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Efficacy of pest management practices against pest complex of okra (*Abelmoschus esculentus*) in Andaman

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The agro-climatic conditions of Andaman and Nicobar islands are extremely suitable for the cultivation of variety of crops. Andaman and Nicobar Islands are group of islands located between 92-94^{o} E longitude and 6-14^{o} N latitude in the Bay of Bengal. In these islands, tropical and humid climate offers congenial environment for spread and multiplication of diseases and pest of varied origin. Intensive agronomic practices and indiscriminate use of insecticides has disrupted the delicate balance between the insect pests and their natural enemies. Okra (*Abelmoschus esculentus* Moench) or bhindi or lady finger has special status in Island in providing nutrition among the varied vegetables and this is the only vegetable which can be grown throughout the year. The yield and quality of okra is hampered severely due to outbreak of various insect pests. IPM is thus important with a view to reduce undesired use of pesticides. Different workers have tested wide range of pesticides across the country to control these pests. Nemade *et al*. (2007) who reported that seed treatment with imidacloprid could effectively check the pest complex in okra. Shinde *et al.* (2007) reported that spinosad resulted in minimum fruit infestation in bhindi. Not much work has been done in the islands on this particular aspect. Therefore, there is a need to develop an effective pest management strategy for okra. Keeping this in view of alarming pest problem, the present study was conducted to evaluate different pest management practices against sucking pest complex and okra shoot and fruit borer in field conditions in Andaman Islands.

Field trials were carried out at the research farm of Central Agricultural Research Institute, Port Blair during rainy (*kharif*) seasons of 2008–09 and 2009–10 with okra. The okra variety Arka Anamika was sown by maintaining spacing of 45cm × 30cm between rows and plants respectively, during 2009 and 2010. The trial was laid in 25 m^2 plots in randomized block design with four treatments (modules) including control replicated four times. Maize seeds were also sown around the bio-intensive module (M_1) and integrated module (M_2) plots only. All the agronomic practices were followed for raising the crop in this location. Bio-intensive module (M_1) included neem cake application @ 250 kg/ha at the time of sowing, sowing of maize at the borders as barrier crop, weekly clipping of infested shoots and fruits, erection of pheromone trap @ 100 traps/ha for mass trapping, foliar spray of neem seed kernel extract @ 30ml/litre, aqueous leaf extracts of cloves (*Syzygium aromaticum*) @ 50 g/litre, karanj oil @ 30 ml/litre at 45, 60 and 75 days after sowing respectively. Integrated module (M_2) included seed treatment with imidacloprid @ 5 g/kg seed, sowing of maize at the borders as barrier crop, weekly clipping of infested shoots and fruits, erection of pheromone trap @ 100traps/ha for mass trapping, foliar spray of neem seed kernel extract @ 30 ml/litre, spinosad 45 SC @0.5ml/lt and karanj oil @ 30 ml/litre at 45 at 45, 60 and 75 days after sowing respectively. Farmer's practice module (M_3) included foliar spray of endosulfan @ 2 ml/litre, cypermethrin @ 1.5 ml/litre and deltamethrin @ 1.5 ml/litre at 45, 60 and 75 days after sowing respectively and untreated control (M_4).

Weekly observations of sucking pests, viz jassid nymphs and adult whitefly were recorded from lower surface of top two leaves below the crown from 10 randomly selected plants in each plot during early morning hours (6–8 AM). A total of twenty leaves per plot were thoroughly screened for recording these data. Regular observations on fruit borer population were recorded and spraying of different insecticides was done at 15 days interval. The spraying was done during evening hours with high volume knapsack sprayer (spray fluid 400-500 litres/ha appr. depending upon the crop growth/stage). As such, a total of three rounds of spraying of different insecticidal treatments were given. The infestation of shoot and fruit borer was recorded on five randomly

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selected tagged plants/plot. The damage was estimated by counting the healthy as well as infested shoots one day before and five days after each spraying. The extent of shoot damage and mortality of larvae were calculated. The number and weight of healthy and damaged fruits were recorded separately for each treatment at every picking. The percentage of damaged fruits was calculated in terms of number and weight. The cumulative yield of all the pickings was computed and expressed in kg/plot and finally tonnes/ha was calculated. The data were subjected to statistical analysis following standard methods using Indostat Statistical Software®.

The results revealed that different types of management practices have significantly reduced jassid and whitefly population than untreated control in okra (M_4). The data presented in Table 1 revealed that there was significant lower jassid population in all the modules as compared to control in periodical observations. The pooled data revealed that integrated module (M_2) and bio-intensive module (M_1) recorded significantly lower jassid population (3.32 jassids/leaf, 4.27 jassids/leaf) than farmer's practices (M_3) (5.31 jassids/leaf) and untreated control (10.12 jassids/leaf). The data on pooled over periods revealed that integrated module (M_2) recorded significantly lower whitefly population (5.79 whitefly/leaf) and bio-intensive module (M_1) (6.17 whitefly/leaf) as compared to and farmer's practices (M_3) (7.11 whitefly/leaf) and control (10.72 whitefly/leaf). Adilakshmi *et al*. (2008) reported that neem based insecticides were more effective in suppressing the sucking pests and fruit borer population and registered significantly low incidence than untreated check. The effectiveness of neem seed kernel extract against jassid (*Amrasca devastans* Dist.) (Singh and Kumar, 2003) and whitefly (*Bemisia tabaci* Genn) (Pun *et al*. 2005) infesting okra reported by various workers in past support the present findings. Our results are also in close agreement with Nemade *et al*. (2007) who reported that seed treatment with imidacloprid could effectively check the pest complex in okra.

It is revealed from data in Table 2 that the fruit damage by borer was significantly lower in all the modules as compared to control at each picking as well as in pooled analysis. There was significant increase in the total yield of okra fruits due to protection of crop with different management modules. The data pooled over picking indicated that integrated module (M_2) recorded significant lower fruit damage than other modules. The maximum fruit yield (8.66 tonnes/ha) was realized in integrated module (M_2), followed by bio-intensive module M_1 (7.03 tonnes/ha). In integrated module, less incidence of shoot borer (4.23%) and fruit borer (5.64%) was recorded as compared to untreated control (13.42%, 16.85%). The yield in untreated control plots was recorded 5.25 tonnes/ha. The per cent increase in yield over control was 65.08 and 33.96 in M_2 and M_1 modules, respectively. Our results are also in agreement with Shinde *et al.* (2007) who reported that spinosad 75 SC @75g ai/ha resulted in minimum fruit infestation in okra. Spinosad is toxic by ingestion and contact and has a unique mode of action on the insect nervous system. Our results are also in close agreement with Shinde *et al*. (2011) who reported that spinosad 0.005% was the most effective insecticide in controlling okra shoot and fruit borer.

Based on the results it can be concluded that seed treatment with imidacloprid and spraying with safer pesticides like spinosad and botanical insecticides (neem and karanj) would not only reduce the incidence of sucking pests and shoot and fruit borer in okra but also improves the quality of marketable fruits. By incorporating these management practices, application of synthetic insecticides can be reduced to a minimum possible level. Such an approach poses a lower risk to people, wildlife and the environment while simultaneously protecting economic interests among farmers.

Table 1 Efficacy of pest management practices against sucking pest population in okra (pooled data of 2008–09 and 2009–10)

Modules	25DAS		35DAS		45DAS		55DAS		65DAS		75DAS		Pooled over Period		Fruit yield (tonnes/ha)	% increase in yield over control
	Average number of jassid nymph and adult whitefly per leaf															
	J	W	J	W	J	W	J	W	J	W	J	W	J	W		
M_1 : Bio-intensive	1.02	3.33	4.33	4.35	5.52	4.33	6.91	7.93	2.85	11.70	4.98	5.37	4.27	6.17	7.03	33.96
M_2: Integrated	1.51	2.35	3.19	4.25	4.10	2.55	3.30	7.04	3.33	11.31	4.50	7.22	3.32	5.79	8.66	65.08
M_3 :Farmer's practice	2.31	3.75	4.31	4.57	7.55	4.77	5.65	8.38	6.16	13.00	5.85	8.20	5.31	7.11	6.57	25.20
M_4: Control	2.50	4.88	7.79	9.77	8.65	7.77	13.33	13.50	13.92	14.63	14.54	13.77	10.12	10.72	5.25	
SEd	0.06	0.03	0.08	0.05	0.38	0.06	0.06	0.14	0.01	0.32	0.12	0.05	0.05	0.05	0.71	
CD (P=0.05)	0.15	0.08	0.20	0.13	0.85	0.15	0.14	0.31	0.03	0.74	0.27	0.12	0.13	0.12	1.61	
CV(%)	5.13	1.48	2.59	1.43	8.33	1.96	1.27	2.15	0.37	3.68	2.28	0.89	1.42	1.05	1.47	

DAS, Days after sowing; J, jassid; W, whitefly

Table 2 Efficacy of pest management practices against shoot and fruit borer and yield of okra (pooled data of 2008–09 and 2009–10)

Module	Picking-wise fruit damage (%)											%
	1st	2nd	3rd	4th	5th	6th	7th	8th	Mean	% shoot borer incidence	Fruit (tonnes /ha)	increase in yield over control
M_1 : Bio-intensive	1.13 (6.02)	9.20 (17.66)	9.33 (17.76)	9.25 (17.66)	9.93 (18.34)	4.53 (12.25)	6.33 (14.54)	5.25 (13.18)	6.87 (15.12)	5.65 (13.69)	7.03	33.96
M_2:Integrated	2.1 (8.33)	5.65 (13.69)	6.57 (14.77)	4.95 (12.79)	2.33 (8.72)	10.11 (18.53)	9.25 (17.66)	4.13 (11.68)	5.64 (13.69)	4.23 (11.83)	8.66	65.08
M_3 :Farmer's practice	2.33 (8.72)	6.95 (15.23)	11.85 (20.09)	5.93 (14.06)	10.73 (19.09)	11.14 (19.46)	3.99 (11.39)	5.53 (13.56)	7.31 (15.68)	6.45 (14.65)	6.57	25.2
M_4: Control	10.93 (19.28)	14.54 (22.38)	13.25 (21.3)	16.25 (23.73)	21.33 (27.49)	21.59 (27.63)	17.59 (24.73)	19.32 (26.06)	16.85 (24.2)	13.42 (21.47)	5.25	
SEd	0.42	0.09	0.33	0.79	0.95	1.29	0.15	0.11	0.06	0.41	0.71	
CD (*P*=0.05)	0.96	0.2	0.75	1.8	2.15	2.92	0.34	0.25	0.14	0.94	1.61	
CV (%)	5.62	0.75	2.54	6.61	7.3	9.62	1.24	1	0.52	7.98	1.47	

Figures in parentheses are arcsin transformed values

SUMMARY

Field trials were conducted during 2008–09 and 2009–10 with okra (*Abelmoschus esculentus*—variety Arka Anamika) to evaluate the pest management modules against sucking pest complex, jassid (*Amrasca devastans* Dist.) and whitefly (*Bemisia tabaci* Genn) and okra shoot and fruit borer, *Earias vittella* (Fab.). The fruit damage by shoot and fruit borer was significantly lower in all the modules as compared to control at each picking as well as in pooled analysis. Integrated module included seed treatment with imidacloprid @ 5 g/kg seed a day before sowing + sowing of maize at the borders as barrier crop + weekly clipping of infested shoots and fruits + erection of pheromone trap @ 100 traps/ha for mass trapping + foliar spray of neem seed kernel extract @ 30 ml/litre, spinosad 45 SC @ 0.5ml/litre and karanj oil @ 30 ml/litre at 45, 60 and 75 days after sowing, respectively. The pooled data revealed that integrated module and bio-intensive module recorded significantly lower jassid population (3.32 jassids/leaf, 4.27 jassids/leaf) than farmer's practices (5.31 jassids/leaf) and untreated control (10.12 jassids/leaf). Less incidence of shoot borer (4.23%) and fruit borer (5.64%) and more fruit yield (8.66 tonnes/ha) was recorded in integrated module as compared to untreated control, 13.42%, 16.85% and fruit yield of 5.25 tonnes/ha respectively. The results revealed that different types of management practices have significantly reduced jassid, whitefly population and shoot and fruit borer damage than untreated control in okra. By incorporating these management practices, application of synthetic insecticides can be reduced to a minimum possible level.

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