



Full Length Research Paper

Adoptability of technologies based on plant protection measures in pulse crops

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Pulses have high nutritional value and worldwide commercial importance because these are rich source of protein and fibers. The productivity of pulses is lower in comparison to potential yield due to several biotic and abiotic stress. To show the productivity potential and profitability of need based plant protection in pulse crops (Black gram, Pigeonpea, Gram, pea and Lentil) total 74 front line demonstrations (FLDs) were conducted in 08 villages of Chhatarpur and Sagar districts of Madhya Pradesh under rain fed and partially irrigated condition. The pod borer (*Helicoverpa armigera*) population in Pigeonpea decreased by 56.6% with increase in seed yield (17.26%), net return Rs. 27430 and B:C ratio 5.03 with improved technology (IT) while larval population of pod borer in chick pea reduced by 80 per cent (from 1.5 to 0.3 per plant) with increase in yield of 28.1%. Yellow mosaic disease incidence in blackgram decreased significantly by application of Improved Technology by 61.5% (32.8 to 12.3%) which ultimately gave 50.7% higher grain yield. Seed treatment and soil application of *Trichoderma viride* decreased incidence of wilt disease by 68.6% in lentil and 68.1% in Gram, which also increased seed yield by 20.7 and 37.3% respectively. The management practice also gave net return of Rs. 15,230 and B:C ratio 3.37 in lentil crop and Rs. 25,650 net return and B:C ratio 4.0 in Gram as compared to FP plots (Rs. 11520 net profit and B:C ratio 3.08 for lentil and Rs. 17300 net profit and 3.27 B:C ratio for chickpea).

Key words: Pigeonpea, gram, blackgram, IPM, *Trichoderma viride*, demonstration.

INTRODUCTION

In India, pulses are the primary source of protein and fibers for the poor and vegetarians within the majority of population. Majority of farmers are small and marginal, cultivating pulse crops under rainfed conditions. India is the largest producer and consumer of pulses in the world.

India produces 17.21 million tonnes of pulses from an area of 24.78 million ha. The average productivity of country is about 689 kg/ha against the global productivity of 857 kg/ha (GOI, 2010). In the rainfed area of Bundelkhand region of Madhya Pradesh (Chhatarpur,

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Tikamgarh, Panna, Sagar, Damoh) pulses grows as cash crop by the farmers. In general, average productivity of Pigeonpea, gram and lentil continues to be lower (670, 1070 and 422 kg/ha respectively) mainly due to its cultivation on marginal lands under poor management, inappropriate production technology (wilt susceptible varieties, under dose of fertilizers, application of poor plant protection measures) and heavy infestation of insect pest at various stage of crop. Gram, lentil and Pigeonpea are attacked by various insects at different growth stages but wilt and pod borer are the key pest that causes heavy economic loss throughout the country. One larva of *Helicoverpa armigera* is capable of damaging 30 to 40 pods in its life time. Estimates indicate that 8 larva reared on 10 plants (in 1 m row) caused up to 39% yield loss (Sharma et al., 2006; Agrawal et al., 2003; Goyal et al., 1991).

The continuous cultivation of pulse crops without proper crop rotation has led to increase in pest and disease incidence causing 40% yield loss. There is potential to increase production of pulses by using best production practices and proper plant protection measures at right time. One way of managing such pest effectively is to grow resistant cultivars. Intensive efforts are underway to develop high yielding and resistant cultivars of pulses in India. Another important approach by which these insect pest and diseases could be managed is adoption of integrated management practices (Agrawal et al., 2002). Several technologies and management options have been developed for pulses, that can significantly reduce the losses due to insect pest and diseases, but adoption of these technologies by farmers has been far less than anticipated. Realizing the importance of extending these technologies for managing insect pest and diseases in pulse crops at farmer's level, front line demonstrations (FLDs) were conducted to show the productivity potential and profitability of need based plant protection measures. It is believed that these FLDs would enhance the adoptability of technologies based on plant protection measures in pulse crops amongst the farmers of Bundelkhand region and Chhattarpur and Sagar districts in particular.

MATERIALS AND METHODS

The improved technology (IT) that is, need based plant protection including seed treatment with pesticides (insecticide and fungicide) and prophylactic sprays (biological and chemical) and spray of safer pesticides as and when required based on the nature of pest and its damage symptoms. The IT was demonstrated on 0.40 ha plots in comparison with farmers practice (FP) of no spraying or indiscriminate use of pesticides, in order to provide farmers an opportunity to compare, evaluate and choose themselves the best practice based on their own criteria. The details of IT are presented in Table 1. The 74 FLDs were conducted in 08 villages of Chhattarpur and Sagar districts of Madhya Pradesh under rainfed or partially irrigated condition during 2009 to 2013. The data on incidence of disease, population of insects, seed yield, cost of cultivation and gross monetary return were collected from IT plots and FP plots. The following formulae were used to calculate the parameters:

1. Insect incidence/ plant = Number of damaging stage of the insect/ plant
2. Increase in grain Yield= Grain yield from IT plot – Grain yield from FP plot / Grain yield from IT plot X 100
3. Net Return= Gross Return – Cost of cultivation
4. Benefit/ Cost Ratio= Net Return / Cost of Cultivation * 100

RESULTS

The results indicate that IT plots recorded mean productivity improvement of 30% as compared to FP plots (Table 2). The pod borer (*H. armigera*) population in Pigeonpea decreased by 56.6% with increase in seed yield (17.26%), net return Rs. 27430 and B:C ratio 5.03 with improved technology as compared to farmers practice. IPM practices reduced the larval population of pod borer in Gram by 80% (from 1.5 to 0.3 per plant) with increase in yield of 28.1% and net profit of Rs. 23390 and 3.85 in comparison to net profit of FP Rs. 17360 and B:C ratio 3.63. Yellow mosaic disease incidence of Blackgram significantly decreased by IT (Seed treatment with Thimethoxam 70 WP at 5 gm/kg followed by spray of dimethoate 35 EC at 750 ml/ha) by 61.5% (32.8 to 12.3%) which ultimately given 50.7% higher seed yield (4.18 to 6.3 q/ha), Rs. 14200 net profit per hectare and 4.02 cost benefit ratio. Seed treatment and soil application of *T. viride* decreased wilt disease incidence by 68.6% in lentil and 68.1% in chickpea which increased seed yield by 20.7 and 37.3%, respectively over farmers practice (seed treatment by carbendazim). Application of *T. viride* also given net return of Rs. 15230 and B:C ratio 3.37 in lentil crop and Rs. 25650 net profit and B:C ratio 4.0 cost benefit ratio in chickpea gram as compared to FP plots (Rs. 11520 net profit and B:C ratio 3.08 for lentil and Rs. 17300 net profit and 3.27 B:C ratio for gram)(Table 3).

DISCUSSION

The reduction in the population of Pod borer may be due to trapping of male insects and timely spray of insecticides which ultimately resulted in the reduction in the insect incidence, increased yield and net return. Similar findings have also been reported by Agrawal et al. (2003), Rao and Reddy (2003) and Tripathi (2014). Their results revealed the reduced incidence of pod borer in Pigeon pea by installation of pheromone trap; spray of insecticide or NPV and at pre-flowering or podding stage with increase in yield of Pigeon pea at farmer's field.

Application of neem oil works as repellent for *H. armigera* and spray of profenophos destroys eggs and larvae thereby reducing their population. Singh et al. (2009) also reported that IPM modules (Installation of bird perches and pheromone trap, spray of insecticide at podding stage) are significantly superior over the untreated control both in term of protection (pod damage 10.86%) and production (Yield 1449 kg/ha) of gram.

Table 1. Crop wise target pest and diseases and the improved technology demonstration (2009-2010 to 2012-2013).

Crop	Target pest/disease	No. of locations	Year	Details of demonstration	Farmers practice
Pigeonpea	Pod borer	14	2010-2012	Improved variety ICPL 87119, Installation of pheromone trap 10/ha, Spray of NPV at 250 LE/ha, followed by dimethoate at 750 ml/ha	Improved variety ICPL 87119, Spray of quinolphos at 1000 ml/ha
Gram	Pod borer	30	2009-2010	Installation of bird perchers, pheromone trap 10/ha, Spray of neem oil 1500 ml/ha, followed by Profenophos at 1000 ml/ha	Spray of Trizophos or quinolphos at 1000 ml/ha
Blackgram	Yellow mosaic disease	10	2010-2011	Seed treatment with Thimethoxam 70 WP at 5 gm/kg followed by spray of dimethoate at 750 ml/ha	Spray of Trizophos at disease appearance at 750 ml/ha
Lentil	Wilt	10	2009-2010	Soil application of <i>Trichoderma viride</i> with FYM at 2.5 kg/ha + seed treatment with the same at 5 gm/kg seed	Seed treatment carbendazim at 2 gm/kg seed
Gram	Wilt	10	2009-2013	Soil application of <i>Trichoderma viride</i> with FYM at 2.5 kg/ha + seed treatment with the same at 5 gm/kg seed	Seed treatment carbendazim at 2 gm/kg seed

Table 2. Productivity potential of need based plant protection in pulses under rainfed semi-irrigated condition during 2009-2010 to 2012-2013.

Crops	No. of demonstrations	Insect incidence/Plant		Increase %	Grain yield (qtl/ha)		Increase in yield (%)
		Demo	F P		Demo	FP	
Pigeonpea	14	0.65	1.5	56.6	9.78	8.34	17.26
Gram	30	0.30	1.5	80.0	10.53	8.22	28.1
Disease incidence (%)							
Blackgram	10	12.3	32.8	61.5	6.3	4.18	50.71
Lentil	10	9.4	30.0	68.6	6.18	5.12	20.7
Gram	10	7.2	22.6	68.1	11.4	8.30	37.3
Total/Mean	74				8.84	6.80	30.0

Table 3. Economics of need based plant protection in pulses (2009 to 2012).

Crops	Cost of cultivation (Rs./ha)		Gross return (Rs./ha)		Net return (Rs./ha)		B:C ratio	
	Demo	FP	Demo	FP	Demo.	FP	Demo.	FP
Pigeonpea	6800	6200	34230	29190	27430	22990	5.03	4.7
Gram	8200	7300	31590	24660	23390	17360	3.85	3.36
Blackgram	4700	4100	18900	12540	14200	8440	4.02	3.05
Lentil	6400	5800	21630	17320	15230	11520	3.37	3.08
Gram	8550	7600	34200	24900	25650	17300	4.0	3.27

Market prize: Pigeonpea- Rs.3500, Gram -3000, Blackgram-3000, Lentil-3500 per quintal.

Seed treatment with Thiamethoxam 70 WP controlled sucking pest up to 15-20 days after germination in black gram and spray of Dimethoate 35 EC checks further

spread of white fly (insect vector of the disease) which ultimately reduces the incidence of yellow mosaic disease due to which yield of black gram increases.

Tomar et al. (2009) also found 117% and Raikwar et al. (2012) found 58% higher yield with improved package of practice of black gram under frontline demonstrations in comparisons to farmers practice.

The quality of fast multiplication and myco-parasitism of *T. viridae* reduces the population of fusarium spp. In gram and lentil fields which results in lower incidence of wilt. Results are in accordance with Sharma et al. (2008) and Tripathi (2014) who reported that soil application of *T. viride* effective in inhibiting the growth of *Fusarium oxysporum* f. Sp. ciceri under field condition which reduced the wilt incidence from 10.45 to 4.05.

Conflict of Interest

The authors have not declared any conflict of interest.

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