Research Article

Impact of IPM Module for Major Pests Complex of Soybean

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Abstract

Field experiments were carried out to assess the performance of IPM module against major insect- pests of soybean as comparison to the recommended insecticidal control schedule (Non-IPM module) and their natural enemies at farmer's field in adopted village of RVSKVV, Krishi Vigyan Kendra, Dewas (M.P.) during kharif season of the year 2011,2012 and 2013.The result based on pooled data revealed that the location specific IPM module comprising various components *viz.* optimum seed rate, Seed treatment carbendazim 50% WDP@ 2.5 grams /kg of seed, soil application of carbofuran 3G @ 1.0 kg *a.i* /ha, Installation of pheromone trap @ 5nos./ha, for tobacco caterpillar, Erection of bird perches @ 25/ha, installation of fabricated cheaper light trap and foliar spraying of triazophos 40% EC @ 800ml/ha at 45-50 DAS or crossing ETL afford excellent reduction of major insect-pests of soybean *i.e.*, whiteflies, leaf hopper, blue beetle, girdle beetle, stemfly, green semilooper, tobacco caterpillar, brown semilooper and pod borer as comparison to Non-IPM module. The appreciable high population of natural enemies *i.e.* lady bird beetle, predatory spiders, chrysoperla, predatory bug and dragonfly was recorded in IPM plots as compared to non IPM plots. The adoption of IPM modules resulted in minimized the number of chemical spray 1.28 from 2.93 in non IPM field. Highest grain yield (19.94 q/ha) was recorded in IPM plot followed by non IPM (14.81 q/ha). The Additional income due to IPM was obtained Rs. 17378/ha from IPM plot. The IPM module was ultimately the promising one with better net returns (Cost benefit ratio1:1.99) and effective conservation of natural enemies than non IPM (Cost benefit ratio1:1.61) fields, respectively during both the years.

Keywords: Soybean, IPM module, girdle beetle, pod borers, semiloppers, natural enemies

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Introduction

Soybean, Glycine *max (L.*) Merrill is subjected to attack by about 275 species of insects right from vegetative stage to harvesting in India. Out of that species, 20 insect pests have been observed on crop in area. Among the various insect defoliators, sap sucking insects are the major constraints for low yield in the soybean [1](Raju *et al.*,2013) them only few are of economic importance. At present, *Obereopsis brevis Swed.*, *Melanagromyza sojae Zehnt.*, *Cneorane* spp.,*Spodoptera litura* Fabr., *Bemisia tabaci*, *Chrysodeixis acuta* Fabr., *Diachrysia orichalcea* Walker, *Mocis undata* Fab., *Helicoverpa armigera* Hub. and *Tetranychus telarius* are predominant and of economic significant can cause severe damage and consequent reduction in yield [2]. Predators are major cause of pest mortality in soybean ecosystem. Researchers have recently attempted to auanting predation rate as an essential mortality component for population dynamics models [3] and to evaluate predator/ prey relationships [4]. Outbreak of any insect- pests can hamper the productivity and production in the region. Due to problems like pest outbreak, development of resistance to insecticides, elimination of natural enemies, risk to human and animal health besides environmental pollution, integrated pest management (IPM) is perceived as the only alternative [5]. Hence, it is very much necessary to adopt a holistic approach with IPM in order to avoid economic damage and to make soybean cultivation sustainable. The available tools for controlling insect pests involve a very wide range of techniques viz., cultural, mechanical, biological, chemical and regulatory methods of control and have been combined to form various IPM modules used in soybean. Plant protection in soybean during early as well as later stage of crop is very much essential to avoid the losses through protecting from insect pests. In view of this adoption of integrated strategies for ecofriendly management incorporating selective, safer, modern pesticides and biopesticides seem to be the best alternative. Hence, the present study on the validation of multifaceted adoptable IPM module on major pests of soybean at Dewas (Madhya Pradesh).

Materials and methods

The investigation were carried out in five locations at farmers's fields of adopted villages in sonkachha and Dewas block near RVSKVV Krishi Vigyan Kendra, Dewas in kharif 2011, 2012 and 2013 to evaluate IPM module against major pests of soybean (var. JS 95-60) in comparison to the recommended non-IPM module. The experiment was taken up in 2 acre block divided into two halves, one half receiving the IPM technology and other half with non-IPM. The recommended agronomical practices were followed. The location specific Sequential details of the IPM module and the recommended insecticidal control schedule (non IPM) are furnished below.

IPM Module

- Deep ploughing and exposure of soil to hot summer to kill pupating larvae
- Use of optimum seed rate @75Kg/ha
- Seed treatment with Carbendazim 50 WP @ 3.0 g/kg seed
- Soil application of Carbofuran 3G @ 1.0 kg *a.i* /ha
- Installation of pheromone trap @ 10/ha, for tobacco caterpillar
- Erection of bird perches @ 50/ha
- Installation of fabricated cheaper light trap
- Foliar spraying of Triazophos 40% EC @ 800ml/ha at 45-50 DAS were applied in soybean.

Farmers practice module

The plant protection measures adopted by local farmers were mostly dependent on Indiscriminate application of insecticides *i.e*. quinalphos, trizophos, profenophos, indaxocarb. These insecticides were sprayed at 10-15 days interval.

The numbers of insects were counted as replication wise in IPM and non IPM trials from each treatment. The observations on the population of the defoliators and stem borers *viz.,* blue beetle, green semi lopper, brown semi lopper, tobacco caterpillar, stemfly, girdle beetle and natural enemies *viz;* predatory spiders, coccinellids, c*hrysoperla* eggs, predatory bug and dragonfly of per meter row length were recorded at fifteen days interval. The immature stage as well as mature stage of sucking pests *viz.,* leaf hopper & whitefly were recorded on 10 randomly selected plants from each 3 leaves/plants. The sampling for pod assessment by pod borer, *Helicoverpa armigera* was done after harvesting and recorded as per cent pod damage. 100 pods were picked up randomly from IPM module and farmer's practices plots for pod damage grain damage assessment. Mechanical control comprised rouging of YVMV infested plants was done when present in fields. Per cent disease incidence was calculated by counting number of plants infected and total number of plants in a plot. For plot yield all the plant were harvested and the sample yield was added to this yield to get the plot yield and then converted in to yield on hectare basis. Net return in term of rupees and Incremental Benefit Cost Ratio (IBCR) were worked out for optimization of the dose by comparison of protective sprays and net monetary gain.

Results and discussion

The data recorded on the insect-pests, diseases, natural enemies and the various economic parameters in IPM and Non IPM plots during 2011-12, 2012-13 and 2013-14 are presented in **Tables 1** and **2**.

Incidence of major insect- pests and diseases of soybean

The result based on pooled data revealed that the location specific IPM module have minimum infestation of insect-pests in soybean *i.e.,* whiteflies, blue beetle, girdle beetle, stemfly, green semilooper, tobacco caterpillar brown semilooper and pod borer as comparison to Non-IPM during all the years. Data indicated that on lower number of whitefly i.e. 2.97,1.87 and 3.82 nymph per 3leaf/plant in IPM as comparison to non-IPM field i.e. 4.65, 5.48 and 6.39 nymph per 3 leaf/plant in were recorded during 2011-2012, 2012-2013 and 2013-2014, respectively. The lowest incidence of blue beetle were observed in IPM plot (1.48, 1.58 and 1.75 per MRL) while it was slightly higher in non IPM trial (2.88,1.82 and 2.45 per MRL) during 2011-2012, 2012-2013 and 2013-2014, respectively. The IPM plot have recorded lowest plant damage due to stemfly (0.43,0.53 & 0.98 plant per MRL) and girdle beetle (1.38, 2.90,& 1.45 plant Per MRL) than non IPM trials (stemfly 0.67,0.0.75 & 0.1.05 and girdle beetle 1.47, 3.42,& 2.23 plant Per MRL) during three years, respectively.

The larval population of green semilooper was observed lower in IPM modules field (1.62, 1.12 and 2.08 MRL) as comparison to higher number of 3.02, 2.12 and 3.27 MRL in Non IPM fields during all the years, respectively. The similar trends were also found in infestation of tobacco caterpillar and brown semilooper during all the years.

Table 1 Mean incidence of major Insect- pests, diseases and natural enemies in scenario in Soybean

Pests/Natural enemies	2011-12		2012-13		2013-14		Pooled mean	
	IPM	FP	IPM	FP	IPM	FP	IPM	FP
White flies (3 leaf /plant)	2.97	4.65	1.87	5.48	3.82	6.39	2.89	5.51
Blue Beetle (per MRL)	1.48	2.88	1.58	1.82	1.75	2.45	1.60	2.38
Stemfly(per MRL)	0.43	0.67	0.53	0.75	0.98	1.05	0.65	0.82
Girdle beetle (per MRL)	1.38	1.47	2.90	3.42	1.45	2.23	1.91	2.37
Green semilooper (per MRL)	1.62	3.02	1.12	2.12	2.08	3.27	1.61	2.80
Tobacco caterpillar (per MRL)	2.03	3.12	0.98	3.27	1.58	4.57	1.53	3.65
Brown semilooper (per MRL)	1.02	2.03	1.02	1.85	1.17	1.72	1.07	1.87
Pod borer (per MRL)	3.28	5.17	2.12	3.15	2.78	4.23	2.73	4.18
Pod damage (%)	5.12	6.05	4.22	5.53	4.30	7.37	4.55	6.32
YVMV Disease incidence (%)	6.13	8.40	4.80	6.58	6.03	8.18	5.65	7.72
Natural enemy								
lady bird beetle (per 10 plants)	1.32	0.75	1.40	1.05	1.62	0.65	1.45	0.82
Predatory spiders (No/m2 row length)	1.02	0.40	0.87	0.17	1.18	0.53	1.02	0.37
Chrysoperla eggs (per 5 plants)	1.13	0.92	1.38	0.97	1.45	0.97	1.32	0.95
Dragonfly (per MRL)	0.98	0.17	1.02	0.45	0.84	0.55	0.95	0.39

Table 2 Economics of IPM and FP technology in Soybean

Parameters	2011-12		2012-13		2013-14		Pooled mean	
	IPM	FP	IPM	FP	IPM	FP	IPM	FP
Grain Yield (Kg/ha)	1938	1563	2379	1762	1665	1117	1994	1481
Yield gain (%)	24.52	-	28.33	-	49.06	-	33.97	-
No. of Spraying	1.80	2.60	1.40	2.80	2.00	3.20	1.73	2.86
Save yield over FP (Kg/ha)	375	-	617	-	548	-	513	-
Cost of cultivation	26799	25599	28120	27880	29822	28422	28247	27300
Grass return	44539	35879	78210	57932	45943	38525	56231	44112
Net return	17740	10280	50090	30052	16120	10103	27983	16811
Incremental Benefit Cost Ratio (IBCR)	1.66	1.40	2.78	2.08	1.54	1.35	1.99	1.61
Net profit due to IPM	42940	34079	76165	55810	43704	36200	54269	42030
Cost of IPM / ha*	1600	1800	2045	2122	2239	2325	1961	2082

*Cost of IPM protection included (insecticides charge+ labour charges +sprayer charge)

The larval population of *Helicoverpa armigera* was found to be minimum in IPM field (3.28,2.12 and 2.78) as comparison to maximum incidence of non IPM (5.17, 3.15 and 4.23 MRL) during 2011-2012, 2012-2013 and 2013-2014, respectively. The data on per cent pod damaged by *H. armigera* during kharif 2011-2012, 2012-2013 and 2013-2014 presented in Table 1 revealed that less per cent of pod damage by *H. armigera* was observed 5.12, 4.22 and 4.30 in IPM field than in 6.05,5.53 and 7.37 in Non IPM, respectively. The similar trends were observed in pod damage. Bharpoda *et al.* [6], who observed that IPM module proved significantly effective for management of *H. armigera* in comparison to the crop protected with recommended insecticide schedule and unprotected condition. Brar *et al*. [7] also reported the lowest incidence of *H. armigera* in IPM modules. Brar *et al*. [7] also reported the lowest incidence of pod borer in IPM modules.

YVMV disease was observed lower incidence in IPM field *viz.* 6.13,4.80 and 6.03 per cent as comparison to Non IPM field 8.40, 6.58 and 8.18 per cent, respectively during 2011-2012, 2012-2013 and 2013-2014.

Occurrence of natural enemies

A large build-up of natural enemies, especially, lady bird beetles, predatory spiders, Chrsoperla eggs, dragonflies and predatory bugs was recorded in IPM fields (Table 1). The Population of lady bird beetles(1.45 per 10plants), predatory spiders (1.02 per MRL), Chrsoperla eggs (1.32 per 5 plants) and dragonflies (0.95 per MRL) was found to be higher in IPM fields than Non IPM fields where it was lower i.e 0.82,0.37,0.95 and 0.39, respectively during all the

years. Thus the location specific need based IPM module resulted in increased biodiversity as this is safer to natural enemies. Lower population of predators in non IPM module was due to the toxic effect of the insecticides. The present findings are more or less similar to those of Mohapatra and Sahu [8] observed higher number of green lacewings in IPM plot than in non IPM plot. Dhawan *et al.* [9] reported that friendly insects increased significantly in IPM fields as compared to non IPM. Bhosle *et al* [10] observed that the mean population of spiders was 0.73 per plant for IPM and for non-IPM it was 0.60 per plant. Bhute [11] also reported highest population of coccinellids in untreated control (2.38 ladybird beetles/5plants). Large presence of these natural enemies was the indication of increase in biodiversity in the absence of chemical pesticides which must have helped in lower incidence of insect pests in IPM fields.

Grain yield and economics:

The results presented in Table 2 revealed that the IPM fields recorded more yield than Non-IPM fields. The IPM plot recorded higher grain yield (19.38, 23.79 & 16.65 q/ha) as compared to non-IPM plot (15.63, 17.62 & 11.17q/ha), respectively during 2011-12, 2012-13 &2013-14. Thirty three per cent gain yields had recorded in IPM fields. The net profit was also higher (Rs. 20,279) in IPM plot as compared to non-IPM plot. The cost of IPM was slightly lower in IPM (Rs. 1600/-, 2045/- & 2239/- per ha) as against non-IPM (` Rs. 1800,2122 & 2325 per ha) fields during 2011-12, 2012-13 and 2013-14, respectively which was mainly due to reduction in number of sprays of pesticides in IPM field which varied from 1.4to2.0 during three years from a maximum of 3.20 in non-IPM fields.

The Incremental Benefit Cost Ratio (IBCR) was obtained slightly higher in IPM plot (1:1.66,1:2.78 and 1:1.54) than Non IPM plot where it was 1:1.40,1:2.08 and 1:1.35 during 2011-2012, 2012-2013 and 2013-2014, respectively which was mainly due to reduce cost of plant protection measures in IPM plots with increasing the grain yield. The present findings are more or less parallel to Sabir *et al.* [12], who observed the cost benefit ratio of 1:4.27 in IPM conditions over non-IPM one. Bhosle *et al.* [10] Existing conventional extension approach consists mainly of the centrally guided transfer of technology with readymade packages which unfortunately are not validated under location specific field condition. These findings are in tune with the reports of [13-15] were reported that cost: benefit ratio higher in IPM plots compared to farmers' practice.

Conclusion

The IPM technology used was not only directly environment friendly but also more sustainable vide increase in (natural enemies, soil flora and fauna) biodiversity and reduced use of pesticides with less load on environment. Several problems related to calendar based approach have limited the effectiveness and impact on further improving the intensive smallholder farming systems.

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