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Evaluation of integrated pest management modules against brinjal shoot and fruit borer *Leucinodes orbonalis* (Guenee) (Lepidoptera: Pyralidae)

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Abstract
An investigation was carried out during *rabi* 2017-18 to evaluate the bioefficacy of seven integrated pest management modules against shoot and fruit borer, *Leucinodes orbonalis* (Guenee) in brinjal. M1- Moderately resistant brinjal genotype selected from screening experiments (IC 136061), M2- Control, M3-M6 comprised of various components from cultural, physical, mechanical, biological and chemical control methods in various combinations, M7-farmers practice. Module-1 consisting moderately resistant genotype received least overall mean per cent shoot infestation (12.98), fruit infestation on number and weight basis (15.05 and14.33), higher B:C ratio (4.05:1) compared to all other modules (M2-M7). However farmers practice M7 recorded with higher marketable fruit yield (32427.73 kg ha^{-1}), gross returns followed by M6 (26073.60 kg ha^{-1}), M5 (23654.40 kg ha^{-1}) M4 (18562.13 kg ha^{-1}), M3 (17472.00 kg ha^{-1}) and M2 (14649.60 kg ha^{-1}) registered with gross returns of Rs.411712.00 ha^{-1} (B:C ratio 3.38:1), Rs.312883.20 ha^{-1} (B: C ratio of 2.68:1), Rs. 283852.80 ha^{-1} (B: C ratio of 2.44:1), Rs.222745.00 ha^{-1} (B: C ratio of 2.18:1), Rs.209664.00 ha^{-1} (B: C ratio of 2.17:1) and Rs. 175795.00 ha^{-1} (B: C ratio of 2.20:1) respectively.

Keywords: Brinjal, shoot and fruit borer, IPM modules evaluation

Introduction
Brinjal is the most common and popular vegetable to all classes of people in India and other parts of the world. India is the second largest country after china in the world and accounts for about 11.89 MT with an area of 0.68 MH under cultivation having productivity of 17.5 t/ha. In Andhra Pradesh, it is grown in an area of 0.28 MH with an annual production of 5.65 MT and productivity of 20.17 t/ ha (NHB, Data base 2015) [7].

Brinjal production is affected by many adverse factors and among them brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee has remained a major pest of brinjal (Haseeb *et al*., 2009) [4]. The yield loss caused by this pest has been estimated up to 67% in Bangladesh (Islam and Karim, 1991) [5]. This pest can cause a crop loss to the extent of 70% even after repeated insecticidal spray (Singh and Pandita, 2009) [13]. Synthetic insecticides are the most effective tools against this pest, however their indiscriminate use causes serious problems including pest resistance and environmental pollution (Panda and Khush, 1995) [8]. Toxic residues in harvested fruits cause serious health hazards to the consumers, and to the non-targeted organisms e.g., natural enemies and pollinators.

It is therefore necessary to develop and follow a rational approach with greater reliance on IPM to promote sustainability and to reduce the number of application of hazardous chemicals. In this regard, the present investigation was planned to evaluate some integrated pest management modules contained cultural, physical, mechanical, botanical, microbial, chemical control practices for the management of shoot and fruit borer.

Material and Methods
The research trial was conducted at college farm, College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem during *Rabi* 2017-18. Nursery with moderately resistant genotype selected from screening experiment (IC 136061) and Dommeru local brinjal variety was sown on raised beds.

The trial was laid out in Randomized Blocked Design with a plot size 10 m x 10 m with seven modules (Treatments) and replicated thrice. The particulars and components in each module are given in Table 1.

The border row crop (Sorghum) was sown 30 days prior to the transplantation of brinjal. The brinjal seedlings of 35 days old were transplanted at a spacing of 70 cm x 60 cm. The intercrop coriander was sown after the transplantation of main crop. All recommended package of practices were followed to raise the crop, except plant protection measures. Insecticides were sprayed at 15 days interval in M4-M7. First spray was started at vegetative stage *i.e.* 35 DAT in M4 to M7. The subsequent sprays were applied at fifteen days interval.

The observations were recorded regarding shoot infestation, fruit infestation (Number basis, weight basis) and yield. The shoot and fruit infestations were recorded at 15 days interval by counting total number of healthy and infested shoot and fruits on five randomly selected and tagged plants in each module starting from 15 DAT to till final harvest for shoot infestation whereas from 45 DAT to till final harvest in case of fruit infestation. The data on shoot infestation, fruit infestation (on number basis, weight basis) and fruit yield were analyzed statistically after suitable transformation for necessary parameters by following the standard procedure as suggested by Gomez and Gomez (1976). Mean per cent shoot infestation and per cent fruit infestation were calculated following the formula suggested by Wakil *et al*. (2009) [14] while comparing the yield from different treatments, the per cent reduction in shoot infestation, per cent reduction in fruit infestation, per cent increase in yield over control were calculated by following the procedure given by Pradhan (1969) [9].

$$\text{Per cent shoot infestation} = \frac{\text{Number of infested shoots}}{\text{Total number of shoots}} \text{ x } 100$$

Per cent reduction in shoot infestation =

$$\frac{\text{Per cent shoot infestation in treatment} - \text{Per cent shoot infestation in control}}{\text{Per cent shoot infestation in treatment}} \text{ x } 100$$

$$\text{Per cent fruit infestation (by number)} = \frac{\text{Number of infested fruits}}{\text{Total number of fruits}} \text{ x } 100$$

$$\text{Per cent fruit infestation (by weight)} = \frac{\text{Weight of infested fruits}}{\text{Weight of total fruits}} \text{ x } 100$$

Per cent reduction in fruit infestation =

$$\frac{\text{Per cent fruit infestation in treatment} - \text{Per cent fruit infestation in control}}{\text{Per cent fruit infestation in treatment}} \text{ x } 100$$

$$\text{Per cent increase in yield over control} = \frac{(T - C)}{C} \text{ X } 100$$

Where T= Yield in treatment C= Yield in control

Results and Discussion

Bio-efficacy of IPM modules on shoot infestation

The observations presented in Table 2 indicated that the incidence of shoot borer infestation in all the IPM modules ranged from 30.00 to 52.22 per cent at 15 DAT. Among the different modules tested, M1 (Moderately resistant genotype selected from screening experiments) recorded lowest shoot infestation (30.00%) and M2 (Control) recorded with highest shoot infestation (52.22%).

At 45 DAT, M7 found to be significantly superior over other modules with low shoot infestation (14.09%) while M1 (20.42%) differed significantly with M2- M6. M3 and M4; M5 and M6 are on par.

Significant reduction in the incidence of shoot borer infestation was observed in all the modules at 150 DAP. IPM modules M7, M6, M5 and M1 were on par due to low level of shoot infestation M7 (2.38%), M6 2.27%), M5 (3.60%), M1 (2.39%) in the modules.

The overall mean percent shoot infestation data of all the modules presented in Table 2 30 revealed that, M1 was effective in recording the lowest incidence of shoot infestation (12.98%) and was followed by M7 (15.14%), M6 (18.79%), M5 (21.94%), M4 (24.34%), M3 (27.27%) and M2 (30.42%).

Module M1 was planted with the moderately resistant genotype (IC 136061), selected from the screening experiment expressed the Antixenosis mechanism of resistance through physicomorphic (Narrow shoot thickness, trichomes on leaf lamina, shoot) and biochemical factors (High content of Phenol, peroxidase, Phenylalanine Ammonialyase) and hence recorded with less shoot infestation without any plant protection measures compared to other modules.

Bio-efficacy of IPM modules on fruit infestation (Number)

The shoot and fruit borer infestation with particular reference to fruit infestation (number basis) was noticed in all the IPM modules which was in the rage of 18.00 to 54.44 per cent at 45 DAT. Among the different modules tested, M1 recorded significantly lowest fruit infestation (18.00%) and M2 with highest fruit infestation (54.44%).

At 90 DAP, M1 (14.70%) and M7 (16.22%) are on par and it was followed by M6 (32.11%), M5 (37.22%), M4 (36.66%), M3 (50.00%) and M2 (50.00%).

It was observed that M1 recorded with low fruit infestation (13.24%) which was on par with M7 (14.44%) and it was followed by M6 (26.66), M5 (28.88%), M4 (34.44%), M3 (46.66%) and M2 (44.44%) at 135 DAT.

The observations presented in Table.3 on overall mean per cent fruit infestation in all the modules indicated that, M1 recorded with significantly low fruit infestation (15.08%) on number basis compared to all other modules followed by M7 (19.14%), M6 (30.75%), M5 (36.73%), M4 (40.34%), M3 (46.52%) and M2 (51.18%).

The inherited character acquired by the moderately resistant genotype through physicomorphic (Pedicel length, calyx length, fruit length, fruit diameter, fruit colour and fruit shape) and biochemical factors (High content of Phenol, peroxidase and Phenylalanine Ammonialyase) of fruit enabled the plant to avoid the fruit borer infestation through antixenosis mechanism. Rahman *et al*. (2009) [10]; Shanmugham *et al*. (2015) reported similar response in IPM modules against shoot and fruit borer.

Bio-efficacy of IPM modules on fruit infestation (weight)

The numerical values on shoot and fruit borer infestation with special reference to fruit infestation (Weight basis) are presented in Table 4. The fruit infestation was ranged between

17.10 to 56.95 per cent at 45 DAT. Among the different modules tested, M1 recorded with lowest fruit infestation (17.10%) and M2 received with highest fruit infestation (56.95%) at 45 DAT on weight basis.

At 90 DAP, low level of fruit borer infestation was observed in M1 (13.93%) and M7 (15.72%) which are on par and it was followed by M6 (31.24%), M5 (36.27%), M4 (34.01%), M3 (49.13%) and M2 (48.94%). Similar trend of fruit infestation in different IPM modules was observed even at 135 DAP and the lowest incidence of 12.54% was recorded in M1 against 43.80% in M2.

Overall mean per cent fruit infestation data on weight basis revealed that among the different IPM modules, M1 showed significantly low fruit infestation (14.33%) on weight basis followed by M7 (18.49%), M6 (29.94%), M5 (35.41%), M4 (39.52), M3 (45.90%) and M2 (51.15%).

Bioefficacy of IPM modules on fruit yield

The observations on the yield performance of various modules formulated for the management of shoot and fruit borer are presented in Table 5. The results revealed that module M2 and M3 are on par whereas rest other modules differed significantly in terms of marketable fruit yield production. Among the different IPM modules evaluated during rabi 2017-18, M7 recorded significantly highest marketable fruit yield 32427.73 kg ha^{-1} whereas M1 recorded with 31449.60 kg ha^{-1} followed by M6 (26073.60 kg ha^{-1}), M5 (23654.40 kg ha^{-1}), M4 (18562.13 kg ha^{-1}), M3 (17472.00 kg ha^{-1}) and M2 (14649.60 kg ha^{-1}).

Yield and cost Economics

The cost involved and returns realized were presented in Table 7. Among different IPM modules, M7 found to be very effective as it was recorded with significantly highest fruit yield (32427.73 kg ha^{-1}), highest gross returns (Rs. 389132.80 ha^{-1}) and B: C ratio (3.20:1). M1 recorded 31449.60 kg ha^{-1} fruit yield with gross returns of Rs. 377395.20 ha^{-1} with highest B: C ratio of 4.05:1. The other modules viz., M6 (26073.60 kg ha^{-1}), M5 (23654.40 kg ha^{-1}) M4 (18562.13 kg ha^{-1}), M3 (17472.00 kg ha^{-1}) and M2 (14649.60 kg ha^{-1}) registered with gross returns of Rs.312883.20 ha^{-1} (B: C ratio of 2.68:1), Rs. 283852.80 ha^{-1} (B: C ratio of 2.44:1), Rs.222745.00 ha^{-1} (B: C ratio of 2.18:1), Rs.209664.00 ha^{-1} (B: C ratio of 2.17:1) and Rs. 175795.00 ha^{-1} (B: C ratio of 2.20:1) respectively.

These findings are in collaboration with the findings of other workers (Chakraborti, 2001; Bhargava *et al*., 2003 and Mishra *et al*., 2004; Rahman and Razzab Ali, 2009; Rath and Maity, 2005; Shanmugham, *et al*., 2015) [2, 1, 6, 10, 11] who conducted experiments with different IPM modules.

It was concluded that brinjal shoot and fruit borer can be managed by selecting moderately resistant genotype along with timely application of cultural, mechanical, biological and chemical measures.

Table 1: Particulars of various IPM modules formulated against brinjal shoot and fruit borer, *L. orbonalis*

Module	Particulars of the module
M1	Moderately resistant genotype IC 136061 (selected from screening experiment)
M2	Susceptible line (Untreated check)
M3	Susceptible line + Border crop (Sorghum) + Intercrop (Brinjal-Coriander 2:1) + Clipping and destruction of infested shoots from 15 DAT
M4	Susceptible line + Border crop (Sorghum) + Intercrop (Brinjal-Coriander 2:1) + Clipping and destruction of infested shoots from 15 DAT + Azadirachtin 1% EC (10000 ppm) @ 3.0 ml/l (3sprays-35, 65, 95 DAT) +*Bacillus thuringiensis* var *kurustaki* 5% WP @ 2g/l (3 sprays- 50, 80,110 DAT) (1x10^{10}cfu/gm)
M5	Susceptible line + Border crop (sorghum) + Intercrop (Brinjal-Coriander 2:1) + Clipping and destruction of infested shoots from 15 DAT + Azadirachtin 1% EC (10000 ppm) @3 ml/l (2sprays-35, 80DAT + *Beauveria bassiana* 1 kg/ac (2 sprays- 50, 95 DAT) (1x10^{9} cfu/gm) + Cartaphydrochloride 50%SP @1.5g/l (2sprays-65, 110 DAT)
M6	Susceptible line + Border crop (Sorghum) + Intercrop (Brinjal-Coriander 2:1) + Clipping and destruction of infested shoots from 15 DAT + Azadirachtin 1% EC (10000 ppm) 3 ml/l (3 sprays- 35, 65, 125 DAT) + Spinosad 45% SC @ 0.36 ml/l (2 sprays- 50, 95 DAT) + Cartaphydrochloride 50% SP @1.5 g/l (2 sprays - 80,110 DAT)
M7	Module- VII-(Farmer practice) Susceptible variety + Thiodicarb 75% WP @1.5 g/l(35 DAT- 1st spray) + Lambdacyhalothrin 5% EC @ 0.5 ml/l (50 DAT-2nd spray) + Profenophos 50% EC @ 2ml/l (65 DAT 3rd spray) + Chlorantraniliprole 18.5% SC @ 0.4ml/l (80 DAT- 4th spray)+Cypermethrin 10% EC @ 2ml/ (90 DAT-5thspray) + Flubendamide 48% SC 0.3ml/l (110 DAT-6th spray).

Table 2: Evaluation of different IPM modules against brinjal shoot and fruit borer, *L.orbonalis* during rabi 2017-18

Module	Mean per cent shoot infestation at 15 days interval										Overall Mean
	15 DAP	30 DAP	45 DAP	60 DAP	75 DAP	90 DAP	105 DAP	120 DAP	135 DAP	150 DAP	
M1	30.00* (33.18) a	28.85 (32.48) a	20.42 (26.82) b	14.59 (22.43)a	9.97 (18.39)a	7.37 (15.73)a	5.96 (14.11)a	5.68 (13.77) a	4.61 (12.36) a	2.39 (8.84) ab	12.98 (21.12) a
M2	52.22 (46.27) b	47.04 (43.3) c	49.05 (44.45) e	37.95 (38.01) d	29.15 (32.66)d	23.85 (29.23)e	23.47 (28.96) d	18.94 (25.79) d	11.81 (20.09) bc	11.42 (19.63) d	30.42 (33.47)g
M3	51.55 (45.89) b	46.32 (42.88) c	39.21 (38.76) d	32.27 (34.57) c	25.59 (30.38)c	22.88 (28.56)de	21.74 (27.78)d	13.78 (21.79) c	11.51 (19.83) bc	7.17 (15.51)c	27.27 (31.48)f
M4	50.01 (45.00) b	40.06 (39.26) b	36.43 (37.08)d	29.96 (33.16)c	24.96 (29.95)c	20.09 (26.63)cd	16.11 (23.66)c	11.64 (19.95) c	8.84 (17.29)ab	5.37 (13.36)bc	24.34 (29.56)e
M5	50.01 (45.01) b	38.42 (38.28) b	32.85 (34.94) cd	28.75 (32.33)c	22.05 (27.99)bc	19.76 (26.37)c	11.75 (20.00) b	7.31 (15.67) ab	4.92 (12.81) a	3.60 (10.93)ab	21.94 (27.93)d
M6	4 8.87 (44.35) b	36.73 (37.29)b	31.31 (33.98) cd	22.34 (28.12)b	19.28 (25.83)b	10.87 (19.24) b	7.56 (15.96)a	5.22 (13.2) a	3.51 (10.73) a	2.27 (8.66)ab	18.79 (25.69)c
M7	51.35 (45.77) b	47.30 (43.45) c	14.09 (21.92) a	11.68 (19.98)a	8.19 (16.59)a	5.26 (13.02)a	4.83 (12.43) a	3.13 (10.1) a	3.55 (10.73) a	2.38 (6.65)ab	15.14 (22.88)b
SEM±	1.45	1.59	1.90	0.95	0.99	0.92	1.16	1.06	1.28	0.76	0.40
CD (P=0.05)	4.47	4.91	5.86	2.94	3.07	2.85	3.57	3.27	3.96	2.35	1.23
CV (%)	5.74	6.95	9.43	5.34	6.63	7.13	10.02	10.60	15.36	11.11	2.52

Mean of 5 plants Values in the parentheses are arc sin transformed
Means followed by same alphabet do not differ significantly by DMRT at 5%

Table 3: Evaluation of different IPM modules against brinjal shoot and fruit borer, *L.orbonalis* during rabi 2017-18

Module	Mean per cent fruit infestation(number basis) at 15 days interval								Overall Mean
	45 DAP	60 DAP	75 DAP	90 DAP	105 DAP	120 DAP	135 DAP	150 DAP	
M1	18.00 (25.08)a	17.23 (24.34) a	15.32 (22.87) a	14.70 (22.54) a	12.97 (21.08) a	16.50 (23.88) a	13.24 (21.31) a	12.66 (20.72) a	15.08 (22.83) a
M2	54.44 (47.57) bc	51.11 (45.64) c	52.77 (46.59)e	50.00 (45.00) d	56.66 (48.83) e	54.44 (47.57) f	44.44 (41.8) d	48.88 (44.35) c	51.18 (45.67) g
M3	51.11 (45.63) b	47.77 (43.72) c	44.44 (41.80) cd	50.00 (45.00) d	42.22 (40.50) d	46.66 (43.08) e	46.66 (43.08) d	43.33 (41.15) c	46.52 (43.00) f
M4	52.22 (46.27) bc	45.55 (42.44) c	40.00 (39.22) c	36.66 (37.24) bc	43.89 (41.47) d	40.00 (39.22) d	34.44 (35.86) c	30.00 (33.18) b	40.34 (39.43) e
M5	51.11 (45.64) b	38.88 (38.55) b	37.22 (37.58) c	37.22 (37.54) c	37.22 (37.54) c	31.11 (33.85) c	28.88 (32.45) b	32.22 (34.54) b	36.73 (37.3) d
M6	49.99 (44.99) b	38.88 (38.55) b	23.89 (29.07) b	32.11 (34.51) b	30.55 (33.53) b	23.89 (29.07) b	26.66 (30.97) b	20.00 (26.42) a	30.75 (33.66) c
M7	47.78 (43.72) b	18.33 (25.24) a	15.00 (22.72) a	16.22 (23.48) a	14.44 (22.28) a	13.55 (21.59) a	14.44 (22.30) a	13.33 (21.31) a	19.14 (25.92 b
SEM ±	1.086	1.747	1.687	1.458	1.593	1.657	1.335	1.967	0.683
CD (P=0.05)	3.347	5.384	5.199	4.493	4.908	5.107	4.115	6.062	2.105
CV (%)	4.586	8.336	8.628	7.327	7.947	8.432	7.198	10.807	3.391

Mean of 5 plants Values in the parentheses are arc sin transformed
Means followed by same alphabet do not differ significantly by DMRT at 5%

Table 4: Evaluation of different IPM modules against brinjal shoot and fruit borer, *L.orbonalis* during kharif 2018-19

Module	Mean per cent fruit infestation(weight basis) at 15 days interval								Overall Mean
	45 DAP	60 DAP	75 DAP	90 DAP	105 DAP	120 DAP	135 DAP	150 DAP	
M1	15.67 (23.31) a	13.26 (21.35) a	11.87 (20.12) a	12.56 (20.64) a	15.45 (23.12) b	15.41 (23.04) a	17.17 (24.47) b	12.74 (20.84) a	14.27 (22.18) a
M2	60.19 (51.00) c	51.02 (45.61) f	54.49 (47.59) d	49.01 (44.43) e	44.35 (41.75) d	49.12 (44.48) e	42.68 (40.78) f	42.60 (40.74) e	49.18 (44.53) g
M3	50.11 (45.06) b	46.06 (42.72) e	41.20 (39.92) c	41.71 (40.22) d	49.08 (44.47) e	42.26 (40.54) d	44.55 (41.85) f	40.38 (39.41) e	44.42 (41.79) f
M4	51.24 (45.71) b	41.33 (39.98) cd	41.05 (39.82) c	37.27 (35.36) c	38.81 (38.52) c	30.67 (33.59) c	31.43 (31.58) e	31.49 (34.06) d	37.91 (37.46) e
M5	51.32 (45.76) b	36.70 (37.23) c	42.70 (40.79) c	34.48 (34.94) c	30.63 (33.57) b	25.80 (30.43) b	27.61 (32.66) d	24.80 (29.79) c	34.25 (35.81) d
M6	48.11 (43.91) b	34.56 (35.99) c	34.65 (36.03) b	28.05 (31.91) b	31.80 (34.3) b	26.43 (30.89) b	24.76 (29.8) c	20.57 (26.86) b	31.11 (33.89) c
M7	49.18 (44.53) b	24.91 (29.81) b	13.93 (21.88) a	14.57 (22.28) a	14.67 (22.43) a	12.28 (20.51) a	11.24 (19.56) a	13.99 (21.76) a	19.34 (26.09) b
SEM ±	1.21	1.46	1.12	1.23	0.60	1.05	0.83	1.31	0.34
CD (P=0.05)	3.72	4.49	3.44	3.78	1.86	3.25	2.56	4.02	1.03
CV (%)	5.06	7.18	5.64	6.45	3.11	5.60	4.57	7.39	1.70

Mean of 5 plants Values in the parentheses are arc sin transformed
Means followed by same alphabet do not differ significantly by DMRT at 5%

Table 5: Evaluation of different IPM modules against brinjal shoot and fruit borer, *L. orbonalis* during rabi 2017-18

Module	Fruit yield (kg plot^{-1}) at 15 days interval								Total Yield (kg plot^{-1})	Yield (kg ha^{-1})
	45 DAP	60 DAP	75 DAP	90 DAP	105 DAP	120 DAP	135 DAP	150 DAP		
M1	25.98 b	38.18 c	46.59 d	47.19 d	45.99 b	46.59 e	38.08 c	26.88 cd	314.50 e	31449.60 e
M2	17.47 a	16.13 a	21.50 a	21.50 a	18.82 a	17.47 a	18.82 a	14.78 a	146.50 a	14649.60 a
M3	17.47 a	22.85 a	22.85 a	28.22 b	22.85 a	22.85 b	20.16 a	17.47 a	174.72 b	17472.00 b
M4	20.16 a	25.31 b	25.54 ab	25.54 ab	24.19 a	22.10 ab	22.62 a	20.16 ab	185.62 b	18562.13 b
M5	20.16 a	29.57 b	32.26 bc	38.98 c	38.98 b	30.91 c	24.19 a	21.50 ab	236.54 c	23654.40 c
M6	21.50 a	28.22 b	38.98 cd	41.66 cd	38.98 b	36.29 d	28.22 ab	26.88 cd	260.74 d	26073.60 d
M7	21.50 a	34.94bc	45.70 d	55.93 e	56.45 c	47.94 e	33.60 b	28.22 d	324.28 e	32427.73e
SEM ±	2.11	2.37	2.86	2.08	2.76	1.52	2.87	1.68	3.92	391.97
CD (P=0.05)	6.52	7.31	8.82	6.40	8.49	4.68	8.84	5.19	12.08	1207.78
CV (%)	16.40	14.32	14.86	9.72	13.57	8.22	18.72	13.10	2.86	2.86

Means followed by same alphabet do not differ significantly by DMRT at 5%

Table 6: Comparative performance of IPM modules with control during 2017-18-rabi season

Module	Mean percent shoot infestation	Mean percent fruit infestation	Total yield (kg ha^{-1})	Percent reduction in shoot infestation over control	Per cent reduction in fruit infestation over control	Per cent increase in yield over control	Increase in yield over control (kg ha^{-1})
M1	12.56	15.08	31449.60	61.10	70.53	53.42	7825.64
M2	32.28	51.18	14649.60	0.00	0.00	0.00	0.00
M3	29.03	46.53	17472.00	10.08	9.09	16.15	2366.47
M4	25.68	40.35	18562.13	20.46	21.17	21.08	3087.85
M5	23.04	36.74	23654.40	28.64	28.22	38.07	5576.84
M6	20.18	30.75	26073.60	37.48	39.92	43.81	6418.64
M7	15.15	19.14	32427.73	53.09	62.60	54.82	8031.48

Table 7: Yield and cost economics of different IPM modules in during 2017-18-rabi season

Module	Yield (kg ha^{-1})	Gross returns (Rs ha^{-1})	Total cost (Cost of inputs and farm operations)	Added returns over control (Rs ha^{-1})	Added cost over control (Rs ha^{-1})	Net profit (Rs ha^{-1})	B:C ratio
1	2	3	4	5	6	7	8
M1*	31449.60	377395.20	93137.00	201600.00	13125.00	188475.00	4.05:1
M2	14649.60	175795.20	80012.00	0.00	0.00	0.00	2.20:!
M3	17472.00	209664.00	96512.00	33868.80	16500.00	17368.80	2.17:1
M4	18562.13	222745.60	102362.00	46950.40	22350.00	24600.40	2.18:1
M5	23654.40	283852.80	116363.00	108057.60	36351.00	71706.60	2.44:1
M6	26073.60	312883.20	116763.00	137088.00	36751.00	100337.00	2.68:1
M7	32427.73	389132.80	121750.00	213337.60	41738.00	171599.60	3.20:1
SEM±	391.97						
C.D (P =0.05)	1207.78						
C.V (%)	2.86						

*Price of Brinjal: Rs.12/kg (M1-M7)

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