➔DOI : 10.15740/HAS/AJBS/11.2/263-268
e ISSN-0976-8343 | ■ Visit us : *www.researchjournal.co.in*
ASIAN JOURNAL OF BIO SCIENCE
Volume **11** | Issue 2 | October, 2016 | 263-268

RESEARCH **P**APER

Studies on major stem pests and incremental cost benefit ration for different integrated pest management modules on soybean

A.A. MOTAPHALE, B.B. BHOSALE **AND** F.S. KHAN

Department of Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth , PARBHANI (M.S.) INDIA

Article Info : Received : 12.07.2016; Revised : 18.08.2016; Accepted : 05.09.2016

The stemfly (*Melanagromyza sojae*, Zehntner) and girdle beetle (*Obereopsis brevis* Swedenbord) are two major pests of soybean in this region during *Kharif* crop. It was felt imperative to develop IPM for these pests hence, this experimentation was carried out. Data revealed that MAU IPM module was effective in reducing the infestation of girdle beetle (6.30%) and stem fly (7.95%), whereas in chemical control infestation was (7.35%) and (8.02%) per cent in girdle beetle and stem fly, respectively. Considering the stem tunneled length it was found that girdle beetle and stem fly was (12.14%) and (15.54%) in MAU IPM module whereas in chemical control, it was (14.56%) and (15.17%) by girdle beetle and stem fly, respectively. Cost benefit ratio of these methods were compared, it was found that CBR was highest (1:7.65) in MAU IPM module followed by chemical control (1:5.82). MAU IPM module included the eco-friendly and sustainable methods to manage these major regular pests of soybean and which was found effective and economical methods.

Key words : IPM, Integrated pest management, Stem pest, Girdle beetle, Stem fly, Stem tunneling, Cost benefit ratio

How to cite this paper : Motaphale, A.A., Bhosale, B.B. and Khan, F.S. (2016). Studies on major stem pests and incremental cost benefit ration for different integrated pest management modules on soybean . *Asian J. Bio. Sci.*, **11** (2) : 263-268.**DOI : 10.15740/HAS/AJBS/11.2/263-268.**

INTRODUCTION

Soybean is the third largest oil seed crop of India (Tiwari, 2003). In Marathwada region, area under soybean crop was 15.10 lakh hectares with production of 12.67 lakh metric tonnes and productivity of 864 kg/ha during 2014-15 (Anonymous, 2015).It is a regular *Kharif* crop lead to have regular infestation of Girdle beetle and stem fly which have a bottleneck in the production of soybean. Chechani *et al*. (2002) stated that the mean infestation due to girdle beetle was ranged from 13.33 to 46.66 whereas Padiwal *et al*. (2007) reported stem tunneling due to stemfly infestation was 21.23 and 24.76 per cent in the first week of October. Insects damage the soybean crop right from germination to till harvesting stage. *M. sojae* causes 30 to 50 per cent reduction in grain yield (Singh and Singh, 1990). Venkateshan and Kundu (1994) reported that stem tunneling due to *M. sojae* was to the extent of 10 to 20 per cent causing loss in grain yield of 2.75 to 3.81 g per plant.

The study was focused to find out effective and economical viable IPM module for the management of stem pests of soybean. The available tools for controlling insect pests involves wide range of techniques and have been combined to form IPM used in soybean. Bhosale *et al*. (2008) reported localized IPM module for soybean pests which comprised summer ploughing to expose hibernating stages to sunlight, judicious use of fertilizer, crop rotation, sowing upto 15 July, clipping and destruction of infested leaves collection and destruction of tobacco leaf eating caterpillars and hairy caterpillar along with

leaves, spraying of 5 per cent NSKE, soil application of phorate 10 per cent G@ 10 kg or carbofuran @ 30 kg/ha found effective in managing the pest complex. Novel molecules were tested against soybean defoliators, chlorantraniliprole (30 g.ai/ha), methomyl (300g.ai/ha) and spinosad (75g.ai/ha) were found effective and statistically at par with each other in protecting the soybean crop from the infestation of lepidopteran pests (Patel *et al*., 2014). The yield and economics on the basis of two years (pooled) data indicated that the maximum gross income of Rs.34650/ha, net profit of Rs.30600/ha and I.C.B.R 1:8.34 was obtained from MAU IPM module followed by chemical control.

RESEARCH METHODOLOGY

IPM experimental design was laid out in Randomized Block Design (RBD) with MAUS 7 variety sown with spacing 45 x 5 cm. The size of plot was 9.9 x 9.0m included 3 treatments and 7 number of replications. Distance between two replications and plots were 2 m and 1 m, respectively. Among the treatments the details of the component of the IPM module are given in Table A. The plot was fertilized and irrigated by following standard agronomic practices. Pest incidence observations were recorded 11 MW after sowing. Spray applications were scheduled based on the economic threshold level of the Girdle beetle (Average 3-5 infested plants per mrl) and Stemfly (Average 10-15 % infested plants/mrl). As per Gomez and Gomez (1984), the data obtained on live population *i.e.*observations on larval population were subjected to $\sqrt{x+0.5}$ transformation *i.e.* Poisson formula. Whereas data on per cent infestation were transformed into arcsin transformation values before statistical analysis. X= Average number of pest population. Yield of soybean from each net plot was recorded separately and computed on hectare basis. Taking into account, the average price of grains in the market and expenditure involved, net profit was calculated and from those values the cost benefit ratio were worked out so as to calculate the economics of different treatments.

RESEARCH FINDINGS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized

Table A : Components of different IPM modules

Module	Components used	Date of applications	
		2010-2011	2011-12
MAU module	Deep summer ploughing before soybean cultivation	17-06-2010	11-07-2011
	Border row of trap crops *i.e.* castor and sunflower	09-07-2010	25-07-2011
	* Recommended spray adopted on trap crop after noticing incidence	25-08-2010	16-09-2011
		20-09-2010	28-09-2011
	Destruction of alternative hosts	Done	Done
	Installation of 25 bird perches/ha	30-6-2010	21-07-2011
	Mechanical collection and destruction of stemfly and girdle beetle affected plant parts	Done	Done
	Application of phorate 10 G @10 kg/ha in soil before sowing	17-06-2010	11-07-2011
	Spraying of NSKE 5% at 25-30 days after sowing	13-07-2010	06-08-2011
	Collection and destruction of *Spodoptera* egg masses and gregarious larvae along with leaves.	Done	Done
	Nomuraea rileyi @4 g/lit after noticing incidence of *Spodoptera litura*	17-07-2010	12-08-2011
	Use of chemical insecticides after crossing the ETL.	16-08-2010	17-09-2011
		04-09-2010	01-10-2010
Chemical	Triazophos 40 EC @ 0.064%	03-07-2010	26-07-2011
control	Quinalphos 25EC @ 0.05%	17-07-2010	10-08-2011
	Emamectin benzoate 5SG @ 0.002%	05-08-2010	25-08-2011
	Indoxacarb 14.5 % @ 0.0145%	18-08-2010	10-09-2011
Untreated control	No plant protection measure adopted. The plots were sprayed with plain water.		

under following heads :

Effect of different IPM modules on per cent plant infested by girdle beetle *O. brevis* :

Per cent plant infestation by girdle beetle during *Kharif* 2010-11 was significantly minimum in MAU module (6.76 %) followed by chemical control (7.91%) which were found significantly superior over untreated control and found at par with each other. Whereas maximum plants infestation by girdle beetle was observed in untreated control (13.28 %). During *Kharif* 2011-12, significantly lower plant infestation by girdle beetle in MAU module (5.84 %) followed by chemical control (6.80 %) which were found significantly superior over untreated control and found at par with each other. On the contrary Maximum plants infestation by girdle beetle was observed in untreated control (14.74 %). The pooled data indicated that the minimum per cent plant infested by girdle beetle was observed in MAU module (6.30%) followed by chemical control (7.35%) which were found significantly superior over untreated control. Maximum per cent plant infested by girdle beetle were observed in untreated control (13.71%). Results obtained during present experiment are in conformity with the findings of Rathod (2011) who reported that significantly minimum per cent plant infested by girdle beetle was observed in MAU module (5.25%) followed by NRCS module (6.07%) and chemical control treatment (7.52%) which were found at par with each other (Table 1).

Effect of different IPM modules on per cent length of stem tunneled by girdle beetle *O. brevis* :

During *Kharif* 2010-11, significantly minimum per cent length of stem tunneled by girdle was observed in MAU module (11.44 %) followed by chemical control (14.22 %) which were found significantly superior over untreated control and found at par with each other. Maximum per cent by girdle beetle was observed in untreated control (30.63%). During *Kharif* 2011-12, significantly minimum per cent length of stem tunneled by girdle beetle was observed in MAU module (12.84 %) followed by chemical control (14.90 %) which were found significantly superior over untreated control and found at par with each other. Maximum per cent by girdle beetle was observed in untreated control (31.59 %). The pooled data indicate that the minimum per cent length of stem tunneled by girdle beetle was observed in MAU module (12.14 %) followed by chemical control (14.56%) which were found significantly superior over untreated control. Maximum per cent by girdle beetle was observed in untreated control (30.63 %). Results obtained during present experiment are in conformity with the findings of Rathod (2011) who reported that significantly minimum per cent length of stem tunneled by girdle beetle was observed in MAU module (10.68 %) followed by NRCS module (11.72%) and chemical control treatment (14.33%) which were found at par with each other.

Effect of different IPM modules on per cent plant infested by stemfly *M. sojae* :

Per cent plant infestation by stemfly during *Kharif* 2010-11 was minimum in MAU module (8.75 %) followed by chemical control (9.09 %) which were found significantly superior over untreated control and found at par with each other. Maximum per cent plant infested by stemfly was observed in untreated control (19.54 %). During *Kharif* 2011-12, significantly minimum per cent plant infested by stemfly was observed in chemical control (6.95%) followed by MAU module (7.16%) which were found significantly superior over untreated control and found at par with each other. Maximum per cent plants infested by stemfly were observed in untreated control (16.30 %). The pooled data indicated that the minimum per cent plant infested by stemfly was observed in MAU module (7.95 %) followed by chemical control (8.02%) which were found significantly superior over

Table 1 : Per cent plant infested and stems tunneling by girdle beetle *O. brevis*

Sr. No.	Modules	% infestation due to girdle beetle			% stem tunneled due to girdle beetle		
		2010-11	2011-12	Pooled	2010-11	2011-12	Pooled
1.	MAU IPM module	6.76* (14.21)	5.84 (13.86)	6.30 (15.12)	11.44* (20.24)	12.84 (20.45)	12.14 (21.03)
2.	Chemical module	7.91 (16.01)	6.80 (15.02)	7.35 (16.06)	14.22 (22.04)	14.90 (21.91)	14.56 (21.48)
3.	Untreated control	13.28 (21.50)	14.74 (22.55)	13.71 (22.00)	30.63(33.25)	31.59 (33.69)	30.63 (33.45)
	S.E.±	0.68	0.89	0.74	2.01	1.96	1.04
	C.D. (P=0.05)	2.25	2.84	1.98	5.94	3.66	3.12

Figures in parentheses are arcsin transformed values *Average of 8 weeks

untreated control. Maximum per cent plant infested by stemfly was observed in untreated control (17.42 %). Results obtained during present experiment are in conformity with the findings of Rathod (2011) who reported that significantly minimum per cent plant infested by stemfly was observed in MAU module (7.87%) followed by NRCS module (9.24%) and chemical control treatment (9.41%) which were found at par with each other. Significantly maximum per cent plant infested by stemfly was observed in untreated control (18.93 %).

Effect of different IPM modules on per cent length of stem tunneled by stemfly *M. sojae* :

During *Kharif* 2010-11, significantly minimum per cent length of stem tunneled by stemfly was observed in MAU module (14.59 %) followed by chemical control (15.36 %) which were found significantly superior over untreated control. Maximum per cent length of stem tunneled by stemfly was observed in untreated control (27.38 %). During *Kharif* 2011-12, significantly minimum per cent length of stem tunneled by stemfly was observed in chemical control (14.98 %) followed by MAU module

Table 2 : Per cent plant infested and stems tunneling by stemfly (*M.Sojae*)

Sr. No.	Modules	% infestation due to stemfly			% stem tunneled due to stemfly		
		2010-11	2011-12	Pooled	2010-11	2011-12	Pooled
1.	MAU IPM module	8.75* (17.40)	7.16 (14.15)	7.95 (14.98)	14.59* (21.47)	16.50 (23.85)	15.54 (21.84)
2.	Chemical module	9.09 (17.09)	6.95 (14.78)	8.02 (17.14)	15.36 (23.14)	14.98 (22.07)	15.17 (22.18)
3.	Untreated control	19.54 (26.35)	16.30 (22.78)	17.42 (25.14)	27.38 (31.93)	26.73 (30.47)	27.05 (32.02)
	S.E.±	0.94	1.47	1.11	1.59	2.07	1.17
	C.D. (P=0.05)	2.47	1.48	1.12	3.14	3.08	2.48

Figures in parentheses are arcsin transformed values *Average of 8 weeks

Table 3 : Average grain yield of soybean in different modules

Sr. No.	Modules	Average grain yield (kg/ha)		
		2010-11	2011-12	Pooled
1.	MAU IPM module	2589	2440	2514
2.	Chemical module	2469	2481	2475
3.	Untreated control	1005	945	975
	S.E.±	52	53	37
	C.D. (P=0.05)	133	148	100

Table 4 : Details of economics and ICBR in different IPM modules in soybean

Treatments	Soybean seed yield (kg/ha)	Increased yield over control (kg/ha)	Gross income (Rs./ha)	Cost of treatment (Rs./ha)	Net profit (Rs./ha)	I.C.B.R.
2010-2011						
MAU,IPM module	2589	1584	36432	3900	32532	1:8.34
Chemical control	2469	1464	33672	4785	28887	1:6.04
Untreated	1005	-	-	-	-	-
2011-2012						
MAU,IPM module	2440	1495	32890	4200	28690	1:6.83
Chemical control	2481	1536	33792	5100	28692	1:5.62
Untreated	945	-	-	-	-	-
Pooled						
MAU, IPM module	2515	1540	34650	4050	30600	1:7.56
Chemical control	2475	1500	33750	4943	28807	1:5.82
Untreated	975	-	-	-	-	-

Market price of seed of soybean was 2010-11=Rs. 2300/q and 2011-12= Rs. 2200/q

(16.50%) which were found significantly superior over untreated control. Maximum per cent stem tunneled by stemfly was observed in untreated control (26.73 %). The pooled data indicate that the minimum per cent per cent length of stem tunneled by stemfly was observed in chemical control (15.17 %) followed by MAU module (15.54 %) which were found significantly superior over untreated control. Maximum per cent stem tunneled by stemfly was observed in untreated control (27.05 %). The data in respect of per cent length of stem tunneled by stemfly *M. sojae* are presented in Table 2 and revealed that all the treatments were found significantly superior over control. Results obtained during present experiment are in conformity with the findings of Rathod (2011) who reported that significantly minimum per cent length of stem tunneled by stemfly was observed in MAU module (9.64%) followed by NRCS module (10.16%) and chemical control treatment (11.20%) which were found at par with each other.

Effect of different IPM modules on grain yield :

The data in respect of seed yield of soybean kg per hectare during *Kharif* 2010-11, *Kharif* 2011-12 and pooled are presented in Table 3, during *Kharif* 2010-11, significantly higher yield of 2589 kg/ha was recorded in MAU module followed by chemical control 2469 kg/ha which was significantly superior over untreated control. On the contrary minimum yield was recorded in untreated control 1005 kg/ha. During *Kharif* 2011-12, significantly more seed yield was recorded in chemical control 2481 kg/ha followed by MAU module 2440 kg/ha which were significantly superior over untreated control. Significantly minimum yield was observed in untreated control 945 kg/ha. The results based on pooled data revealed that significantly higher yield of 2514 kg/ha was recorded in MAU module followed by chemical control 2475 kg/ha which were significantly superior over untreated control. On the other hand minimum seed yield was recorded in untreated control 975 kg/ha. Patel *et al.* (2015) recorded plant height (14.18 and 66.17 cm), number of pods/plant (34.12) and grain yield (26.55 q/ha) in their experiment.

Economics and ICBR in different soybean modules:

The relative economics of module and control treatment in soybean pests during 2010-11, 2011-12 and pooled was worked out and presented in Table 4. Economics of different modules during *Kharif* 2010-11, indicated that the maximum gross income was obtained from the MAU IPM module Rs.36,432 /ha followed by Rs. 33,672/ha in chemical control. During *Kharif* 2011-12 the maximum gross income of Rs. 33,792/ha was obtained from chemical control followed by Rs.32,890 /ha in MAU IPM module. Considering the net profit realized from different modules, it was observed that during *Kharif* 2010-11, the highest net profit of Rs.32,532/ha was obtained from the MAU IPM module followed by Rs. 28,887/ha in chemical control. During *Kharif* 2011-12 the highest net profit was obtained from chemical control Rs.28,692/ha followed by MAU IPM module Rs.28,690/ha.The yield and economics on the basis of two years pooled data indicated that the maximum gross income of Rs.34, 650/ha and net profit of Rs.30,600/ha was obtained from MAU IPM module followed by Rs.33,750 and Rs. 28,807 in chemical control.

Incremental cost benefit ratio (I.C.B.R.) :

Incremental cost benefit ratio for different treatments was worked out separately for both years and also on the basis of pooled data and presented in Table 4. During 2010-11, 2011-12 and on the basis of pooled data, the highest I.C.B.R. of 1:8.34, 1:6.83 and 1:7.56 were obtained in MAU IPM module followed by 1:6.04, 1:5.62 and 1:5.82 in chemical control, respectively.

LITERATURE CITED

Anonymous (1995). Annual report, *All India Co-ordinated Research Project on Soybean*, Marathwada Agricultural University, Parbhani (M.S.) INDIA. 122-144pp.

Anonymous (1997).*Annual report all India co-ordinated research project on soybean*. Marathwada Agricultural University, Parbhani (M.S.) INDIA, 45-46pp.

Anonymous (2014). *Annual report all India co-ordinated research project on soybean*.Vasantrao Naik Marathwada Agricultural University, Parbhani (M.S.) INDIA, 4-5pp.

Bhosale, B.B., Bhede, B.V., Patange, N.R., Kambale,S.K. and Baig, K.S. (2008). *IPM in soybean*, Marathwada Agricultural University Extn. Folder No. 2/2008.

Chechani, V.K., Joshi, F.L. Sharma, U.S. and Ameta, O.P. (2002). Incidence and chemical control of stemfly *Melanagromyza sojae* (Zehntner) on soybean. *Indian J. Appl. Ent.*, **14** : 9-12.

Odulaja and Nokoe (1993). Maximin- minimax method. A Maximin- minimax approach for classifying crop varieties into resistant groups based on yield potential and loss. *Int.J. Pest. Mgmt.*, **39** : 64-67.

Padiwal, N.K., Rana, B.S. and Ameta, O.P. (2007). Incidence of insect pests in soybean in relation to abiotic environmental factors. *Pestology*, **31**(2): 21-24.

Patel, Meena U., Kulkarni, A.V. and Gavkare, Omkar (2014). Evaluating the efficacy of Novel molecules against soybean defoliators. *The Bioscan.*, **9** (2) : 577-580.

Patel, Rakesh Kumar, Gupta, S. B. and Thakur, Ashwini Kumar (2015). Attributing characteres, yield and nodulation on soybean of Chhatisgarh plain, *The Bioscan*, **10** (1) : 275-278.

Puri, S.N.,Sharma O.P., Murthy, K., Dhandapani. S.A. and Kumar, P. (1999). Validation of IPM modules in cotton NCIPM Annual Report 1998-1999. pp. 21-27.

Rathod, P.K. (2011). Evaluation of IPM modules for soybean. Ph.D. (Ag.) Thesis, Marathwada Krishi Vidyapeeth, Parbhani, M.S. (INDIA).

Singh, O.P. and Singh, K.J. (1990). Seasonal incidence and damage of *Melanagromyza sojae* on soybean. *Indian J. Plant Protec.*, **18** (2) : 271-275.

Tiwari, S.P. (2003). Improvement of yield and yield potential in soybean : An analysis and synthesis. *J. Oilseed Res.*, **20** (1) : 1-8.

Venkateshan, T. and Kundu, G.G. (1994). Bioefficacy of insecticides for the control of stemfly and white fly infesting the soybean crop. *Indian J. Ent.*, **56**(4): 418-421.