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Impact Assessment of Plant Protection Technologies for Sustainable Production of Pulses in Central India

Agriculture

KEYWORDS : Plant protection technologies, Impact, Assessment and pulses production

Satya Prakash Singh Tomar	RVS Krishi Vishwa Vidhyalaya, Gwalior-474002 (M.P.) India
Pradeep Singh Kushwah	Shivpuri (M.P.)
Pushpendra Singh	Krishi Vigyan Kendra, Piparsama Shivpuri

ABSTRACT

On farms trails (OFT) and Frontline demonstration (FLD) are the most powerful tools for assessment and demonstration of technology in micro farming situation. Keeping in view of an effective extension approach for dissemination of plant protection technologies for sustainable production of pulses in central India farming system conducted at 45 farmers fields in 10 villages of three districts viz, Gwalior, Bhind and Morena in Gird agro climatic zone of Madhya Pradesh at central India during four consecutive years 2008-09 to 2011-12 was assessed. The impact assessment was based on the technologies assessed over farmers' practices with reference to plant infestation per cent, yield, net return and cost benefit ratio. There are nine plant protection technologies were assessed and demonstrated at the farmers field for management of disease and insect pests in pulses. Average 4.7 per cent infestation , 16.17 q/ha yield, Rs 27351/ha net return and 2.4 cost benefit ratio in comparison to farmers practice 13.24 percent infestation , 13.73 q/ha yield, Rs 20654/ha net return and 2.0 cost benefit ratio. On farm trails and front line demonstrations were undertaken to validate location specific plant protection technologies to manage the insect pests' infestation and disease complex in pulses.

INTRODUCTION

Technology demonstration is the most effective way to show how a thing works, how to do the work, principles involved in an operation and to show the end results of the technology/ methodology adopted. Over the next three decades, production of food grains in India has to increase at least 2 million tonnes a year to meet the food demand of the growing population (Paroda and Kumar, 2000). In the past, agricultural production increased through area expansion and increasing use of high yielding seeds, chemical fertilizers, pesticides and irrigation water. Now, prospects of raising agricultural production through area expansion and application of existing technologies appear to be severely constrained. Land frontiers are closing down, and there is little, if any, scope to bring additional land under cultivation. Green revolution technologies have now been widely adopted, and the process of diminishing returns to additional input usage has set in. Concurrently, agricultural production continues to be constrained by a number of biotic and abiotic factors. For instance, insect pests, diseases and weeds cause considerable damage to potential agricultural production. Evidences indicate that pests cause 25 percent loss in rice, 5-10 percent in wheat, 30 percent in pulses, 35 percent in oilseeds, 20 percent in sugarcane and 50 percent in cotton (Dhaliwal and Arora, 1996).

Pulses, the food legumes, have been grown by farmers since millennia providing nutritionally balanced food to the people of India (Nene, 2006) and many other countries in the world. Pulses occupy a unique position in the agricultural economy of India being the major source of proteins in Indian dietary. Moreover, their role in improving the fertility of the soil, by microbial fixation of atmospheric nitrogen, further enhances their importance and utility. Traditionally, the farmers grow pulses as companion crops on marginal and unirrigated lands.

Introduction of green revolution technologies in mid-1960s gave a fillip to pesticide use, and in 1975-76, it had increased to 266 g/ha, and reached a peak of 404 g/ha in 1990-91 (Birthal, 2003). Although, there is a paucity of reliable time-series information on pest-induced production losses, anecdotal evidences suggest increase in losses (Pradhan 1983, Atwal 1986, Dhaliwal and Arora, 1996), despite increase in the pesticide use. The crop protection technologies and practices embedded provide better protection against insect pests, improve crop yields and net benefits to the farmers. Farmers are facing scarcity to improved and competent plant protection technology for diminish the losses due to infestation of different insect pests and diseases in their farms for sustainable production. Chick pea, pigeon pea, green gram and lentil are the dominant pulse crop and cultivated in the study area of Madhya Pradesh. The production of pulses has remained almost stagnant. The adoption rate of new technologies in pulses is low as compared to other crops. Pulses have highly unstable performance due to many biotic and abiotic stresses. Though, the role of plant protection is very well documented in pulses still there is a great scope to increase the total production through plant protection measures. Hence, there is an urgent need to implement, assessment and demonstrated the plant protection technologies for effective management of disease and insect pests in pulses. There are several disease, which attack pulses crop, the major ones, wilt, viral mosaic and among the insects- pests the pod borer, termite and sucking insects, which attack the reproductive stages, are of major economic importance.

No work has been done for minimize the losses due to insect-pests and disease and validate the suitable plant protection technology to the farmers of gird agro climatic zones of Madhya Pradesh in central India. Therefore, the present study was undertaken with the following specific objective:

1. An impact assessment of plant protection technologies for sustainable production of pulses at farmers field in central India farming system

MATERIALS AND METHODS

The field experiment was laid down five consecutive years during 2008 - 09 to 2011 – 12 at 45 farmers' fields in 10 villages of three districts *viz*, Gwalior, Bhind, Morena in Gird agro climatic zone of Madhya Pradesh, which is the part of central India. Madhya Pradesh is bounded by the state of Uttar Pradesh and Rajasthan on the north, Uttar Pradesh and Chhattisgarh on the east, Maharasthra on the south and Gujarat on the west, it is located between latitudes 23^0 10' N and longitudes77^0 12' E. The mean annual maximum and minimum temperature is ranged from 50^0 to 2^0 C. The average annual rainfall received from 750 mm to 1250 mm, out of which 90 per cent received during rainy session 15th June to September. The soils of study area are deep black, medium black, sandy light and alluvial. Five farmers fields in each crop were selected for assessment and demonstrate the one plant protection technologies with compared to farmers

practices. All the pulses crops were sown in the time and recommended agronomical package of practices were followed in all the plots. Treatments and plant protection technologies assessed and demonstrated in different crops were given in following tables with farmers practice (table 1). Data of damage plant per cent were recorded after sowing of the crop. The data of per cent infestation of damaged plant was calculated by using following formula.

$$\text{Damage plant percentage} = \frac{\text{Damaged plant/part}}{\text{Total plant}} \times 100$$

Yield, net returns and cost; benefit ratio were also calculated to find out the economics of various treatments under study.

Table 1: Treatments and plant protection technologies assessed and demonstrated in pulses

Crop	Technology Assessed
gram	Foliar application of profenophos 50 EC @ 1.5 lit/ha for management of pod borer infestation
	FP-(Endosulfan 35 EC @ 2.0 l/ha)
gram	Seed treatment with trichoderma viridi @ 5 gm/kg seed for management of wilt infestation
	FP- No use of seed treatment
Gram	Soil application of Trichoderma viridi @ 2.5 kg with 65 kg FYM/h for wilt management in gram
	FP-(No use of pesticides)
Gram	Soil application of Fipronil 0.3 % G @12.5 kg/ha for termite management
	FP-(No use of pesticides)
Pigeon pea	Foliar application of Spinosad 45% SC @ 250 gm/ha for the management of pod borer
	Indosulfan, trizophos @ 1.0 lit/ha
Pigeon pea	Pheromon trap @ 20 + HaNPV 500 LE + Quinolphos 25 EC @1.5 lit/ha for the management of pod borer
	FP- Indosulphan @1.5 lit/ha
Green Gram	Foliar application of Imidachloprid 17.8 % SL @ 250 ml /ha for management of YVM
	FP-(No use of pesticides)
Green gram	Seed treatment with Carbendazim @ 2 g/kg seed + Foliar application of Carbendazim @ 1 g/lit for the management of leaf spot disease complex
	FP- No use of Fungicide
lentil	Foliar application of Imidachloprid 17.8 % SL @ 250 ml/ha for the management of aphid
	FP-(No use of any management practices)

FP: Farmers Practices

RESULTS AND DISCUSSION

On farm trails and front line demonstrations were undertaken to validate location specific plant protection technologies to manage the insect pests' infestation and disease complex in pulses, results are given in table 2.

There are four plant protection technologies were assessed and demonstrated at the farmers field for management of disease and insect pests in chick pea are given in table 2. Among them two for the wilt management, first is seed treatment with trichoderma viridi @ 5 g/kg seed were evaluated and observed that 8.0 per cent infestation, 16.5 q/ha yield, Rs 24350/ha net return and 2.3 cost benefit ratio in comparison to farmers practice 23.0 percent infestation , 14.05 q/ha yield, Rs 19350/ha net return and 1.9 cost benefit ratio. Another one is soil application of *trichoderma viridi* @ 2.5 kg with 65 kg FYM/h for wilt management in gram were recorded the 2.5 percent infestation , 19.53 q/ha yield, Rs 20313/ha net return and 2.0 cost benefit ratio over farmers practice 6.5 percent infestation , 18.44 q/ha yield, Rs 18724/ha net return and 1.9 cost benefit ratio. Both the method of trichoderma application found superior over farmers practice and gave higher economics. Jeswani et al., 2004 were also reported trichoderma found effective for controlling wilt disease in gram. The antagonistic activity of trichoderma was noticed. Singh and Singh (2003); Tripathi and Khare (2005). Shrivastava et. Al. (2009); Prasad et.al (2003) found that trichoderma was found superior. Fungi of the genus Trichoderma had the ability to control numerous foliar, root and fruit pathogen (Singh et. al., 2010). Pod borer (*Helicoverpa*) was the major pest and its incidence was quite low 3.0 per cent infestation in foliar application of profenophos 50 % EC @ 1.5 lit/ha with 16.65 q/ha yield, Rs 23170 /ha net return and 2.8 cost benefit ratio, while in farmers practice (Endosulfan 35 % EC @ 2.0 lit/ha) were high (10.5 percent) infestation, 15.45 q/ha yield, Rs 20900/ha net return and 2.2 cost benefit ratio obtained in gram. On farm trails and front line demonstrations in soil application of fipronil 0.3 G @ 12.5 kg/ha to control the termite infestation in chick pea was also carried out. The average 4.2 per cent termite infestation was recorded with 19.8 q/ha yield, Rs 41560/ha net return and 2.9 cost benefit ratio over farmers practice 18.2 per cent infestation were showed with 16.7 q/ha yield, Rs 32340/ha net return and 2.5 cost benefit ratio. Termite feed upon roots and plants become dried. The above findings are in confirmed with Sharma *et.al.,* (2009) thus also reported termite infestation 20-25 per cent in rain fed and up to 10 per cent in irrigated crop.

In pigeon pea two pod borer management technologies were validated. Foliar application of (Spinosad 45 % SC @ 250 gm/ha) gave low 3.0 per cent pod borer infestation with 21.12 q/ha yield, Rs 40660/ha net return and 2.8 cost benefit ratio, farmers were happy in comparison to their own practice (Endosulfan and trizophos) higher 8.0 per cent infestation with lower yield 16.7 q/ha, Rs 29200/ha net return and 2.3 cost benefit ratio. Another technology pheromone trap 20 /ha, HaNPV 500 LE/ha and quinolphos 25 % EC @ 1.5 lit/ha was validated for pod borer management in pigeon pea and it was found that 4.0 per cent infestation with 21.5 q/ha yield, Rs 42000/ha net return and 2.8 cost benefit ratio in comparison to farmers practice (endosulfan 35 % Ec @ 2.0 lit/ha) 9.0 per cent infestation, 17.12 q/ha yield, Rs 30760/ha net return and 2.4 cost benefit ratio (Table-2). Spinosad and HaNPV both of the bio rational unique pesticides.

In case of green gram two plant protection technologies were selected for the management of yellow vein mosaic and leaf spot diseases. Due to incidence of yellow vein mosaic viral disease 6.0 per cent plant infestations was observed in recommended practice as foliar applica-

tion of imidachloprid 17.8 % SC @ 250 ml/ha with 3.0 q/ha yield, Rs. 1900/ha net return and 1.22 cost benefit ratio in comparison to farmers practice 19.5 percent infestation with 2.6 q/ha yield, Rs 1100/ha net return and 1.13 cost benefit ratio. Mung bean yellow mosaic virus (MYMV) is a major constraint to the cultivation of grain legumes in India, particularly green gram and blackgram. Gupta and Pathak (2009) reported that in epidemic year, 100 per cent yield loss was observed from MYMV infested blackgram in Bundelkhand agroclimatic zone. The viral diseases of pulses account up to 80 per cent yield losses with poor quality of seed, while the MYMV alone is capable to produce losses up to 80 to 100 per cent in green gram and black gram (Naimuddin, 2001). Low yield and economics were recorded in green gram, because crop was damaged due to continues rains in kharif session. Application of systemic insecticides such as aldicarb, disyston and foliar application of metasystox has been found effective in controlling the disease by reducing vector control (Vishwa Dhar et al., 2004). Seed treatment with carbendazim 50 % WP @ 2 g /kg seed and foliar application @ 500 gm/ha in green gram was carried out for the control of leaf spot disease and it was found that 6.0 per cent infestation with their yield 8.22 q/ha, net return Rs 13946 /ha and cost benefit ratio 1.7 observed over farmers practice 12.0 percent infestation with 6.78 q/ha yield, Rs 8554 /ha net return and 1.4 cost benefit ratio.

In the lentil Aphid is the major problem for minimize the yield. Foliar application of imidachloprid 17.8 % SC @ 250 ml/ha were gave the minimum infestation 5.5 per cent with higher production (19.2 q/ha.), net return (Rs. 38260/ha) and cost benefit ratio (2.96) in compression to farmers practice (not used any protection measures) with higher infestation 12.5 per cent with production 15.7 q/ha, net return Rs. 24960/ha and 2.3 cost benefit ratio. Yield losses in excess of 30% and associated reduced seed size in excess of 26% have been attributed to aphid feeding in lentils (Burns and Bragg, 1999), they are also confirmed and agreed with present findings.

Table: 2 Impact assessments of Plant protection technologies for management of insect pests and diseases in pulses

No.	Problem	Crop	Place	Technology Assessed	Performance of the Technology with parameter	Production (q/ha)	Net Return (Rs. / ha)	C : B Ratio
1	Low yield due to pod borer infestation	Gram	Gwalior*	Foliar application of profenofos 50 EC @ 1.5 l/ha	Infestation : 3 %	16.65	23170	2.8
				FP-(Endosulfan 35 EC @ 2.0 l/ha)	Infestation : 10.5 %	15.45	20900	2.2
2	Low yield due to wilt	Gram	Gwalior***	Seed treatment with trichoderma viridi @ 5gm/kg seed	Infestation – 8.0%	16.5	24350/-	2.3
				FP- No use of seed treatment	Infestation – 23.0%	14.05	19350/-	1.9
3	Low yield due to wilt disease	Gram	Bhind**	Assessment of Trichoderma viridi @ 2.5 kg with 65 kg FYM/ ha for wilt management	Infestation -2.5	19.53	20313/-	2.0
				FP-(No use of pesticides)	Infestation -6.5	18.44	18724/-	1.9
4	Low yield due to termite infestation	Gram	Morena***	Soil application of Fipronil 0.3 % G @ 12.5 kg/ha for termite management	Infestation -4.2	19.8	41560	2.9
				FP-(No use of pesticides)	Infestation -18.2	16.7	32340	2.5
5	Low productivity due to pod borer complex	Pigeon pea	Morena***	Pheromon trap @ 20/ha + HaNPV 500 LE/ha + quinolphos 25 EC @1.5 lit/ha	Infestation -4.0 %	21.5	42000	2.8
				FP- Indosulphan @1.5 lit/ha	Infestation -9.0 %	17.12	30760	2.4
6	Low yield due to pod borer infestation	Pigeon pea	Morena***	Foliar application of Spinosad 45% SC @ 250 gm/ha for the management of pod borer	Infestation -3 %	21.12	40660/-	2.8
				Indosulfan/ trizophos @ 1.0 lit/ha	Infestation -8 %	16.7	29200/-	2.3
7	Low yield due to yellow vein mosiac disease	Green Gram	Bhind**	Assessmant of Imidachloprid 17.8 % SL @ 250 ml / ha for management of YVM	Infestation -6 %	3.0	1900/-	1.22
				FP-(No use of pesticides)	Infestation -19.5 %	2.6	1100/-	1.13
8	Low productivity due to disease complex	Green gram	Morena***	Seed treatment with Carbendazim 50 % WP @ 2 g/kg seed + Foliar application of Carbendazim @ 1 g/lit	Infestation -6.0%	8.22	13946	1.7
				FP- No use of Fungicide	Infestation -12.0 %	6.78	8554	1.4
9	Low yield due to aphid infestation	lentil	Morena***	Foliar application of Imidachloprid 17.8 % SL @ 250 ml/ha	Infestation -5.5 %	19.2	38260	2.96
				FP-(No use management practices)	Infestation -12.5 %	15.7	24960	2.3
Average impact of plant protection technologies					4.7	16.17	27351	2.4
Average of farmers practices					13.24	13.73	20654	2.0

No of trails: 5 each

Farming situation: Rain fed *, Irrigated** and Semi irrigated*** FP: Farmers practice

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