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Research Note

Beauveria bassiana as an effective IPM component against cotton stem weevil, *Pempherulus affinis* Faust

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ABSTRACT: The Integrated Pest Management (IPM) in reduction of cotton stem weevil in ecofriendly manner is attaining importance in recent days. In present study, three treatments including IPM module 1, IPM module 2 and farmers' practice were imposed against cotton stem weevil in a field trial. Among the three treatments, IPM module 2 which included basal application of FYM 25 t/ha and 250 kg/ha of neem cake, seed treatment with *Beauveria bassania* @10g/kg of seed, border crop with *Hibiscus cannabinus*, soil drenching with Imidacloprid 17.80 SL @ 25 g a.i./ha (125 ml/ha) at 15 DAS and placement of cotton stem bits (25 kg/500box/ha) + *Hibiscus cannabinus* stem bits (25 kg/500box/ha) + Chlorpyriphos dust 1.5 DP (2.5 kg/500box/ha) @ 30 DAS followed by earthing up @ 30 DAS recorded least stem weevil infestation of 13.21% with a yield of 1642.75 kg/ha. It was followed by IPM module 1 (21.78%) and farmers' practice (33.56%) with yield of 1456.25 kg/ha and 1588.25 kg/ha, respectively. The mean survival of plants was also higher in IPM module 2 (94.28%) followed by farmers' practice (88.57%) and IPM module 1 (80.00%).

KEY WORDS: Cotton stem weevil, farmers' practice, IPM module, per cent damage, plant survival

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Cotton is a salient fibre and towering commercial crop aptly described as "white gold" and "king of fibre" cultivated for its fibre and oil which contributes 65% of total raw materials for textile industry (Dharajothi *et al*., 2011). In Tamil Nadu, the average area, production and productivity of cotton during 2019-2020 was 1.7 lakh ha, 5.00 lakh bales and 500 kg/ha, respectively (Indiastat, 2020). Stem weevil causes serious menace when the cotton crop is grown during off-season (Murugesan *et al*., 2010). The entire life cycle of the weevil is completed within the stem (Mohan *et al*., 2009) and the symptom is detected only after the complete damage of the plant (Parameswaran and Chelliah, 1984). The female is capable of laying upto 50–121 eggs. The egg, larval, pupal and adult period of the pest are 6–9, 35–57, 9–12 and 12–50 days respectively (Dharajothi *et al.*, 2011). It causes extensive yield loss and requires high cost for pesticide application.

Inappropriate and continual use of stronger pesticides against pest in the initial and later stage of the crop has failed to check the pest population in cotton which paved the way for adoption of IPM technology (Raheeja, 1998). It also results in elimination of natural enemies, upsurge in plant protection costs and ends in poor yield and returns (Krishnamoorthy *et al*., 2003). The pesticide application is not only of cost significance but also of environment consideration. Hence, considering the importance of this pest, the present study was undertaken to develop integrated pest management strategies to manage the pest, cotton stem weevil in an ecofriendly manner.

A field trial was conducted during summer season 2021 at Bannari, Erode district to compare the IPM modules with farmers' practice in which variety CO17 was used for raising the crop. The experiment had two IPM modules and a farmers' practice which were taken up in 10 cents each. The treatments were replicated seven times and the design was Randomised Block Design. IPM module 1 included basal application of FYM 25 t/ha and 250 kg/ha of neem cake, seed treatment with Carbosulfan 25 DS @ 15 g/kg of seed, border crop with *Jatropha curcas*, soil drenching with Carbosulfan 25 EC @ 250 g a.i/ha (1000ml/ha) at 15 Days After Sowing (DAS) and placement of cotton stem bits (25 kg/500box/ha) + Chlorpyriphos dust 1.5 DP (2.5 kg/500box/ha) @ 30 DAS followed by earthing up @ 30 DAS. IPM module 2 comprised of basal application of FYM 25 t/ha and 250 kg/ha of neem cake, seed treatment with *Beauveria bassania*

Table 1. Per cent stem weevil damage in IPM modules and farmers' practice

Treatment	Mean survival of plants (%)	Stem weevil infestation (%)				Mean	Reduction over FP (%)	Yield kg/ha
		30DAS	60DAS	90DAS	120DAS			
IPM 1	80.00 (63.85) [b]	15.71 (23.08) [b]	21.43 (27.51) [b]	24.29 (29.41) [b]	25.71 (30.36) [b]	21.78 (27.77) [b]	35.10	1456.25 [b]
IPM 2	94.28 (79.34) [a]	10.00 (18.43) [a]	12.86 (20.75) [a]	14.29 (21.91) [a]	15.71 (23.08) [a]	13.21 (21.21) [a]	60.63	1642.75 [a]
FP	88.57 (70.40) [b]	25.71 (30.27) [c]	32.85 (34.93) [c]	37.14 (37.51) [c]	38.57 (38.37) [c]	33.56 (35.38) [c]	-	1588.25 [a]
SE.D	3.45	1.80	1.77	1.69	1.44	0.91	-	0.36
C.D (p = 0.05)	7.52	3.92	3.87	3.68	3.13	1.98	-	0.79

DAS - Days after sowing; FP - Farmers' practice; C.D - Critical Difference
Figures in parenthesis are arcsine transformed values
In columns, means followed by different letters are significantly different at 5% level of significance (Duncan's multiple range test)

@ 10 g/kg of seed, border crop with *Hibiscus cannabinus*, soil drenching with Imidacloprid 17.80 SL @ 25 g a.i /ha (125 ml/ha) at 15 DAS and placement of cotton stem bits (25 kg/500box/ha) + *Hibiscus cannabinus* stem bits (25 kg/500box/ha) + Chlorpyriphos dust 1.5 DP (2.5 kg/500box/ha) @ 30 DAS followed by earthing up @ 30 DAS. Farmers' practice includes eight rounds of plant protection chemicals at 30, 45, 50, 60, 70, 80, 90, 105 DAS respectively.

Observations were made on the number of plants showing characteristic galls near the collar region at 30, 60, 90, 120 DAS. Per cent infestation was worked out by number of plants infested and total number of plants. Per cent mean survival of plants was calculated by number of plants survived with stem weevil infestation and total number of plants.

Statistical analysis

Data were transformed using angular transformation with AGRES statistical software (Snedecor and Cochran, 1967). Duncan's Multiple Range Test (DMRT) was used to compare the treatment means at 5% level of significance (Gomez and Gomez, 1976).

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Per cent stem weevil damage

The results pertaining to Per cent stem weevil damage is presented in Table 1. IPM module 2 recorded the least Per cent infestation of 10.00, 12,86, 14.29 and 15.71 at 30, 60, 90 and 120 DAS respectively which was significantly different from IPM module 1 which registered per cent stem weevil damage of 15.71, 21.43, 24.29 and 25.71 at 30, 60, 120 DAS respectively. Farmers' practice attained mean per cent stem weevil damage of 33.56% which was high when compared to IPM modules. The per cent reduction over farmers practice is 60.63 in IPM module 2 and 35.10 in IPM module 1.

Mean survival of plants

The mean survival of plants was observed higher in IPM module 2 (94.28%) followed by farmers' practice and IPM module 1 of 88.57% and 80.00%, respectively (Fig. 1).

Yield

The recorded yield was also highest in IPM module 2 (1642.75 kg/ha) which is on par with farmers' practice (1588.25 kg/ha).

The present investigation is in agreement with the results of Mohan *et al*. (2009) who reported that the seed treatment performed with *Beauveria bassania* prior to sowing which possessed endophytic nature resulted in endodermal thickening of stem tissues (hypersensitive reaction) and intact nature of xylem and phloem vessels prevented the movement of grub outside the cortex area. Juliet *et al*. (2008) revealed that *Beauveria bassiana* was effective against Banana weevil (*Cosmopolites sordidus*) which supports our present findings. Monir (2019) reported that different concentration of *Beauveria bassiana* against Red palm weevil reduced the Per cent plant damage which are in accordance with our present findings.

In IPM module 2, reduction in per cent damage of stem weevil in early stage of the crop might be due to the application of neem cake 250 kg/ha which would deter the stem weevil from oviposition in the collar region of the stem. As Imidacloprid, a systemic insecticide which was soil drenched might also be a reason for the reduction of per cent stem weevil damage in IPM module 2. The present findings

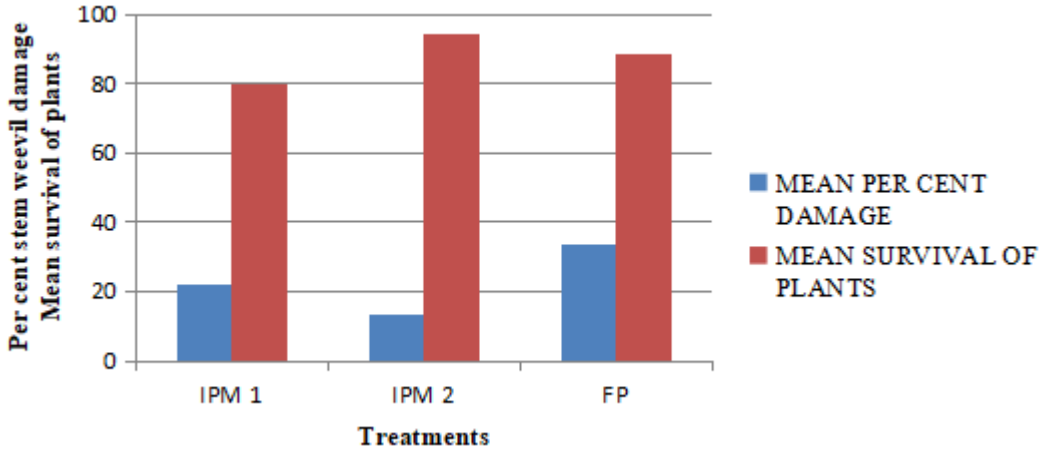

Fig. 1. Per cent stem weevil damage and mean survival of plants in IPM modules and farmers' practice

are in accordance with Anandhi *et al.* (2020) who reported that application of FYM 25 t/ha and neem cake 250 kg/ha significantly reduced the stem weevil damage in cotton crop.

In IPM module 1, placement of young cotton stem bits (25 kg/500box/ha) with chlorpyriphos dust 1.5 DP (2.5 kg/500box/ha) and in IPM module 2, placement of cotton stem bits (25 kg/500box/ha) + *Hibiscus cannabinus* stem bits (25 kg/500box/ha) mixed with chlorpyriphos dust 1.5 DP (2.5 kg/500box/ha) in field attracted few adult weevils may contribute for the reduction in per cent stem weevil damage.

Although the mean per cent stem weevil infestation was recorded higher in farmers' practice (33.56), the survival of plants was also higher when compared to IPM module 1. This could be due to the application of eight rounds of chemical pesticides which might have affected the growth stages of stem weevil, thereby allowing the plants to survive. Next to IPM module 2, high yield was obtained in farmers' practice due to high plant survival rate when compared to IPM module 1.

CONCLUSION

Of all the evaluated IPM modules against stem weevil damage in cotton, the IPM module 2 was found to be effective in reduction of stem weevil damage followed by IPM module 1 and farmers' practice. The biocontrol agents used as one of the components in IPM module 2 is gaining substantial importance in insect pest management as it is reliable, ecologically safe and economically viable. The future studies may be directed to explore alternate host plant for cotton stem weevil which can be used as a trap/intercrop for effective management practices.

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