Soybean Research (Special Issue Number 2): 241-248: 2014

Magnitude of Crop Losses Due to Insect-Pest, Diseases and Weeds in Soybean – An Economic Analysis

S C MEENA[1], DEEPAK RATHI[2] and H O SHARMA[3],
Agro – Economic Research Centre, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur 482 004, Madhya Pradesh, India
E mail: agrianss@gmail.com

ABSTRACT

The study analyzed the extent of physical and financial losses caused by weeds, insect-pest and diseases in cultivation of soybean in Madhya Pradesh. The relevant primary data were collected from 160 soybean growers of two major soybean producing districts (Ujjain and Raisen) of Madhya Pradesh during the year 2012 -13. The study revealed that 67.50 per cent of soybean growers were able to distinguish between the pest and disease attack by quantitative assessment followed by qualitative (15.00 %) and both (17.50 %). Out of them 96.25 per cent and 73.75 per cent households respectively reported that frequency of attack of major pests like girdle beetle and caterpillar were found to occur every year. It was also observed that the size of farms is directly proportional to pre-harvest losses over actual and normal production of soybean and adoption of control measures. Among total plant protection chemicals used by the soybean growers, average soybean grower found to invest more in insecticide (Rs 1,376/ha) followed by weedicide (Rs 1,019/ha) and fungicide (Rs 242/ha). None of the households were found to use biological method for control of insect-pest and diseases in the area. Amongst different sources of information, private input dealers were found to be most important source for seeking advice whereas, government extension agents and fellow farmers important and least important source of extension services on pest and disease control management as reported by majority of households.

Key words: Losses, magnitude, pest and diseases, soybean

The estimation of crop loss due to pests and diseases is a complex subject. It is in fact, difficult to assess the loss caused by the individual pest as a particular crop may be infested by the pest complex in the farmers' field conditions. Further, extent of crop loss, either physical or financial, depends on the type of variety, stage of crop growth, pest population and weather conditions. Nevertheless, the crop loss estimates have been made and updated regularly at global level. The worldwide yield loss due to various types of pest was estimated to be 37.4 per cent in rice, 28.2 per cent in wheat, 31.2 per cent in maize and 26.3 per cent in soybean (Oerke, 2007). At all India level, crop loss estimates due to insect -pests provided by Dhaliwal *et al.* (2010) brought out that 25 per cent losses were in rice and maize, 5 per cent in wheat, 15 per cent in pulses and 50 per cent in cotton. The crop loss has increased during post-green revolution period when compared to pre-green revolution period. The severity of pest problems has reportedly been changing with the developments in agricultural technology and modifications of agricultural practices. The damage caused by major inspect-pests in various crops has also been compiled and

[1]*Senior Research Fellow;* [2]*DeputyDirector;* [3]*Director*

reported by Reddy and Zehr (2004). Further, a number of studies have established a strong relationship between pest infestation and yield loss in various crops in India (Nair, 1975; Dhaliwal and Arora, 1994; Muralidharan, 2003; Rajeswari *et al.*, 2004; Muralidharan and Pasalu, 2006; Rajeswari and Muralidharan, 2006, Nag *et al.*, 2000, Solanki *et al.*, 2011). To estimate the crop loss, most of the existing studies have adopted experimental treatment approach (with or without pest attack through artificial infestation) or fields with natural infestation wherein half of the field is protected against the pest while the other half is not. But, the results obtained from artificial infestation or natural infestation in the selected plots/fields will not be appropriate for extrapolation over a geographical area (De Groote, 2002). It is for the reason that the estimated crop losses under these conditions may not represent the actual field conditions of farmers. Alternatively, the estimates collected directly from the farmers through sample survey may be reliable and could be used for extrapolation in similar geographical settings. However, the farmers' estimates are likely to be subjective and these should be validated with expert estimates of the state department of agriculture. Hence, the present study has been formulated to estimate the physical and financial losses caused by pests and diseases and examine the measures of pest and disease management to reduce the crop loss due to pests and diseases at farm level.

MATERIAL AND METHODS

Soybean crop has been considered for assessment of pre- and post-harvest losses in Madhya Pradesh as state have remarkable position in the area and production of the crops in India (Table 1). The primary data were collected from the selected respondents of the study area with survey method with the help of personal interview. A multistage sampling technique has been used for selection of respondents of the study.

At the first stage, Ujjain and Raisen districts from Malwa plateau and Vindhyan plateau agro-climatic regions respectively, were selected as these were found to be a true representative for soybean in Madhya Pradesh. Further, 3 villages near by the regulated market (in radius of 10 km) and 3 villages far away from the regulated market (> 10 km from regulated market) have been selected for the study in second stage (Table 2).

Table 1. Present status of soybean crop in India (2010-11)

Soybean growing states	Area sown (mha)	Percen - tage to total	Yield (kg/ ha)	Percen - tage to total	Total produc - tion (mt)	Percen - tage to total
Madhya Pradesh	5.317	54.96	1051.67	103.04	5.601	57.62
Maharashtra	3.026	31.28	988.33	96.83	2.857	29.39
Rajasthan	0.724	7.48	940.67	92.16	0.702	7.22
Andhra Pradesh	0.174	1.80	1055.00	103.36	0.166	1.71
Karnataka	0.222	2.30	1021.67	100.10	0.208	2.14
Chhattisgarh	0.123	1.27	950.00	93.08	0.127	1.31
Rest of India	0.088	0.91	936.67	91.77	0.060	0.62
Grand Total	9.673	100.00	1020.67	100.00	9.720	100.00

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Agricultural Statistics at a Glance, 2012

Table 2. Selected districts and villages for the study

Agro -climatic regions	Selected districts	Selected villages	
		In radius of 10 km	> 10 km
Malwa Plateau	Ujjain	Matana	Ganvadi
		Munjakheda	Piploda
		Semaliya (nasar)	Narvar
Vindhyan Plateau	Raisen	Kotpar	Chingwara kalan
		Kamton	Arjni
		Kinagi	Tulsipar

In third stage, a list of all the farmers of the selected village has been prepared and classified them in marginal (below 2 acre) , small (2- 4 acre), medium (4-10 acre) and large (above 10 acre) categories according to their size of operational holdings and 20 farmers were selected randomly in each category for the study (Table 3).

Table 3. Number of respondents in different categories of farms in selected districts

Selected crops	Selected districts	Size of farms				
		Marginal	Small	Medium	Large	Total
Soybean	Ujjain	20	20	20	20	80
	Raisen	20	20	20	20	80
	Total	40	40	40	40	160

The collected data has been classified, tabulated and analyzed in the light of stated objectives of the study using statistical package of social science (SPSS).

RESULTS AND DISCUSSION

The incidence, magnitude of crop loss due to pests, disease and weed infestation, cost of chemical methods adopted by soybean growers of different size of farms to control pests and diseases and extension services perceived by them on pests and disease control management were observed in the present study.

Identification of pests and disease attack

The cent per cent of households able to distinguish pest and disease attack in cultivation of soybean crop revealed that majority (67.50 %) of them assess the severity of the attack by quantitative assessment. Only 15 per cent of households were able to assess the pest and disease attack by qualitative assessment in soybean crop (Table 4).

Incidence of major pests and disease

In soybean, girdle beetle and tobacco caterpillar were found very important pest of soybean in the study area as their rank of severity was found to be very important as reported by 91.25 per cent (girdle beetle) and 57.50 per cent (tobacco caterpillar) of households (Table 5).

In case of diseases in the study area, dry root rot (73.75 %), yellow mosaic (58.75 %) and fusarium wilt (50.00 %) were found to be major diseases of soybean as reported by the

majority of households. The frequency of attack by yellow mosaic and dry root rot in every season was reported by 53.75 per cent and 47.50 per cent of households, while that of fusarium wilt was reported to be once in a two season (48.75 %) as reported by the majority of households. But the losses occurred by these diseases were not found more than 5 per cent as reported by the more than 85 per cent of households.

Table 4. Identification of pests and disease attack

Description	Percentage of HHs
Households able to distinguish pests and disease attack	100
Assessment about the severity of the attack	
Quantitative assessment	67.50
Qualitative assessment	15.00
Both	17.50

As regards to the infestation of weeds in cultivation of soybean; *Samel, Dudhi, Motha and Krishaneel* were found to be very important weeds of the as soybean reported by 63.75 per cent, 77.50 per cent, 92.50 per cent and 60 per cent, respectively of the study area. The frequency of all these weeds was found to be every season but the production losses were found to be less than 5 per cent as majority of the households were using the weedicides to control these weeds in soybean field.

Magnitude of crop loss due to pests, disease and weed infestation

The magnitude of crop losses due to insect-pests, diseases and weeds infestation in soybean observed revealed that on an average size of farm 13.39 per cent and 11.75 per cent losses were recorded over actual (1,381 kg/ha) and normal (1,563 kg/ha) production, respectively. The losses due to insect-pests, diseases and weeds infestation were found to be directly proportionate to the size of holdings or scale of operation of the farm. The losses among different size of holdings found to increase from 10.11 to 16.51 per cent and 9.18 to 14.17 per cent over actual and normal production of soybean, respectively (Table 6).

Cost of chemical methods adopted for insect-pests and disease control

The control of weeds is the major problem in cultivation of soybean. As soybean is a rainy season crop, various types of weeds infested the soybean fields. Chemical control (weedicide) was found to most popular and only method to control weeds in the area under study. As hand weeding is not possible due to excess moisture in the soil (black cotton soil). An average household invested Rs 1,019 per ha to control weeds in soybean. The cost of weedicide was found to increase with the size of farms from Rs 974 per ha (marginal) to Rs 1,039 per ha (large).

Incidence of insect-pest in soybean was found to be very common in study area and all the farmers used insecticide to control them. An average household found to invest Rs 1,376 per ha in insecticide. Medium farmers (Rs 1,410/ha) were found to use more on insecticides as compared to marginal (Rs 1,342/ha), small (Rs 1,351/ha) and large (Rs 1,400/ha). The seed treatment with fungicide was also found to be common in the study area in cultivation of soybean. An average household invested Rs 242 per ha in fungicide (Table 7).

The cost of seed treatment was found to be somewhat more in medium (Rs 260/ha) followed by large (Rs 252/ha), small (Rs 234/ha), and marginal (Rs 221/ha) farms (Table 7).

Table 5. Incidence of major pests and disease (percentage of households)

Name of the pe st/disease/weed	Rank of severity*			Frequency of attack**			Production loss***				
	1	2	3	1	2	3	1	2	3	4	5
Major insect -pests											
Girdle beetle	91.25	6.25	2.50	96.25	3.75	0.00	11.25	78.75	3.75	3.75	2.50
Tobacco Caterpillar	57.50	27.50	15.00	73.75	26.25	0.00	85. 00	3.75	6.25	3.75	1.25
Major diseases											
Fusarium Wilt	50.00	42.50	7.50	31.25	48.75	20.00	88.75	7.50	1.25	2.50	0.00
Yellow Mosaic	58.75	28.75	12.50	53.75	32.50	13.75	86.25	11.25	2.50	0.00	0.00
Dry Root Rot	73.75	5.00	21.25	47.50	16.25	36.25	91.25	7.50	0.00	1.25	0.00
Major weeds											
Samel	63.75	13.13	23.13	100.00	0.00	0.00	91.25	6.25	2.50	0.00	0.00
Dudhi	77.50	8.75	13.75	98.75	1.25	0.00	88.75	8.75	2.50	0.00	0.00
Motha	92.50	6.25	1.25	100.00	0.00	0.00	95.63	4.38	0.00	0.00	0.00
Krishnneel	60.00	36.25	3.75	73.75	22.50	3.75	100.00	0.00	0.00	0.00	0.00

Very important = 1, important = 2, not important = 3; ** Every season = 1, once in two seasons = 2, once in three seasons = 3 ; * < 5% = 1; 5-10 % = 2; 10-25 % = 3; 25-50 % = 4; >50 % = 5*

Table 6. The magnitude of crop loss in soybean due to pests, disease and weed infestation across different size of holdings

Description	Marginal	Small	Medium	Large	Total
Actual production (kg/ha) with attack	1613	136 6	1230	1317	1381
Normal production (kg/ha) without attack	1776	1512	1430	1534	1563
Loss of output (kg/ha)	163	146	200	217	182
Loss over actual production (%)	10.11	10.67	16.27	16.51	13.39
Loss over normal production (%)	9.18	9.64	13.99	14.17	11.75

Table 7. Cost of chemical methods adopted in soybean for pests and disease control

Particulars	Marginal	Small	Medium	Large	Total
Per cent households adopted control measures	87.50	90.00	100.00	100.00	94 .38
Weedicide					
Sprays/ha (Rs)	2.27	2.32	2.47	2.47	2.38
Cost of chemical (Rs)	795.86	838.15	869.93	883.99	846.98
Labour charges (Rs)	176.31	187.87	162.40	152.13	169.68
Total Cost	974.44	1028.34	1034.81	1038.59	1019.04
Insecticide					
Sprays/ha (No)	3.2 6	3.48	4.82	5.38	4.24
Cost of chemical (Rs)	1054.69	1078.38	1124.89	1141.71	1099.92
Labour charges (Rs)	284.05	269.55	280.00	253.00	271.65
Total cost (Rs)	1342.00	1351.41	1409.70	1400.09	1375.80
Fungicide					
Sprays/ha (No)	0.30	0.32	0.35	0.35	0.33
Cost of chemical (Rs)	151.29	155.61	172.90	172.90	163.17
Labour charges (Rs)	69.16	77.81	86.45	79.04	78.11
Total cost (Rs)	220.74	233.74	259.70	252.29	241.62

Biological methods adopted for pests and disease control

None of the households followed the biological method for control of insect-pest and diseases in the area under study.

Extension services on pests and disease control management

The data related to extension services on insect-pest and disease control management for selected crop brought out that only 77.50 per cent households were

found seeking advice related to control of pest and disease for soybean. Private input dealers constituted most important source of seeking advice on insect-pest and disease control management as reported by 71.77 per cent of households followed by fellow farmers (21.77 %) and agricultural university/ Krishi Vigyan Kendras (11.29 %), while fellow Farmer were found to be important source of seeking advice as reported by 45.97 per cent of households followed by private input dealers (15.32 %), TV/radio service/news paper (15.32 %) and agricultural university/ Krishi Vigyan Kendras (8.87 %) It is also observed that government extension agent was found to be least important for seeking advice to control on pest and disease.

Hence, it can be concluded that private input dealers were found to be most important whereas, government extension agent and fellow farmers were found to be important and least important source of extension services on insect-pest and disease control management as reported by majority of households of study area.

Table 8. Extension services on pests and disease control management

Particulars			**Soybean**	
Households seeking advice			77.50	
Rank of sources				
Sources of advice	***Most important***	***Important***	***Least important***	***Details of advice***
Government extension agent	4.03	4.03	91.94	Plant geometry, soil testing, inputs
Private input dealer	71.77	15.32	12.90	Proper plant protection measures, seeds
Fellow farmers	21.77	45.97	32.26	Fertilizer and manure application
TV/Radio service/Newspaper	0.00	15.32	84.68	Government schemes for agriculture
Agricultural University/KVK	11.29	8.87	79.84	Varietals and machinery information
Any other	0.00	0.00	0.00	

REFERENCES

Oerke E C. 2007. Crop losses to animal pests, plant pathogens, and weeds, *In*: David Pimental (Ed), *Encyclopedia of Pest Management*, pp 116-20, CRC Press, USA.

Dhaliwal G S, Jindal Vikas and Dhawan A K. 2010. Insect pest problems and crop losses: Changing trends. *Indian Journal of Ecology* **37**(1): 1-7.

Dhaliwal G S and Arora Ramesh. 1994. *Trends in Agricultural Insect Pest Management*, Commonwealth Publishers, New Delhi.

De Groote H. 2002. Maize yield losses from stem borers in Kenya. *Insect Science and its Application* **22**(2): 89-96

Muralidharan K, Krishnaveni D, Rajeswari N V L and Prasad A S R. 2003. Tungro epidemics and yield

losses in paddy fields in India. *Current Science* **85**(8): 1143-7.

Muralidharan K and Pasalu I C. 2006. Assessments of crop losses in rice ecosystems due to stem borer damage (Lepidoptera: Pyralidae). *Crop Protection* **25**: 409-17.

Nag S K, Nahatkar S B and Sharma H O. 2000. Post-harvest losses of chickpea as perceived the producers of Sehore District of Madhaya Pradesh. *Agricultural Marketing* **43** (3): 12-6.

Nair M R G K. 1975. *Insects and Mites of Crops in India*, Indian Council of Agricultural Research, New Delhi.

Rajarajeswari N V L and Muralidharan K. 2006. Estimates of farm yields and district production loss from blast epidemics. *Journal of Mycology and Plant Pathology* **36**(2): 115-24.

Rajarajeswari N V L, Dinaker C and Muralidharan K. 2004. Assessing injury to grain filling and yield losses from Tungro virus epidemics. *Indian Journal of Plant Protection* **32**(1): 73-9.

Reddy K V S and Zehr Usha B. 2004. Novel strategies for overcoming pests and diseases in India. *In*: *New Directions for a Diverse Planet*, Proceedings of the 4th International Crop Science Congress, 26 September-1 October 2004, Brisbane, Australia.

Solanki B S, Singh Rajesh, Meena S C and Niranjan H K. 2011. An analytical study of post– harvest losses of soybean as perceived by the producers of Rewa District (M.P.). *Flora and Fauna* **17**(1), (Special Issue): 190–4.