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Rudra N Borkakati
AICRP on Biological Control, Department of Entomology, Assam Agricultural University, Jorhat, India

DK Saikia
AICRP on Biological Control, Department of Entomology, Assam Agricultural University, Jorhat, India

Corresponding Author:
Rudra N Borkakati
AICRP on Biological Control, Department of Entomology, Assam Agricultural University, Jorhat, India

Evaluation of IPM for the management of insect pests of Okra

Rudra N Borkakati and DK Saikia

Abstract
Experiment for evaluation of IPM package of okra was carried out in 2015-16 and 2016-17 at Allengmora, Jorhat. The results revealed that the population development of sucking pests {*Amrasca biguttula biguttula* (Ishida) and *Bemisia tabaci* (Gennadius)} of IPM package and farmer's practice (Chemical control) were statistically at par. The number of *A. biguttula biguttula* and *B. tabaci* population/plant were 0.98 and 0.76 in IPM package whereas they were 1.03 and 0.74 was recorded in farmers' practice respectively, after third spray. Pertinent to fruit damage, the minimum fruit damage of 8.17% was obtained in chemical control plots as against 9.06% in IPM plot, although they were on par with each other. Regarding yield, maximum yield (102.2q/ha) was registered in IPM package followed by farmer's practice with 98.57 q/ha and they were statistically significant with each other. Similarly, the highest Cost: Benefit ratio (1: 8.46) was observed in case of IPM plot followed by farmers' practice (1: 7.98).

Keywords: Evaluation of IPM, pests of Okra, *Amrasca biguttula biguttula* (Ishida), *Bemisia tabaci* (Gennadius), per cent fruit damage, farmers practice

Introduction
Okra (*Abelmoschus esculentus* L.) belongs to the family Malvaceae, commonly known as Lady's finger is one the predominant vegetables cultivated in throughout India. Okra constitutes various vitamin like A, B, C and is it also rich source of protein, carbohydrates, fats, iron and iodine etc, which are important components of human diet [1]. Okra seeds are a potential source of oil, with concentrations varying from 20% to 40%, which consists of linoleic acid up to 47.4%. Okra seed oil is also a rich source of linoleic acid, a polyunsaturated fatty acid essential for human nutrition [2]. As a nutritious vegetable, okra is a superb food to address doubling farmer's income as well as the problem of malnutrition. Like other crops, Okra is also attacked by a number of biotic and abiotic factors, including insect pests and diseases [3]. However, insect pests and diseases are major constraints to the reduction of fruit yield of okra. It is ravaged by numerous insect pests, amongst all okra shoot and fruit borer, *Earias vittella* Fab. is the major threats to okra production, causes a yield reduction up to 50 – 70%[4]. In addition to this, different insects viz., aphid, jassids, whitefly, thrip, spotted bollworms, whitefly are the most important pest of okra crop right from sowing till harvesting. These pests attacks the crop either directly by sucking the sap or indirectly by transmitting a large number of viral diseases as vector [5, 6, 7, 8]. However, jassid is a very destructive sucking insect pest of many crops in the majority areas of the growing countries of the world and has been found damaging many crops in the world. Due to sap sucking by adult and nymph of jassids, the colour turns grayish and leaves may fall down due to the injection of toxic saliva into the plant tissues of okra crops [9]. Unfortunately, farmers are depends on the use of synthetic chemical pesticides, thereby endangering the human health as well as pollutes environment [10]. The neem products with half the dose of conventional insecticide has resulted in more efficient control than insecticide alone [11]. Therefore, to overcome this problem of insect pests and diseases adoption of IPM module is the need of the hour. A number of IPM trials have been implemented in different parts of the globe, showed that integration of different control tectics along with the right dose of pesticides after pest attaining the ETL reduces their problem to a great extent [12]. However, Begam *et al.*, [13] reporte that conservation of natural enemies are very much important, which is achieved only chemical free agriculture. From an another experiment conducted by Borkakati *et al.*, [14], found that the a number of natural enemies were present in any kind of agri-horti ecosystem.

Fortunately, integration of biopesticides with pest management technology is also gaining momentum in last few years [15, 16]. Future transgenic of vegetables may also be an important part of IPM [17].

Materials and Methods

Field experiment on evaluation of IPM package of okra was compared with farmers' practice (chemical control) and untreated check covering an area of 210 m^2, 210 m^2 and 30 m^2, respectively at Allengmora, Jorhat with a variety *Arka Anamika*. The IPM package comprised with the installation of yellow sticky traps (YST) @ 1 / 30 m^2 was done at 15 days after sowing of okra against *B. tabaci* and *A. biguttula biguttula*; three releases of *Trichogramma chilonis* @ 50,000/ha/week against fruit borer at bud initiation stage; installation of light trap @ 1/ 500 sq.m was done at 15 days after sowing of okra against adult lepidopteran pests; removal & destruction of infested fruits/shoots, roughing of YMV infested plants and need based application of insecticides *ie.* two sprays of malathion 50 EC @ 2ml/ lit of water. The entire plot was sub divided in to seven sub plots to serve as 7 replicates in case of IPM package and farmers' practice. Observations were made on pre and post count for shoots and fruit damage before or after each spray at 3 and 7 day intervals. In case of *A. biguttula biguttula* and *B. tabaci*, observation was recorded from upper, middle and lower leaf / plant from randomly selected 10 plants from each replication. Yield of fruits at each harvest was recorded. In farmer's practice, six sprays of Deltamethrin (Decis 2.8 EC) @ .0.5 ml/lit was sprayed against *Earias vittella*, *A. biguttula biguttula* and *B. tabaci.*

Results and Discussion

The result of the experiment (Table 1) revealed that no significant differences was observed in IPM package and farmer's practice (Chemical control) in respect of the population development of sucking pests (*A. biguttula biguttula* and *B. tabaci*). The number of *A. biguttula biguttula* and *B. tabaci* population/plant were 0.98 and 0.76 in IPM package whereas they were 1.03 and 0.74 was recorded in farmers' practice respectively, after third spray. But in case of per cent fruit damage, the minimum fruit damage of 8.17 was obtained in chemical control plots as against 9.06 in IPM plot, although they were on par with each other. In case of untreated check fruit damage of 14.10 per cent was significantly different from IPM package and farmers' practice.

Maximum yield (102.2q/ha) was registered in IPM package followed by farmer's practice with 98.57 q/ha, although they were statistically significant with each other. Similarly, the highest Cost: Benefit ratio (1: 8.46) was observed in IPM plot followed by farmers' practice (1: 7.98) and untreated check (1: 4.42) (Table 2).

These results are in confirmation with the findings of Kumar *et al.* [18] and Ashfaque *et al.* [19] who reported less incidence of jassids in IPM grown okra plots than in farmers practice and untreated control plots of okra. Mohankumar [20], reported that the IPM approach registered significantly lower populations of different insect pests coupled with yield increase in the IPM plots was 12.43–45.54 % above the farmers practice. The benefit: cost ratio was 2.53–3.23:1 in the IPM plots as compared to 1.23–1.52:1 in the farmer's practices plots. Similarly, Zakir *et al.* [21] reported that IPM treatments influenced maximum mean population reduction of complex sucking pests on Okra crop. Similarly, an experiment codcte by Saikia and Borkakati [22], also observed that bio intensive IPM plot registered highest yield than chemical control plot in case of tomato. Ashis *et al.*, (2020)[23], reported that the management module comprised with azadirachtin 300 ppm, dimethoate 30 EC, thiamethoxam 25 WG, and quinolphos 25 EC was very effective to control insect pests of Okra. From another experiment conducted by Kanimozhi *et al.*, (2020) [24] revealed that the highest reduction of leafhopper population was recorded in dinotefuran 20 SG @ 0.30g/l (91.34 and 90.57%) followed by buprofezin 25 SC @ 2ml/l (88.36 and 87.02%).

Table 1: Effect of IPM module on incidence of insect pests of okra (pooled data 2015-2017)

Treatments	Pre count sucking pests/leaf		Post count sucking pests/leaf*						% Fruit damage	Fruit yield (q/ha)
			After 1st spray		After 2nd spray		After 3rd spray			
	A. biguttula biguttula	*B. tabaci*	*A. biguttula biguttula*	*B. tabaci*	*A. biguttula biguttula*	*B. tabaci*	*A. biguttula biguttula*	*B. tabaci*		
IPM	4.19	3.09	2.8 a	2.81 a	1.28 a	1.47 a	0.98 a	0.76 a	9.06 a (17.46)	102.2 a
Farmers' practice	4.47	3.0	2.71 a	2.61 a	1.52 a	1.18 a	1.03 a	0.74 a	8.17 a (16.57)	98.57b
Untreated check	4.14	3.14	3.85 b	3.57 b	3.42 b	3.52 b	3.57 b	2.76 b	14.10 b (22.00)	69.14c
S Ed ±	0.24	0.14	0.15	0.23	0.23	0.19	0.17	0.08	0.84	1.43
CD at 5%	NS	NS	0.34	0.50	0.51	0.42	0.37	0.18	1.83	3.12
CV%	14.96	12.48	13.51	20.45	29.85	23.23	24.56	15.74	8.40	4.21

*Values in parenthesis are angular transform

Means in the same column by common letter are not significantly different

Table 2: Cost benefit ratio (pooled data 2015-2017)

Treatments	Observed Yield (Kg/ha)	Yield gain over control (Kg/ha)	Gross Profit (Rs/ha)	Cost of production (Rs/ha)	Net profit (Rs/ha)	Cost benefit ratio
IPM Package	10220	3310	102200.00	10803.38	91396.62	1: 8.46
Farmers' practice	9850	2940	98500.00	10968.82	87531.18	1: 7.98
Control	6910	-	69100.00	12749.08	56350.92	1: 4.42

Cost of produce/kg = Rs 10.00

Fig 1: A view of Okra field

Conclusion

The study showed that maximum yield (q/ha) and highest benefit (Rs./ha) achieved in IPM plots as compared to famers practice as well as untreated check. It can be concluded that IPM package proved as effective as chemical control on large scale for the management of insect pest of okra. Therefore, use of the IPM module may be an appropriate tool of wise application of synthetic chemical insecticides. Moreover, IPM may be recommended as a good substitute for the solely chemical dependent agriculture.

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