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Popularization of IPM Practices for Management of Chickpea Pod Borer, through Frontline Demonstrations under Semi Arid Conditions

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ABSTRACT

The present study was conducted to popularize the IPM practices for the management of chickpea pod borer through frontline demonstrations in Panchmahals district of Central Gujarat. Constraints in chickpea production were identified through participatory approach. Preferential ranking technique was utilized to identify the constraints faced by the farmers in chickpea production. The results revealed that Helicoverpa armigera (Hubner) was the dominant chickpea constraint ranked first followed by lack of knowledge about IPM (rank 2) and Agrotis ipsilon (rank 3). Fusarium wilt (Fusarium oxysporum f sp ciceri) occupied the fourth rank. The extent of yield losses in chickpea were due to biotic stresses, viz. H. armigera, Agrotis ipsilon, Fusarium wilt and stored grain insect pests was reported by the farmers. On the basis of Rank Based Quotient (RBQ) and Value Based Index (VBI), it was found that H. armigera (VBI = 2303) is a major threat to chickpea causing highest damage to the crop. Results indicate that IPM practices, application of bio-pesticides i.e., HaNPV and neem oil revealed the best performance reduction in pod damage. The yield of chickpea in IPM practice was 17.55 q/ha as compared to farmers practices (13.75 q/ha). The percentage increase in yield over farmer's practices was computed to be 27.64. Results of study on economic analysis of the yield performance revealed that the IPM practices recorded higher gross returns (` 43,875/ha) and net return (` 21,075/ha) with higher benefit cost ratio (1.92) as compared to farmer's practices (1.62). Mean difference with respect to farmers' knowledge level after implementation of frontline demonstrations increased to the tune of 33.13. The impact of frontline demonstrations was also analyzed which reflected significant improvement in knowledge and satisfaction level on the part of farmers. Frontline demonstrations brings out that the IPM practice is feasible and economically viable over farmers practice and is a better option to manage chickpea pod borer using eco-friendly measures.

Key words: Bio-pesticides, chickpea pod borer, IPM, Frontline Demonstration;

INTRODUCTION

Chickpea *(Cicer arietinum L.)* is one of the important pulse crop of world which is used extensively as a primary source of protein for human beings as well as nitrogen for many cropping systems and is widely grown in all Indian states. India is the largest producer of chickpea accounting for about 67 per cent of global production (GOI, 2011). Out of 10.94 mt chickpea produced world over from 11.99 m ha, India produces 7.48 mt from 8.21 m ha (FAO 2012). In Gujarat, chickpea occupies an area of 2.15 lakh hectares with a production of 2.10 lakh tones with an average productivity of 977 kg/ha, accounts for 2.46 per cent and 2.80 per cent area and production of country, respectively (Singh, 2010). Sharma and Peshin (2015). But the state's productivity in comparison to other state's average productivity is low. The low productivity can be attributed to several factors *i.e.* quality seed, growing methods and adaption of appropriate plant protection measures. By conducting survey, farmer's interaction and field diagnostics, it was observed that one of the important factors for low productivity of chickpea was attributed to infestation by pod borer, Helicoverpa armiger Hubner which causes both quantitative and qualitative loss. The yield loss in chickpea due to pod borer was 10-60 per cent in normal weather conditions (Bhatt and Patel, 2001). On an average, 30-40 per cent pods were found to be damaged by this pest and an average of 400 kg/ha grain was lost by the borer. In favourable condition, pod damage goes up to 90-95 per cent (Shengal and Ujagir, 1990). So far, use of chemical pesticides has been the major approach for controlling this pest in different crops in lndia and in most of the developing countries. Chemical control is one of the

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effective and quicker methods in reducing pest population, where farmer obtains spectacular results within a short period. However, over reliance and indiscriminate use of pesticides for longer periods resulted in a series of problems, mainly risk of environmental contamination, loss of biodiversity which contributed to the development of insecticide resistant H. armigera population, resurgence, out breaks of the secondary pests into primary pest status, destruction of natural enemies, increase in inputs on chemicals and toxicological hazards due to pesticide residue etc., The use of excessive and un-recommended pesticides to manage the menace is in vogue with the farmers. In IPM practices, bio-pesticides *viz.,* neem oil and HaNPV have been recommended for management of pod borer. In view of the above factors, front line demonstrations were undertaken in a systematic manner on farmers' field to show the worth of IPM practices and convince the farmers to adapt management practices of chickpea pod borer for enhancing production and productivity of chickpea.

METHODOLOGY

The present study was conducted in Panchmahals district of central Gujarat during 2009-2011 for popularization of IPM practices for management of chickpea pod borer and to find out the constraints in chickpea production, Participatory Rural Appraisal (PRA) technique was used. Preferential ranking technique was utilized to identify the constraints faced by the respondent farmers in chickpea production. Farmers were asked to perceive the extent of damage or yield loss (%) due to various biotic constraints in chickpea production. Further, the biotic constraints were quantified on the basis of Rank Based Quotient (RBQ) and Value Based Index (VBI) as per Ray, 1996; $RBQ = S[\{Fi(n + 1– I)\}/N \times n] \times 100$ where, Fi = Frequency of respondents for ith rank, N = number of respondent, n = number of rank, I = rank order. Then, VBI was calculated for each biotic constraint by multiplying RBQ and per cent losses due to various biotic constraints reported by the farmers. The biotic constraint having highest VBI was given the first rank. Based on higher order problems identified, front line demonstrations were planned and conducted at the farmers' field under technology demonstration. In all, 60 frontline demonstrations were conducted to convince them about IPM practices for H. armigera on chickpea. The two bio-pesticides used in IPM practices were neem oil and HaNPV. Neem oil : Locally available fresh neem oil was procured from market and used as foliar spray at two per cent concentration. Teepol solution was added at 0.1 per cent as a spreader at the time of spraying. Helicoverpa armigera Nuclear Polyhedrosis Virus (HaNPV) : Readily available HaNPV formulation was procured from Agro centre, Vejalpur. One per cent jaggery as a sticker, one per cent teepol as a spreader and 0.1 per cent Robin blue as a UV protectant were added at the time of spraying. The spraying operation was done in the evening hours to protect spores from UV rays. All the recommended cultural and agronomical practices were followed to raise healthy crop. One spray of azadirachtin (0.03%) in the form of neem oil followed by two sprays of HaNPV @ 250 LE/ha to manage the chickpea pod borer (IPM practices) was applied while the existing farmers practice i.e. excessive and un-recommended pesticides sprays was treated as check for comparison. The first spraying was initiated on the basis of economic threshold level of the insect (1 larva/5 plants) in the last week of February during both the seasons/years and repeated at 10 days interval with knapsack sprayer (spray fluid 500 litres/ha approx.). Thus, a total of three rounds of spraying were given during both the years. The larval population of H. armigera was recorded three days after each spraying by observing ten tagged plants from each treatment. At maturity, all the pods were collected from ten randomly selected plants from middle rows of each field and examined. Number of pods per plant and number of damaged pods; number of healthy and infested seeds were recorded and expressed as per cent pod damage and seed damage respectively. Pod damage (%) = Number of damaged pods/ Total No. of pods observed

Table 1: Ranks given by farmers for different constraints n=60

Constraints	Ranks							
	I	II	III	IV	V	VI	VII	VIII
Helicoverpa armigera	42	08	05	05	00	00	00	00
Lack of knowledge about IPM	35	10	07	05	02	01	00	00
Non-availability of good quality seed	31	09	07	05	02	03	02	01
Agrotis ipsilon	28	10	09	06	01	03	02	01
Fusarium wilt	27	11	06	04	04	03	02	03
Stored grain insect pests	24	10	07	05	05	03	02	04
Non-availability of reliable biocontrol agent	17	09	07	06	02	05	08	06
Lack of knowledge about crop production	15	10	06	05	02	04	09	10

Table 2: Prioritization of biotic stresses based on Value Based Index (VBI)

Biotic constraints	RBQ	Average yield loss (%)	VBI	Rank
H. armigera	93.13	26	2421	I
Agrotis ipsilon	82.50	23	1899	II
Fusarium wilt	79.38	15	1191	III
Stored grain insect pests	76.25	9	687	IV

Performance of FLD

A comparison of Frontline Demonstrations (FLD) based on recommended IPM technology and farmers practice were analyzed (Table 3). Of the two practices, IPM practice i.e. use of neem oil and HaNPV was found to be more effective in managing pod borer, H. armigera over farmers practice. IPM practices recorded significantly lower mean larval population of H. armigera. The dead cadavers of larvae were observed which hanged from top of inflorescence. The highest mean larval population was recorded in farmers' practices. H. armigera larval population varied from 1.38 (IPM practices) to 3.35 (farmers practices) larvae per ten plants. The findings are in close agreement with Padmanaban and Arora (2002) who reported three sprays at weekly interval of HaNPV 375 LE/ha recorded significantly lower larval population of 0.83/ten plants, and was as good as carbaryl 50 WP. HaNPV and neem oil combination too effectively checked pod borer infestation. The present observations are in close affirmity with the findings of Ramachandra Rao et al. (1990) who opined neem oil 3 per cent has high repellency activity against S. litura. Similar results were stated by Prabu (2009) who found neem oil effective against several insect pests. Dong and Zhao (1996) noted that azadirachtin has repellent, antifeedent, stomach and contact poison properties as well as inhibits growth of many insects.

Yield parameters revealed lowest per cent of pod damage (12.79), grain damage (9.62) and highest chickpea yield quintal per hectare (17.55) in the IPM fields whereas farmers practices encountered higher pod damage (27.38) and seed damage (18.22) which lead to lower yield of 13.75 q per hectare. The per cent increase in yield over farmers' practices was 27.64. The present findings are in agreement to those of Mallikarjuna (2009) and Gopali (1998) where they recorded pod damage up to 50 and seed damage of 46.86 per cent in untreated control. Mishra *et al.* (1984) noticed lower pod damage and highest grain yield in single spray of either insecticide or NPV, whereas five sprays of HaNPV @ 250 LE per ha at weekly interval gave satisfactory control of pests and resulted in increased grain yield. More or less yield enhancement in different crops in front line demonstration has amply been documented by Hossain (2007) who obtained significantly higher yield (1,856 kg/ha) from HaNPV sprayed plots which was statistically identical to cypermethrin followed by azadirachtin 0.03 per cent EC.

From these results, it is evident that the IPM practices faired better than the farmers practices under local conditions. Farmers were motivated by results of agro technologies applied in the front line demonstrations trials and it is expected that they would adapt these technologies in the coming years. Yield of the front line demonstration trials and potential yield of the crop was compared to estimate the yield gaps which were further categorized into technology index. The technology gap shows the gap in the demonstration yield over potential yield and it was 7.45 q/ha. The observed technology gap may be attributed to dissimilarities in soil fertility, salinity, erratic rainfall and vagaries of weather conditions in the region. Hence, to narrow down the gap location specific recommendation appears to be necessary. Technology index shows the feasibility of IPM practices at the farmer's field. The lower the value of technology index more is the feasibility. Result of study depicted in Table 3 revealed that the technology index values were 29.80. The results of the present study are in consonance with the findings of Hiremath and Nagaraju (2009) in case of onion crop.

Table 3: Yield attributes, technology gap and technology index of demonstration (Pooled data of 2 years)

Variables	Larval population of H. armigera (per 10 plants) [a]	Pod damage (%) [b]	Grain damage (%) [b]	Yield (q/h)	Yield increase (%) (q/h)	Technology gap (q/h)	Technology index (%)
Farmer's practice	3.35 (2.08)	27.38 (31.53)	18.22 (25.35)	13.75			
IPM practices	1.38 (1.54)	12.79 (20.94)	9.62 (18.06)	17.55	27.64	7.45	29.80
S.E±	0.05	0.33	0.30	0.25			
CV	8.59	3.98	4.37	3.62			
CD (P = 0.05)	0.14	1.07	0.97	0.79			

a Figures in parenthesis are transformed values of $\sqrt{x+1}$

b Figures in parenthesis are transformed angular values;

The economics of chickpea production under front line demonstrations were estimated and the results have been presented in Table 4. Economic analysis of the yield performance revealed that front line demonstrations with IPM practices recorded higher gross returns (₹ 43,875/ha) and net return (₹ 21,075/ha) with higher benefit cost ratio (1.92) as compared to farmers practices. These results are in accordance with the findings of Byrappa *et al.* (2012). Further, additional cost of ₹ 1600 /ha in demonstration has increased additional net returns by ₹ 7,900/ha with incremental benefit cost ratio 5.94 suggesting its higher profitability and economic viability of the demonstration. Similar results were also reported by Hiremath and Nagaraju (2009).

Table 4: Economics of frontline demonstrations (Pooled data of 2 years)

Variables	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	Benefit cost ratio
Farmer's practice	21,200	34,375	13,175	1.62
IPM practice	22,800	43,875	21,075	1.92
Additional in IPM practice	1,600	9,500	7,900	5.94*

*Incremental benefit cost ratio

Increase in knowledge:

Knowledge level of respondent farmers on various aspects of scientific chickpea production technologies before conducting front line demonstration and after implementation was measured and compared by applying dependent 't' test. It could be seen from Table 5 that farmers mean knowledge score increased by 33.13 after implementation of front line demonstrations. The increase in mean knowledge score of farmers was observed significantly higher, as the computed 't' value (6.81) was statistically significant at 5 per cent probability level. The results are at par with Narayanaswamy and Eshwarappa (1998). It means there was significant increase in knowledge level of the farmers due to (IPM practices) front line demonstration. This showed positive impact of front line demonstration on knowledge of the farmers that have resulted in higher adaption of improved farm practices. The results so arrived might be due to the concerted educational efforts made by the scientists.

Table 5: Comparison between knowledge levels of the respondent farmers about scientific farming practices of chickpea

n=60

Mean score			Calculated 't' value
Before FLD implementation	After FLD implementation	Mean difference	
26.9	60.03	33.13	6.81*

* Significant at 5% probability level.

Farmers' satisfaction:

The extent of satisfaction level of respondent farmers over extension services and performance of IPM practices of chickpea pod borer was measured by Client Satisfaction Index (CSI), the results of which are presented in Table 6.

Table 6: Extent of farmers satisfaction of extension services rendered

n=60

Satisfaction	Level number	Per cent
Low	07	11.67
Medium	19	31.67
High	34	56.67

CONCLUSIONS

It was observed from Table 6 that majority of the respondent farmers expressed high (56.67 %) to medium (31.67%) level of satisfaction for extension services and performance of IPM technology under demonstrations, whereas, only 11.67 per cent of respondents expressed lower level of satisfaction. The results are in conformity with the results of Narayanaswamy and Eshwarappa (1998), Kumaran and Vijayaragavan (2005) in case of bajra crop. The medium to higher level of satisfaction with respect to services rendered, linkage with farmers, and technologies demonstrated *etc.* indicate stronger conviction, physical and mental involvement in front line demonstration which in turn would lead to higher adaption. This shows the relevance of front line demonstration.

Based on the observation on various aspects it may be inferred that IPM practices for management of chickpea pod borer was found to be superior over farmers practice. The demonstration could convince the farmers to use IPM technology on account of its obvious advantages and effective management of pod borer. These innovative practices would minimize farmer's problem, improve decision-making and innovativeness to modify their farming practices. The impact of frontline demonstration was also analyzed which showed that there was significant improvement in knowledge level and satisfaction on the part of farmers.

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