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Evaluation of treatment modules for managing scarring beetle, *Basilepta subcostatum* Jacoby infestation in banana

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ABSTRACT

A field experiment was conducted for the evaluation of some treatment modules against banana scarring beetle, Basilepta subcostatum Jacoby in banana cv. Martaman (Musa AAB) during 2017-2018 at the Banana Research Unit, ICAR-AICRP on Fruits, Mondouri, BCKV, Nadia, West Bengal, India. Five treatment modules comprising bioagent, Beauveria bassiana (Bals.-Criv.) Vuill. (1×10^9 cfu ml^{-1}) as soil drench application @ 1500 ml ha^{-1} and as bunch spray @ 1500 ml ha^{-1}, chemical insecticides, chlorpyriphos 20EC @ 2000 ml ha^{-1}as soil drench application and acephate 75 SP @ 750 g ha^{-1} along with APSA 80 (adjuvant) @ 200 ml ha^{-1}as bunch spray, mechanical practice of covering the bunches after insecticidal spray with 17 GSM white polypropylene bunch sleeve and untreated control were replicated four times. The experimental results revealed least number of scar per 20 cm^2 leaf area and finger, least fruit injury (%), maximum number of fingers $hand^{-1}$ and hands $bunch^{-1}$ as well as maximum fruit yield (t ha^{-1}) in soil application of chlorpyriphos 20EC @ 2000ml ha^{-1} + bunch spray with acephate 75SP @ 750g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} followed by bunch wrapping with white polypropylene sleeve (T_1). Soil drenching with B. bassiana @ 1500 ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening followed by bunch covering with white polypropylene sleeve and bioagent + mechanical practice module i.e. application of B. bassiana @ 1500 ml ha^{-1} once as soil drench and other as bunch spray just at the time of flag leaf emergence followed by bunch covering with white polypropylene sleeve were found at par with the chemical insecticides+ mechanical practice module (T_1) but superior to insecticidal check (T_4) and untreated check when compared based on afore-mentioned variables. Incremental monetary benefit due to treatment execution was maximum in soil application of chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spraying with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening (T_4) and was trailed by the T_1, T_2 (bioagent + insecticide + mechanical practice module) and T_3 (bioagent + mechanical practice module). Considering environmental and human health perspective, bioagent + mechanical practice module could be a promising and economic alternative if bunch sleeves are made available at low cost.

***Keywords*:** Banana scarring beetle, *Basilepta subcostatum*, *Beauveria bassiana*, ICBR, management and treatment module

Banana (*Musa* sp.) is the second most important fruit crop in India next to mango. Because of its availability round the year, low cost, varietal variations, taste, nutritive and medicinal value, it is one of the favourite fruits among all classes of people. It has also good export potential. Bananas are predominantly produced in Asia, Latin America and Africa. The biggest producers are India, which produced 29 million tons per year on an average between 2010 and 2017 (https://www.worldatlas.com). More than two hundred species of insect and non-insect pests infest banana (Simmonds, 1966; Singh, 1970). In India, about nineteen insect pests have been found frequently associated with banana from planting to harvesting (Padmanaban *et al*., 2002). These include insects, mites, mollusks and birds. Of these, banana scarring beetle, *Basilepta subcostatum* Jacoby has been considered as the most serious one in different parts of the country (Sah *et al*., 2018). It causes extensive damage to leaves as well as fruits during summer and kharif seasons (Singh *et al*., 1997). The extent of damage has been reported to be approximately 30 per cent of the banana bunches during rainy season in Bihar (Ahmad *et al*., 2003; Mukherjee, 2004; Samui *et al*., 2004; Mukherjee, 2006). Leaf and fruit scarring beetle is considered as one of the most economically important pests in Eastern India which is reported to occur in West Bengal and some other parts of India too. The damage done by this beetle has tremendous influence on both quantity and quality of banana. The grub attack roots and the adults feed on leaves and fruit causing heavy damage, fruits become blemished and reduce market value (Ahmed, 1963; Prasad and Singh, 1987). The extent of damage inflicted upon banana crop by this pest has been reported to be around 80 per cent. In severe infestation, the percentage of infested orchards and intensity of the pest have been recorded up to 100 per cent (Roy and Sharma, 1952). In view of the growing economic importance of *B. subcostatum*, an attempt has been made to know the extent of damage induced by the pest and to evaluate some treatment modules for its sustainable management in susceptible banana cv. Martaman (*Musa* AAB).

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MATERIALS AND METHODS

A field experiment was conducted during August, 2017 to September, 2018 at the banana orchard of Banana Research Unit, ICAR-AICRP on Fruits, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India. The experimental site was geographically located at 22.9358°N latitude and 88.5100°E longitude with an elevation of 12m above mean sea level. The soil of the experimental field was typically *Gangetic* alluvial soil (Entisol) having sandy clay loam texture with good drainage facility, neutral in reaction and moderate in fertility. Weather variables recorded during the period of experimentation include 8.8^{0}C minimum and 35.37^{0}C maximum mean temperatures, 39.9-97.57% mean RH and 1901.78 mm total rainfall.

Sword suckers of banana cultivar Martaman (*Musa* AAB) was planted on 14.08.2017 at a spacing of 2m×2m in a plot size of 8m×8m. The plant was fertilized with N:P_2O_5:K_2O @ 200:50:250 g plant^{-1} and raised following standard recommended package of practices. The Randomized Complete Block Design was adopted for the experiment. Four replicates of the five treatment modules *viz*., T_1: soil drench application of chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} along with APSA 80 (adjuvant) @ 200 ml ha^{-1} just after first hand opening followed by bunch covering with 17 GSM white polypropylene bunch sleeve (chemical insecticides + mechanical practice module), T_2: soil drench application of *Beauveria bassiana* (Bals.-Criv.) Vuill. (1×10^9 cfu ml^{-1}) @ 1500 ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening followed by bunch covering with 17 GSM white polypropylene bunch sleeve (bioagent + chemical insecticides + mechanical practice module), T_3: soil application of *B. bassiana* (1×10^9 cfu ml^{-1}) @ 1500 ml ha^{-1} + bunch spraying with *B. bassiana* (1×10^9 cfu ml^{-1}) @ 1500 ml ha^{-1} just at the time of flag leaf emergence followed by bunch covering with 17 GSM white polypropylene bunch sleeve (bioagent + mechanical practice module), T_4: soil application of chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spraying with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening (insecticidal check) and T_5: untreated control were evaluated in the experiment. Soil drenching application of chemical insecticide and bio-agent to control the pupae of *B. subcostatum* was made in October, 2017 using knapsack sprayer. Adjuvant (APSA 80) was added along with the insecticide acephate 75 SP @ 0.4 ml litre^{-1} of water while bunch spraying for the better retention and action of the insecticidal molecule on the waxy bunch surface. Bunch spraying was done on 11.05.18 using hand sprayer (400 ml capacity).

Observations were recorded on number of scars per 20 cm^2 leaf area, fruit injury (%), number of hands bunch^{-1}, number of fingers hand^{-1} and bunch weight (kg bunch^{-1} and t ha^{-1}). Five plants at random from each plot (each replication of the treatments) were selected and tagged for taking observations on number of scars induced by the scrapping of *B. subcostatum* from 20 cm^2 area of leaf. Three leaves *viz*., one central leaf, one new full furl leaf and one lower leaf were selected to take a count on the number of scars at weekly interval. Month wise average number of scars per 20 cm^2 area of leaf is presented for interpretation of data (Table 1). Fruit injury due to development of scars by the feeding of *B. subcostatum* was recorded at the time of harvest. Three hands (one each from lower, middle and bottom) each from five randomly selected bunches per plot were considered to work out per cent fruit injury using following formula.

$$\text{Fruit injury } (\%) = \frac{\text{Total number of scars}}{\text{Total number of fruits studied}} \times 100$$

Observation on number of hands bunch^{-1} and number of fingers hand^{-1} were recorded from five randomly selected bunches per plot at harvest. Bunch weight (kg bunch^{-1}) was recorded from each plot at harvest and transformed the bunch yield in t ha^{-1}.

Data collected during experimentation was subjected to statistical analysis after suitable transformation of the data whenever necessary. Analysis of variance was worked according to RBD at 5% level of probability and mean was compared for interpretation of result (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Month wise observation on number of scar per 20 cm^2 area of banana leaf due to infestation of *B. subcostatum* is presented in table-1. The number of scars on leaf was found non-significant before commencement of treatment application i.e. during September, 2017. From October 2017 (when soil drenching of insecticides was advocated) till the harvest of crop in September 2018, a significant variation in the number of scars per 20 cm^2 area of leaf was observed. Bunch spray was given in the month of May 2018. Least number of scarring beetle induced leaf scar varied from 7- 25.4 per 20 cm^2 area was registered throughout the study period in soil application of chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spray with acephate 75SP @ 750g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening followed by bunch covering with 17 GSM white polypropylene bunch sleeve (T_1). Irrespective of the

Table 1: Efficacy of treatment modules on number of leaf scars induced by the scarring beetle, *B. subcostatum* in banana cv. Martaman (*Musa* AAB) during 2017-18

Treatments	Number of scars per 20 cm² leaf area												
	Sept 2017	**Oct 2017**	**Nov 2017**	**Dec 2017**	**Jan 2018**	**Feb 2018**	**March 2018**	**April 2018**	**May 2018**	**June 2018**	**July 2018**	**Aug 2018**	**Sept 2018**
T_1 (Chemical insecticide + mechanical practice module)	14.0 (3.8)	12.0 (3.5)	10.5 (3.3)	15.3 (4.0)	17.8 (4.3)	25.4 (5.1)	23.1 (4.9)	21.6 (4.7)	14.7 (3.9)	9.6 (3.2)	9.9 (3.2)	9.4 (3.1)	7.0 (2.7)
T_2 (Bioagent + insecticide + mechanical practice module)	11.8 (3.2)	11.5 (3.4)	12.5 (3.6)	15.6 (4.0)	17.4 (4.2)	25.4 (5.1)	24.1 (5.0)	36.7 (6.1)	15.3 (4.0)	11.4 (3.5)	10.6 (3.3)	9.9 (3.2)	7.5 (2.8)
T_3 (Bioagent + mechanical practice module)	13.3 (3.6)	9.3 (3.1)	15.0 (3.9)	14.7 (3.9)	18.9 (4.4)	27.5 (5.3)	28.6 (5.4)	38.3 (6.2)	17.5 (4.2)	11.1 (3.4)	10.4 (3.2)	10.0 (3.2)	8.3 (2.9)
T_4 (Insecticidal check)	8.0 (2.9)	16.5 (4.1)	17.5 (4.2)	18.7 (4.4)	20.4 (4.6)	27.4 (5.3)	29.3 (5.5)	42.4 (6.6)	18.8 (4.4)	18.8 (4.4)	11.4 (3.5)	12.5 (3.6)	8.5 (3.0)
T_5 (Control)	14.3 (3.8)	14.5 (3.9)	20.5 (4.6)	19.3 (4.4)	21.4 (4.7)	33.4 (5.8)	36.6 (6.1)	44.9 (6.7)	42.4 (6.5)	43.5 (6.6)	45.8 (6.8)	46.5 (6.9)	48.3 (7.0)
SEm (±)	**0.47**	**0.15**	**0.18**	**0.13**	**0.08**	**0.12**	**0.14**	**0.08**	**0.16**	**0.11**	**0.20**	**0.14**	**0.18**
LSD (0.05)	**NS**	**0.46**	**0.55**	**0.40**	**0.25**	**0.37**	**0.43**	**0.25**	**0.49**	**0.34**	**0.62**	**0.43**	**0.55**

Note: Data in parentheses indicate $\sqrt{(x+0.5)}$ transformed values

treatments, a generalized peak in leaf infestation by *B. subcostatum* was noticed during the month of April 2018. The performance of T_2 i.e. soil application of *B. bass*iana (1×10^9 cfu ml^{-1}) @ 1500ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening followed by bunch covering with 17 GSM white polypropylene bunch sleeve and T_3 i.e. soil application of *B. bassiana* @ 1500 ml ha^{-1} + bunch spray with *B. bassiana* @ 1500 ml ha^{-1} just at the time of flag leaf emergence followed by bunch covering with 17 GSM white polypropylene bunch sleeve (bioagent + mechanical practice module) in terms of leaf injury was followed just after chemical insecticides + mechanical practice module (T_1). Numbers of leaf scars per 20 cm^2 of leaf area in T_2 and T_3 ranged from 7.5-36.7 and 8.3-38.3, respectively (Table 1). Maximum number of scar per 20 cm^2 of leaf area was recorded in the untreated control plot being, 48.3. The treatment modules, T_2 and T_3, were found superior to insecticidal check (soil application of chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spraying with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening) and untreated check when compared based on number of scar per 20 cm^2 area of leaf.

Spraying of acephate 75SP @ 0.125% in the heart of the plant recorded 3.8 scars per 5 cm^2 leaf surface in banana cv. Basrai in Samastipur, Bihar, India (Mukherjee, 2005). In the present study, the least number of leaf scar was recorded all the way through the growing period in soil drench application of chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening followed by bunch covering with 17 GSM white polypropylene bunch sleeve. This finding remains in conformity with the earlier observation made by Mukherjee, 2005; Das and Baruah, 2018.

Significantly least number of scar per finger was recorded in soil application of chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening followed by bunch covering with 17 GSM white polypropylene sleeve (T_1) being, 3.8 (Table 2). Treatment module, T_2 and T_3 were found statistically at par with T_1 in reference to the number of scar per finger but they were significantly superior to the insecticidal check and untreated check.

Minimum fruit injury was recorded in T_1 being, 7.4% and was at par with the T_2 where fruit injury was recorded as 9.7% (Table 2). Fruit injury in T_2 and T_3 were found statistically on par with the treated check but superior to the untreated one.

Table 2: Efficacy of treatment modules against scarring beetle, *B. subcostatum* on fruit scar, fruit injury, yield attributes and yields of banana cv. Martaman (*Musa* AAB) during 2017-18

Treatments	Number of scars finger^{-1}	Fruit injury (%)	Number of hands bunch^{-1}	Number of fingers hand^{-1}	Bunch wt. (kg bunch^{-1})	Bunch wt. (t ha^{-1})
T_1 (Chemical insecticide + mechanical practice module)	3.8	7.4	7.8	15.3	16.97	42.43
T_2 (Bioagent + insecticide + mechanical practice module)	4.0	9.7	7.7	14.6	15.93	39.81
T_3 (Bioagent + mechanical practice module)	4.1	10.4	7.7	14.9	15.74	39.69
T_4 (Insecticidal check)	10.7	11.4	7.4	14.4	15.48	39.34
T_5 (Control)	22.4	24.5	7.2	14.4	14.28	35.69
SEm (±)	**0.13**	**0.84**	**0.07**	**0.45**	**0.47**	**1.17**
LSD (0.05)	**0.40**	**2.59**	**0.22**	**NS**	**1.44**	**3.60**

Choudhury *et al*. (1996) reported 7.5% fruit infestation of banana by *B. subcostatum* in white polyethylene bunch cover treatment as against the 52.91% fruit infestation in untreated control plot. Here, the least number of fruit scar (3.8) and per cent fruit injury (7.4) on account of *B. subcostatum* infestation in banana was recorded in rhizospheric soil treatment with chlorpyriphos + bunch spray with acephate followed by its covering with white polypropylene bunch sleeve. This observation remains in parity with the finding of Choudhury *et al*., 1996. *B. bassiana* @ 5 g litre^{-1} of water has been reported highly effective against banana scarring beetle (Choudhury *et al*., 2010; Saikia *et al*., 2016). Soil application of *B. bassiana* (1×10^9 cfu ml^{-1}) @ 1500 ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} just after first hand opening followed by wrapping of bunch with white polypropylene sleeve was found at par with soil drenching of chlorpyriphos + bunch spraying with acephate 75SP followed by wrapping of bunch with white polypropylene sleeve. This observation too corroborates the earlier result documented by Choudhury *et al*. (2010).

Number of hands bunch^{-1} was recorded maximum in soil drenching with chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening followed by bunch covering with 17 GSM white polypropylene sleeve (T_1) being, 7.8 (Table 2). Treatment modules, T_2 and T_3 were found statistically on par with T_1 in reference to the number of hands per bunch but they were significantly superior to the insecticidal check and untreated check.

Treatment modules didn't reveal significant impact on number of fingers hand^{-1} though, the maximum number of fingers hand^{-1} was recorded in T_1 being, 15.3 (Table 2).

Fruit yield (42.43 t ha^{-1}) was recorded maximum in T_1 and was followed by T_2 (soil drenching with *B. bassiana* @ 1500ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening followed by bunch wrapping with 17 GSM white polypropylene sleeve) and T_3 (soil drenching with *B. bassiana* @ 1500 ml ha^{-1} + bunch spray with *B. bassiana* @ 1500 ml ha^{-1} just at the time of flag leaf emergence followed by bunch covering with 17 GSM white polypropylene sleeve) being, 39.81 t ha^{-1} and 39.69 t ha^{-1}, respectively (Table 2). With regard to the fruit yield, the treatment modules T_1, T_2 and T_3 were on par with the insecticidal check (soil drenching with chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spraying with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening) but superior over untreated one.

Covering banana bunches with white polyethylene is an effective, economic and safe way to control the damage inflicted by *B. subcostatum*, avoiding the use of insecticides and resulting in higher yields (Choudhury *et al*., 1996; Pathak and Mitra, 2014). Spraying of chemical insecticides followed by bunch covering with polythene cover had significant impact on fruit size and shape, number of fingers per bunch and bunch weight (Sit *et al*., 2011). Foliar application of acephate 75SP @ 0.11% spray + bunch wrapping with polypropylene bag and application of *B. bassiana* @ 10^9 cfu ml^{-1} were found effective in reducing the infestation of banana scarring beetle and thereby increasing the yield with the best benefit cost ratio. The mentioned treatments significantly reduced the incidence, number of scars on leaf, fruit

Table 3: Comparative economics of treatment modules against scarring beetle, *B. subcostatum* in banana cv. Martaman during 2017-18

Treatments	Gain in yield over control (t ha^{-1})	Fresh fruit (t ha^{-1})	Value of fresh fruit (Rs)	Scarred fruit (t ha^{-1})	Value of scarred fruit (Rs)	Gross value of additional yield (Rs)	Cost of treatment (Rs)	Net gain (Rs)	Incremental Cost:Benefit (ICBR)
T_1: Soil drenching with chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} + APSA 80 @ 200 ml ha^{-1} after first hand opening followed by bunch covering white polypropylene bunch sleeve	6.74	6.24	62400	0.499	2495	64895	25788	39107	1:2.52
T_2: Soil drenching with *B. bassiana* (1×10^9 cfu ml^{-1}) @ 1500 ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} + APSA 80 @ 200 ml ha^{-1} after first hand opening followed by bunch covering with white polypropylene bunch sleeve	4.12	3.72	37200	0.400	2000	39200	25488	13712	1:1.54
T_3: Soil drenching with *B. bassiana* (1×10^9 cfu ml^{-1}) @ 1500 ml ha^{-1} + bunch spray with *B. bassiana* (1×10^9 cfu ml^{-1}) @ 1500 ml ha^{-1} at flag leaf emergence followed by bunch covering with white polypropylene bunch sleeve	4.00	3.58	35800	0.416	2080	37880	25480	12400	1:1.49
T_4: Soil drenching with chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spray with acephate 75SP @ 750 g ha^{-1} + APSA 80 @ 200 ml ha^{-1} after first hand opening (insecticidal check)	3.65	3.23	32300	0.416	2080	34380	2820	31560	1:12.19

Note: Market price of chlorpyriphos 20EC @ Rs 450 litre^{-1}, acephate 75WP @ Rs 480 kg^{-1}, B. bassiana @ Rs 400 litre^{-1}, APSA 80 @ Rs 1240 litre^{-1} and 17 GSM white polypropylene bunch sleeve @ Rs 1500 per 200m roll, labour wages @ Rs. 328 man-day^{-1}, value of fresh and scarred fruits @ Rs. 10,000 and 5,000 t^{-1}, respectively were considered to compute the incremental benefit cost ratio of treatment modules

injury and increased the yield or yield attributing characters (Das and Baruah, 2018). In this study, significantly least number of scars finger^{-1}, least fruit injury (%), maximum number fingers hand^{-1}, maximum number of hands bunch^{-1} and maximum fruit yield were recorded in soil drench application of chlorpyriphos 20EC @ 2000 ml ha^{-1}+ bunch spray with acephate 75SP @ 750 g ha^{-1} followed by bunch covering with polypropylene bunch sleeve (T_1). Performance of *B. bassiana* @ 1500ml ha^{-1} as soil drench + bunch spray with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} after first hand opening followed by bunch wrapping with polypropylene sleeve (T_2) and *B. bassiana* @ 1500 ml ha^{-1} once as soil drench and other as bunch spray at flag leaf emergence followed by bunch covering with polypropylene sleeve (T_3) were found at par with T_1 but superior to insecticidal check and untreated check when compared based on afore-mentioned variables. The findings of the present study remain in close adherence with the earlier findings made by the previous workers (Choudhury *et al*., 1996; Sit *et al*., 2011; Pathak and Mitra, 2014; Das and Baruah, 2018).

It is evident from the result (Table 3) that among five treatment modules, the adoption of insecticide + mechanical practice module (T_1) was much better in increasing the fruit production and securing maximum net return of Rs. 39107 ha^{-1} through suppression of scarring beetle infestation. The incremental cost benefit ratio (ICBR) was maximum (1:12.19) in insecticidal check (T_4) and was trailed by the T_1, T_2 (bioagent + insecticide + mechanical practice module) and T_3 (bioagent + mechanical practice module). Insecticidal check (T_4) fetched more monetary return because of less treatment cost. Inclusion of polypropylene bunch sleeve as a wrapping material (a component of mechanical practice) in all the modules except insecticidal check and untreated control added huge monetary cost (Rs 21000) of treatment. Therefore, in spite of securing more return from the additional yield, the treatments T_1, T_2 and T_3 could not compete with the insecticidal check treatment (T_4) to secure more monetary benefit. Considering environmental and human health perspective and effects on non-targets, soil drench application of *B. bassiana* @ 1500 ml ha^{-1} + bunch spray with *B. bassiana* @ 1500 ml ha^{-1} just at the time of flag leaf emergence followed by bunch covering with 17 GSM white polypropylene bunch sleeve (T_3) could be a promising and economic alternative if bunch sleeves are made available at low cost.

The study unveiled significantly least fruit injury with simultaneous increase of fruit yield in soil drench application of chlorpyriphos 20EC @ 2000 ml ha^{-1}+ bunch spray with acephate 75SP @ 750 g ha^{-1} followed by wrapping of bunch with white polypropylene bunch sleeve (T_1). The monetary benefit was maximum in soil application of chlorpyriphos 20EC @ 2000 ml ha^{-1} + bunch spraying with acephate 75SP @ 750 g ha^{-1} along with APSA 80 @ 200 ml ha^{-1} just after first hand opening (T_4) and was trailed by the T_1, T_2 (bioagent + insecticide + mechanical practice module) and T_3 (bioagent + mechanical practice module). Besides, T_1 and T_2, the module comprising bioagent and mechanical practice (T_3) is showing promising result in defending scarring beetle infestation in banana and this may have a recommendable prospect in organic cultivation system. Further, banana is consumed as ripe fruit and it has good export potential too. Because of the application of insecticides, residues remain in the fruit may hinder its export potential. Considering environmental and human health perspective and effects on non-targets, it is absolutely necessary to adopt biointensive module for its management unlike pest management tactics adopted for other commercial fruit crops. Henceforth, soil drenching with *B. bassiana* (1×10^9 cfu ml^{-1}) @ 1500 ml ha^{-1} + bunch spray with *B. bassiana* (1×10^9 cfu ml^{-1}) @ 1500 ml ha^{-1} just at the time of flag leaf emergence followed by bunch covering with white polypropylene sleeve may be considered for further evaluation to establish the module as a good option for managing the scarring beetle (*B. subcostatum*) infestation in banana. It could be a promising and economic alternative if bunch sleeves are made available at low cost.

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