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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(6): 317-320

www.thepharmajournal.com
Received: 18-03-2023
Accepted: 21-04-2023

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Demonstration on management strategies of stem weevil *Pempherulus affinis* (Faust) and its economic impact in cotton

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Abstract
The KVK, Bhadradri Kothagudem conducted front line demonstration during *Kharif* season of 2019-20, 2020-21 and 2021-22 in KVK operational area of adopted villages on "Management of Stem Weevil in Cotton". Demonstrations were conducted in ten different farmers fields to assess the damage potential and its management strategies. Two treatments *viz.*, technology demonstration i.e application of neem cake to the soil mixed with farmyard manure (FYM) during the basal fertilization (10 tons FYM + 250 Kg of Neem cake/ha). Prophylactic spray of Chlorpyriphos 2.5 ml/l of water. In case of severity, application of chlorantraniliprole 18.5 SC at 0.3 ml/l and clothianidin 50 WDG at 0.2 g/l of water and check (farmers practice) *i.e.*, spraying of Chlorpyriphos 2.5ml after observation of insect incidence. Significant higher income was recorded from the technology demonstrated plot over the three years compared to control plot. On an average, the benefit cost ratio was high in treatment *i.e.*, 1.98, 1.78 and 1.98 compared to control plot *i.e.*, 1.53, 1.43 and 1.62 during *Kharif* 2019-20, 2020-21 and 2021-22 respectively.

Keywords: Cotton, stem weevil, chemical control, economics, gross income, net returns

Introduction
Cotton is the most important crop producing natural fibre which has been under commercial cultivation and export needs of about 111 countries in the world and hence called "King of fibres" or "White gold". India is one of the largest producer of cotton in the world accounting for about 26% of the world cotton production. In India during 2021-22, production of Cotton was 311.17 lakh bales cultivated under an area of 123.71 lakh hectares with a productivity of 428 kg per hectare. (Cotton Corporation of India, 2023) [1]. Among the states, Maharashtra is leading in cotton acreage (42.25 lakh ha) followed by Telangana (24.13 lakh ha), Gujarat (22.78 lakh ha), Haryana (7.37 lakh ha) and Karnataka (6.88 lakh ha) [2].

The cotton production remained stagnant over the years due to many biotic and abiotic constraints. Among the biotic problems, insect pests are major in India. The insect pests spectrum of cotton is quite complex and as many as 1326 species of insect pests have been reported on this crop throughout the world. About 130 different species of insects and mites found to devour cotton at different stages of crop growth in India. Of the economically important insect species next to bollworms, the cotton stem weevil has been reported as a major pest in South India [3, 4].

Stem weevil, *Pempherulus affinis* (Faust) (Curculionidae: Coleoptera) is not a serious menace in regular season crop and only less than 10% mortality of plants is encountered. Infestation of the weevil occurs in 12-15 days old seedlings. During the early days of the crop, the mortality rate of the plant reaches up to 90%. Grub cuts through the medullary rays, tunnels round the stem along the cambium [5]. This causes spiral galleries which damage the vascular tissues, disrupting transport of plant nutrients. Mature plants survive by developing a woody shoot axis gall at the collar region of the plant. Galls are the weak points of the plant which are regular, localized, globular, oval (or) fusiform and extensively nodded. Infested plant gets killed in course of time either due to blockage of plant nutrients, break down at galled regions due to strong winds, intercultural operations, or excessive boll load at later stage. It is being observed that stem weevil infestation predisposes the infection of root rot complex and the combined infection accelerate the death of the plants aggressively [6]. On the other hand inappropriate use of stronger insecticides against stem weevil results in elimination of natural enemies, escalation of plant protection costs and finally ends in very poor yields and returns [7].

In the recent years, farmers tend to raise cotton during the off-season *i.e.*, during winter season in summer irrigated cotton tract. Similarly, farmers of winter cotton tract opt for an additional summer crop. Under such conditions, mortality of cotton plants due to stem weevil is more than 60% and becoming serious botheration to cotton growers [8]. Moreover, the off season management tactics also miserably fail, as they could not be carried out in time due to prevailing unfriendly weather conditions. Such continuous availability of cotton, throughout the year, favors this pest to scourge the cotton crop severely in the off-season. Already, it has been recorded that cotton is the most preferred plant that supports to complete its life cycle apart from *Triumfetta rhomboidea*, a wild Tiliaceous plant. In addition to that, due to the cultivation of high yielding varieties in cotton growing tracts of Tamil Nadu and other South Indian states, extensive outbreak of stem weevil was reported in many places [4].

In Bhadradri Kothagudem district cotton is the predominant crop grown by tribal population. Recently its outbreak has been reported from Bhadradri Kothagudem district of Telangana, as there was more than 62% of the forest area in the district. The cotton crop grown in and around forest area is highly infested by stem weevil. The farmers are unable to diagnose the pest and assess the damage potential caused by it. Hence the FLD was planned to demonstrate the damage potential caused by stem weevil in cotton and its management strategies.

Materials and Methods

The present study was undertaken at ten different farmers fields of Bhadradri Kothagudem district of Telangana in medium black soils with cropping pattern of cotton followed by summer pulses with two treatments *viz.*, technology demonstration and check (farmers practice) (Table 1). The experiment was conducted consecutively for three years i.e. during *Kharif* season of 2019-20, 2020-21 and 2021-22. The experimental design, site and farmer selection, the layout of demonstration, farmer's participation, etc., were followed as suggested by Choudhary (1999) [9]. The farmers have shown Mahyco Bt cotton hybrid by following row to row and plant to plant spacing of 90 x 60 cm. The crops were grown by following all the agronomic practices.

To determine the severity of the damage caused by the cotton stem weevil, a set of twenty plants were tagged and the pest incidence was calculated by observing the damage symptoms visually. In these plants, infestation by the weevil was assessed by counting the total and infested plants. (Subramanian and Leela David, 1959) [10] and the plants that were dead due to weevil infestation were also recorded. The yield data were collected from both technology assessment plot and farmers practiced plot by random crop cutting method. Yield parameters of both technology assessment plot and farmers practiced plot were recorded. Using the yield parameters extension gap, technology gap, yield gap, technology index was calculated as per the procedure suggested by Rajashekhar *et al.* [11] and Samui *et al.* [12]. To find out the economic impact of treatments effected due to stem weevil incidence, yield and the benefit cost ratio was calculated.

Extension gap (Kg/ha) = Demonstrations yield –Yield under existing farmer's practice

Technology gap (Kg/ha) = Potential Yield – Demo Yield

Additional return = Demonstration return – farmer's practice return

$$\text{Extension gap} = \frac{\text{Extension gap}}{\text{Yield under farmers practice}} \times 100$$

$$\text{Technology gap (\%)} = \frac{\text{Technology gap}}{\text{Potential yield}} \times 100$$

$$\text{Technology index (\%)} = \frac{\text{Potential yield - Demonstration yield}}{\text{Potential yield}} \times 100$$

Results and Discussion

According to the current results and subsequent analysis of the results in all the three consecutive years stem weevil incidence was lower in the technology demonstrated plot compared to farmers practice. The reason behind this is regular monitoring of the pest incidence and timely application of neem cake to the soil mixed with farmyard manure followed byprophylactic and curative spraying of insecticides which further reduced up to 5.95-11.7 per cent stem weevil incidence compared to farmer practice (17.8 to 10.41%) whereas the plant mortality is reduced upto 7.06-3.4 per cent compared to farmer practice (10.24 to 5.32%) (Table 1, 2 and 3).

Table 1: Difference between technological intervention through farmers practice

Technology intervention	Farmers practice	Gap
Application of neem cake to the soil mixed with farmyard manure (FYM) during the basal fertilization (10 tons FYM + 250 Kg of Neem cake/ha).	Not Followed	Full Gap
Prophylactic spray of Chlorpyriphos 2.5 ml/l of water	Not Followed	Full Gap
In case of severity, application of chlorantraniliprole 18.5 SC at 0.3 ml/l and clothianidin 50 WDG at 0.2 g/lof water	Indiscriminate use of insecticides	Partial Gap

Table 2: Per cent stem weevil incidence at different locations of farmers plots

		Per cent stem weevil incidence/ locations										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Mean**
2019-20	Farmers Practice	18.2	19.5	17.2	20.3	17.2	16.0	17.3	16.2	17.6	18.5	17.8
	Demo	12.3	8.5	13.2	9.5	10.5	10.8	12.9	14.2	13.2	12.3	11.7
2020-21	Farmers Practice	13.2	15.9	12.5	14.7	16.9	10.2	16	15.3	18.0	10.5	14.32
	Demo	9.2	10.7	12.5	13.1	7.8	5.9	10.3	12.1	10.3	7.8	9.97
2021-22	Farmers Practice	10.2	9.1	11.3	11.2	9.6	11.2	10.7	10.5	9.8	10.5	10.41
	Demo	5.2	6.3	6.0	5.2	5.7	6.3	6.7	7.0	5.2	5.9	5.95

Table 3: Per cent plant mortality due to stem weevil at different locations of farmers plots

		Per cent plant mortality/ locations										
		1	2	3	4	5	6	7	8	9	10	Mean
2019-20	Farmers Practice	11.3	9.1	11	10	10.6	10.5	8.3	10.9	10.2	10.5	10.24
	Demo	9.2	7.3	8.4	7.1	8.3	5.6	6.3	5.2	7.3	5.9	7.06
2020-21	Farmers Practice	5.6	7.2	8.9	8.5	7.3	9.5	8.5	9.5	8.3	9.2	8.25
	Demo	6.3	6.2	7.2	5.2	4.2	6.3	5.2	6.7	5.2	7.2	5.97
2021-22	Farmers Practice	5.8	4.2	3.8	4.2	5.3	6.8	4.2	6.3	7.3	5.3	5.32
	Demo	2.3	5.3	3.2	2.3	2.2	1.7	2.3	7	5.2	5.9	3.74

The highest yield of 2035.0, 2067.0 and 2141.0 (Kg/ha) was recorded in the technology demonstrated plot, while lower yield of 1832.5, 1583.5 and 1652.0 (Kg/ha) was recorded in the farmers practice plots during *Kharif* 2019-20, 2020-21 and 2021-22, respectively. The per cent increase in yield in technology assessment plot when compared with the farmers practiced plot was 11.05, 9.05 and 14.01, respectively (Table 4).Subsequently, higher net returns were recorded in the technology demonstrated plots with Rs 51,847/-, Rs.48,700/- and Rs.51,384/ha and lower net returns of Rs.33,246/-, Rs.41,500/- and Rs. 39,648/-, respectively were recorded in the farmers practice plots during 2019-20, 2020-21 and 2021-22, respectively. On an average, the benefit cost ratio was high in treatment compared to control plot during three years of experimentation. The results clearly indicated that the technology provided was proved effective for the farmers, as it recorded the least incidence of stem weevil and reaped higher yields, accordingly, highest benefit cost ratio.

Table 4: Economic impact of experiment

Year	Yield (Kg/ha)		% Increase in yield	Net returns Rs. /ha		B:C Ratio	
	Demo	Farmers Practice		Demo	Farmers Practice	Demo	Farmers Practice
2019-20	2035.0	1832.5	11.05	51,847	33,246	1.98:1	1.53:1
2020-21	2067.0	1583.5	09.05	48,700	41,500	1.78:1	1.41:1
2021-22	2141.0	1652.0	14.01	51,384	39,648	1.98:1	1.62:1

Table 5: Grain yield and gap analysis

Year	Yield gap (%)	Extension gap (Kg/ha)	Technology gap (Kg/ha)	Technology index (%)	Additional returns (Rs.)
2019-20	11.05	202.5	215	9.56	18,601
2020-21	9.05	483.5	183	8.13	7,200
2021-22	14.01	489.0	109	4.84	11,736

The results are in concurrence with of previous publication where farmers practice recorded 50% stem weevil infestation while the IPM module registered only 18.4% at harvest. This could be due to prophylactic basal application of neem cake @ 150 kg/ ha coupled with drenching of 1% neem oil suspension at 20 and 30 DAS in IPM module [7]. Vimala *et al*., (2009) recorded the effect of neem cake and chlorpyriphos 20 EC @ 2.5 ml/l found to be effective in registering the minimum infestation of stem weevil and maximum seed cotton yield.

Conclusion
Based on the results obtained in the present study it can be concluded that location specific IPM modules have gained significance due to the changing pest scenario in different seasons and agro eco systems. The yield gap between farmer practice and technology demo plot was perceptibly higher. Hence, there is urgent need to make stronger extension services for educating the cultivators in the implementation of improved technology. However, the yield level under local practice was lower which could be further improved by adopting recommended integrated pest management technologies. The FLD intervention is highly effective among farmers with increased net returns. With the results obtained in the technology demonstrated plot it is recommended to take further into wide scale in Bhadradri Kothagudem district.

Acknowledgement
Authors are sincerely thankful to ICAR- ATARI & PJTSAU, Rajendranagar, Hyderabad for the financial support. We also thank innovative cotton farmers of the Bhadradri Kothagudem district, Telangana for their help in the field layout, experiment planning, data collection and smooth execution of the investigation in three consecutive years.

Authors' contributions
This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

References
1. Cotton Corporation of India; c2023. Website: https://cotcorp.org.in/statistics. aspx?pageid =3
2. Borkar P. Growth rates and decomposition analysis of cotton production in Maharashtra The Pharma Innovation Journal. 2022;SP-11(11):1986-1990.
3. Fletcher. Some South Indian Insects. Superintend Govt. Press, Madras, 1914, 565.
4. Chandramani P, Murugesan N, Ramalingam A. Screening of cotton entries against stem weevil, *Pempherulus affinis* Faust in field conditions. Journal of Cotton Research and Development. 2006;20(2):149-150.
5. Thirumurthi S, Subramanian TR, Parameswaran S. Incidence of the stem weevil, *Pempherulus affinis* Faust in MCU 5 cotton. Madras Agricultural Journal. 1974;60:10-15.
6. Vimala R, Suriachandraselvan M, Murugesan N, Ramalingam A. Development of a management strategy against stem weevil and root rot complex in cotton Journal of Biopesticides. 2009;2(1):18-21.
7. Krishnamoorthy SV, Subramanian S, Ramalingam A, Sivasamy N. An IPM system for summer irrigated cotton in South India. World Cotton Research Conference-3.;

Cape Town - South Africa; c2003. p. 1018-1024.
8. Anandhi P, Gailce Leo, Justin C, Elamathi S. Development of integrated pest management strategiesfor the management of cotton stem weevil, *Pempherulus affinis* (Faust). Journal of Entomology and Zoology Studies. 2020;8(3):1239-1244.
9. Choudhary BN. Krishi Vigyan Kendra: A guide for KVK managers. Publication, Division of Agricultural Extension, ICAR; c1999. p. 73-78.
10. Subramanian TR, Leela David, A. Preliminary experiments on the control of cotton stem weevil, *Pempherulus affinis* Faust with insecticides. Madras Agricultural Journal. 1959;46:19-21.
11. Rajashekhar M, Prabhakar Reddy T, Chandrashekara KM, Rajashekar B, Jagan Mohan Reddy M, Ramakrishna K, *et al*. Evaluation of integrated pest management module for pink bollworm, *Pectinophora gossypiella* (Saunders) and its economic analysis under farmer's field conditions. International Journal of Pest Management. 2022;68(3):1-9.
12. Samui SK, Maitra S, Roy DK, Mondal AK, Saha D. Evaluation of front-line demonstration on groundnut (*Arachis hypoggaea* L.) in Sundarbans. Journal of the Indian Society of Coastal Agricultural Research. 2000;18(2):180-183.