Two trainings | 48 | 40.00 |
| | | Three trainings | 27 | 22.50 |
| | | More than 3trainings | 16 | 13.33 |
| 8 | Farming system | Agriculture only | 70 | 58.33 |
| | | Agriculture + Animal Husbandry | 31 | 25.83 |
| | | Agriculture + Animal Husbandry + Horticulture | 19 | 15.83 |
| 9 | Extension contact (Mean = 5.78, S.D. = 2.72) | Low (< 28.13) | 16 | 13.33 |
| | | Medium (28.13 – 43.13) | 79 | 65.83 |
| | | High ( > 43.13) | 25 | 20.83 |

It can be inferred from Table 1 that nearly 44.17 percent of the respondents were in the middle age group, 65.83 percent of the respondents had high school or above education levels, with nearly three quarters of the respondents had 2.5 or above farm size (75.84%) and 86.67 percent of the respondents had more than 5years of experience in farming, 46.67 percent of the farmers had an area of 2.5 to 5acres under cotton, 45.00 percent of the respondents had membership in one organization, 40.00 percent of the farmers participated in two trainings conducted in Cotton by extension agencies, 58.33 percent of the farmers had agriculture as the farming system, 65.83 percent of the farmers had medium extension contacts. The results are in tune with the findings of Madhu shaker et al. (2020), who reported similar findings of medium extension contact among selected respodents.

**Knowledge levels of cotton farmers on package of practices on cotton stubble incorporation**

**Table 2. Distribution of respondents according to their knowledge in cotton crop(n=120)**

| S.no | Category | Range | Frequency | Percentage |
|---|---|---|---|---|
| 1 | Low level of Knowledge | 26 – 34 | 33 | 27.50 |
| 2 | Medium level of Knowledge | 35 – 43 | 41 | 34.16 |
| 3 | High level of Knowledge | 44 - 52 | 46 | 38.33 |

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It can be inferred from Table 2 that 38.33 percent of the farmers had medium level of knowledge on cotton stubble incorporation for management of PBW followed by 34.16 percent with medium knowledge levels and 27.50 percent of the farmers under low knowledge level category. The findings are similar to the findings of Madhu shaker et al. (2020).

**Table 3. Distribution of respondents according to management practices adopted by farmers to control PBW (n=120)**

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| S.no | Management practices | Knowledge level | |
|---|---|---|---|
| | | Frequency | Percentage |
| I | Monitoring of PBW | | |
| 1 | Weekly monitoring | 19 | 15.83 |
| 2 | Collection & destruction of Rosette flowers | 35 | 29.17 |
| 3 | Damaged bolls | 17 | 14.17 |
| 4 | Pheromone traps | 49 | 40.83 |
| II | Preventive measures | | |
| 1 | Avoid ratooning/ termination of the crop by December | 11 | 9.17 |
| 2 | Crop rotation | 9 | 7.50 |
| 3 | Sowing of Non Bt as refugee crop | 41 | 34.17 |
| 4 | Use of Shredder for stubble incorporation | 32 | 26.67 |
| 5 | Deep summer ploughing during April-May | 27 | 22.50 |
| III | Cultural measures | | |
| 1 | Cattle grazing of the leftover field at the end of the crop season | 37 | 30.83 |
| 2 | Timely sowing (Sowing after receiving 50 mm rainfall) | 11 | 9.17 |
| 3 | Trap crops-Growing of bhendi as trap crop | 25 | 20.83 |
| 4 | Avoiding stacking of cotton stalks for fuel purpose over long periods | 47 | 39.17 |

| | | | |
|---|---|---|---|
| IV | Curative measures | | |
| 1 | Spraying of Neem oil | 21 | 17.50 |
| 2 | Use of need based insecticides | 81 | 67.50 |
| 3 | Trichogramma egg cards soon after appearance of bollworms | 05 | 4.17 |
| 4 | Hand picking /killing and destruction of insect pests | 13 | 10.83 |

It can be indicated from Table 3 that 40.83 percent of the farmers felt that pheromone traps are best management practices for monitoring of PBW followed by collection and destruction of rosette flowers by 29.17 percent of the farmers. Among preventive measures 34.17 percent of farmers felt sowing of Non Bt as refugee crop as the best preventive measure followed by use of shredder for stubble incorporation by 26.67 percent of the respondents. 39.17 percent of the respondents avoided stacking of cotton stalks for fuel purpose as the major cultural measures adopted by them. 67.50 percent of the respondents considered use of need based insecticides as the best curative measure for management of PBW.

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**Adoption of the recommended package of practices in cotton**

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**Table 4. Distribution of respondents according to their extent of adoption in cotton crop (n=120)**

| S.no | Category | Criteria & Score | Frequency | Percentage |
|---|---|---|---|---|
| 1 | Low level of adoption | <x- ½ SD (< 11.0) | 31 | 25.83 |
| 2 | Medium level of adoption | <x± ½ SD (< 11.1-22.0) | 47 | 39.16 |
| 3 | High level of adoption | >x+½ SD (> 22.0) | 42 | 35.00 |

The data was collected on the extent of adoption of stubble incorporation by the farmers. The results from the Table 4 indicated that the percentage of the respondents according to their extent of adoption in cotton crop were categorized and ranged from 25.83% (Low), 39.16% (Medium) and 35.00% (High).

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**Perception of cotton farmers on incorporation of cotton stubbles for management of PBW**

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**Table 5. Distribution of respondents according to their level of perception on incorporation of cotton stubbles**

| S.no | Level of Perception | Number of farmers | Percentage |
|---|---|---|---|
| 1 | Low (< 98.71) | 71 | 59.17 |

| | | | |
|---|---|---|---|
| 2 | Medium (98.72 – 109.75) | 28 | 23.33 |
| 3 | High (> 109.75) | 21 | 17.50 |

The data in Table 5 indicated that majority of the cotton farmers (59.17 per cent) had low level of perception followed by medium and high perception 23.33 and 17.50 percent respectively on incorporation of cotton stubbles for management of PBW.

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**Table 6. Economic condition after adopting the cotton shredder technology** (n=120)

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| S.no | Aspects | Adopted | Not adopted |
|---|---|---|---|
| 1 | Level of improvement in annual income | 45 (37.50) | 75 (62.50) |
| 2 | Increase in yields per acre | 68 (56.67) | 52 (43.33) |
| 3 | Total increased gross income | 57 (47.50) | 63 (52.50) |
| 4 | Total increased net income | 53 (44.17) | 67 (55.83) |

The results from the Table 6 indicated that the among the 120 respondents, 45 respondents opined that their level of improvement in annual income increased after stubble incorporation and 75 respondents opined that their level of improvement in annual income has not increased as they are yet to see the results. Further among the 120 respondents, 68 respondents opined that increase in yields per acre increased after stubble incorporation where the incorporated stubbles acted as manure to the crop and 52 respondents opined that there was no increase in yield per acre. Among the 120 respondents, 57 respondents opined that the total gross income is increased and 63 respondents opined that there is no total increase in gross income. Further among the 120 respondents, 53 respondents opined that the total net income is increased and 67 respondents opined that that there is no total increase in net income. The findings are in agreement with Ramanjaneyulu et al. (2021) who reported that use of shredder helps in saving income and improving soil fertility as the stalks acts as manure top the soil.

**Table 7. Constraints elicited by the respondent (n=120)**

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| S. no | Constraint | Frequency | Percentage |
|---|---|---|---|
| 1 | Non-availability of the implement | 91 | 75.83 |
| 2 | Initial high cost of the implement | 79 | 65.83 |
| 3 | Single use of the implement only for cutting / remaining idle for most part of the season | 87 | 72.50 |
| 4 | No govt support on the implement | 81 | 67.50 |
| 5 | Demonstrations are conducted in few pockets only | 65 | 54.17 |

The results from the Table 7 indicated that among the 120 respondents, 75.83 percent of the respondents suggested non-availability of the implement as the major constraint elicited by the farmers followed by 72.50 percent of the respondents opined that shredder is used once in the crop period and will remain idle for the major part of the season which is the second most major constraint. 67.50 percent of the respondents felt that since the initial cost of the

implement is very high and also use of the implement is only for single purpose, they opined that government should give support inform of the subsidies/incentives for the purchase of the implement and popularizing habit of the incorporating the cotton stubbles into the soil by the farming community.

**Table 8. Suggestions expressed by the respondents (n=120)**

| S.no | Suggestions | Frequency | Percentage |
|---|---|---|---|
| 1 | More demos should be conducted to know the working and usage of the implement | 75 | 62.50 |
| 2 | Awards/incentives to the farmers for increasing adoption of this technology | 79 | 65.83 |
| 3 | Implement can be brought under Custom hiring centres by Agril dept | 87 | 72.50 |
| 4 | Govt support/ subsidy should be given on the implement | 81 | 67.50 |

The results from Table 8 indicated that among the 120 respondents, 72.50 of the respondents opined that Implement can be brought under Custom hiring centres by Agril dept followed by 67.50 percent of the farmers felt that Govt support/ subsidy should be given on the implement to know the working and usage of the implement and also for creating awareness on the technology, its uses and benefits among the farming community. 65.83 percent of the respondents opined that awards/incentives should be given for successful adoption of this technology by the farmers, which will help in motivating the fellow neighboring farmers towards adoption of the technology and thereby the technology spreads in larger areas.

## 4. CONCLUSION:

In cotton, pink boll worm is the major pest effecting the crop right from flowering stage to boll maturity stage. Incidence of the pink boll worm during the flowering stage results in rosette flowers, flower drop and subsequently effect the bolls if no proper plant protection measures are not taken. Incidence of pink boll worm on the bolls results in the premature opening of the bolls, poor quality of cotton lint due to the change in the colour and reduction in the weight of the cotton as the seed is effected by pink boll worm. To control the pink boll worm integrated pest management practices are to be taken collectively by all the farmers which mainly include steps like installation of pheromone traps, spraying of neem oil and recommended insecticides based on the ETL levels of the pest, destruction of rosette flowers, timely termination of the crop and incorporation of cotton stubbles into the soil by the shredder. Incorporation of cotton stubbles into the soil after harvesting will help in reducing the pink boll worm incidence. The present study was conducted with an aim to determine the effectiveness and usefulness of incorporation of cotton stubbles into the soil by the farmers. More studies are to be done on the effectiveness of incorporation of the cotton stubbles and the pink boll worm incidence by taking the feedback from all the cotton growing farmers in the country for creating awareness on pink boll worm management and thus helping the farmers to achieve more yields and good net returns.

## REFERENCES



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**Comment [x21]:** Plesese, take sure to adopt on basic puncuatin rules of references below such as , . (), etc.

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