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An approach for site-specific assessment of pod borer management in chickpea

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Abstract
Chickpea is an important legume widely consumed in India. It also plays an important role in sustainable agriculture enriching the soil through biological nitrogen-fixation. The gram pod borer (*Helicoverpa armigera*) is a major pest of chickpea accounting for 75 percent pod damage in the crop. The pod borer pest, collar rot and wilt pathogen constitute a major constraint to increase production. The on-farm trial (OFT) were undertaken by Mahayogi Gorakhnath Krishi Vigyan Kendra, Gorakhpur of Uttar Pradesh on the improved package and practices of chickpea in the district for the two consecutive years *viz*. 2017-18 and 2018-19 at the farmers field including control. Different integrated pest management (IPM) components i.e. proper tillage, line sowing and inter cropping with coriander/linseed, HYV GNG 1581, seed treatment with Carbendazim @ 2gm/kg of seed for management of collar rot and spray of indoxacarb 15.8% EC @ 1ml/liter water at 50% flowering and at 50% pod filling stage were comprised during 2017-18 and same technology with Emamectinbenzoate 5% SG @ 0.4 gm/litre water at 50% flowering and at 50% pod filling stage were also comprised during 2018-19 under on farm trial.The performance of improved technology was found most effective in controlling least number of affected plants/m^2 as well as least number of pods/plants. The average per cent reduction in affected plant/m^2 and affected pod/plantin chickpeawere recorded 43.65and 48.42 per cent respectively. The application of IPM strategies recorded mean grain yield of 17.28 which was 43.13 per cent more over farmers practice. The integrated approaches gave higher mean net returns of Rs. 48437/ha in chickpea which was 55.12 per cent more over farmers practices. On an average benefit cost ratio 3.34 was found under demonstrated technologies while it was 2.83 in farmer's practices. It was much encouraging to the farming communities and paved the way for implementation and evaluation at grass root level.

Keywords: Chickpea, IPM practices, pod borer (*Helicoverpa armigera* Hubner)

Introduction
Chickpea (*Cicer arietinum* L.) is one of the most important food grain legumes in the world with production of 14.78 million tons from an area of 14.56 million hectares and productivity of 1014.60 kg/ha in 2017 (FAOSTAT, 2019) [5]. It is an important source of energy, protein and soluble and insoluble fiber. Mature chickpea grains contain 60-65 per cent carbohydrates, 6 per cent fat and between 12 to 31 per cent protein, which is higher than any other pulse crop (Kerketta *et al.*, 2015) [7]. Chickpea is also good source of vitamins (especially Vitamins B) and minerals like potassium, phosphorous, calcium, magnesium, iron and zinc. Chickpea plays a significant role in improving soil fertility by fixing atmospheric nitrogen and the crop meets up to 80 per cent of the soil nitrogen needs from symbiotic biological nitrogen fixation, so farmers have to apply less nitrogenous fertilizer than they do for other non-legume crops.
India is the world's leading producers of chickpea accounting for 11.23 million tons from the 10.56 million hectares with a productivity of 1063 kg/ha in 2017-18 (Agricultural Statistics at a Glance, 2018) [1]. In India, it is grown throughout the country excepting on high altitude of northern and north eastern regions and coastal peninsula. Madhya Pradesh (4.60 million tons), Maharashtra (1.78 million tons), Rajasthan (1.67 million tons), Karnataka (0.72 million tons), Andhra Pradesh (0.59 million tons), Uttar Pradesh (0.58 million tons), Gujrat (0.37 million tons), Chhattisgarh (0.32 million tons), Jharkhand (0.29 million tons) and others (0.32 million tons) are the major chickpea producing states sharing over 95% area. In Uttar Pradesh, chickpea crop is cultivated over an area of 0.50 million hectare with an annual production of 0.58 million tones and productivity of 1156 kg/ha (Agricultural Statistics at a Glance, 2018)[1].In 2018-19, district Gorakhpur produced 268 metric tons production from 179thousand hectares area with average productivity of 15.00 q/ha (DES, 2019) [3]. The major biotic stresses *viz*. gram pod borer, gram semi looper, termite, wilt, collar rot, black rot, stem

rot, root rot, ascochyta blight and botrytis grey are responsible for low yield of chickpea. Among these biotic stresses, wilt/root rot causes yield loss in chickpea about 20-25 per cent (Chandrashekar *et al.*, 2014) [2] and gram pod borer is a major pest (Kumar, *et al.*, 2019) [8] accounting for 21 per cent yield losses and 50-60 per cent pod damage in the crop (Kambrekar, 2012) [6]. Therefore, present studies were carried out at farmer field as on farm trial (OFT). The on-farm trial conducted under the close supervision of scientist of the KVK. The basic objectives of OFT were to identify existing practices that may help to solve major problems of many farmers in defined areas and also create awareness/ establishment of new management technologies available.

Materials and Methods

The on-farm trial on chickpea for pod borer management was conducted by Mahayogi Gorakhnath Krishi Vigyan Kendra, Gorakhpur (U.P.) during the Rabi season 2017-18 and 2018-19 at farmers field. Technological gap between improved management package and farmers practices were studied based on survey and group discussion with farmer interactive group (FIG) of chickpea growers in selected villages. The farmers of this villages had small and marginal land holdings. The total number of farmers were100, out of these 25 farmers were chosen at random separately from each village and eight improved management packages were selected to study the technological gap. Among these, the eight number of innovative farmers were selected for on farm trial (OFT) programme during both the year.

The on-farm trial OFT on chickpea for pod borer management technology was taken in an area of 0.1 hectare of each farmer and repeated four times during both the years. The total 0.8 hectares area was covered in two years for trial of assessment of IPM practices for pod borer management of chickpea. The chickpea variety GNG 1581 was sown with two treatment and four replications. The IPM practices for pod borer management i.e. proper tillage, line sowing and inter cropping with coriander/linseed, HYV GNG 1581, seed treatment with Carbendazim @ 2gm/kg of seed for management of collar rot and spray of indoxacarb 15.8% EC @ 1ml/liter water at 50% flowering and at 50% pod filling stage were comprised during 2017-18 and same technology with Emamectinbenzoate 5% SG @ 0.4 gm/litre water at 50% flowering and at 50% pod filling stage were also comprised during 2018-19 under on farm trial. The control plots i.e. no use of seed treatment, no weed management no spray of insecticide and non-application of other IPM strategies were also kept in OFT. Performance of IPM practices against pod borer was observed in terms of the percentage of infected plant per meter square and damage pod due to pod borer on the basis of affected plants and pod in relation to total pods in respective treatment. Benefit cost ratio of each treatment was also assessed. Farmers reactions were observed with the help of personal interview and data on quantitative parameters were recorded and percent increase yield was calculated by using following formula.

$$\text{Percent increase yield} = \frac{\text{Demonstrated yield-Farmers practices yield}}{\text{Farmers practices yield}} \text{ x } 100$$

Results and Discussion

The data given in table 1 revealed that the farmers were not aware recommended improved crop production technology i.e. HYV, seed rate, sowing method, balance dose of fertilizer, seed treatment, weed management and plant protection measures due to lack of knowledge about advantage of improved management package. The farmers were using local variety/non-identified variety and are not using the recommended sowing method and seed rate also. As per recommendation 18 Kg N, 46 Kg P_2O_5 and 20 kg sulphur in deficient soil per hectare should be applied as a basal dressing at the time of sowing but the farmers were not using fertilizers. The reason of not using recommended dose of chemical fertilizer were mostly attributed by the farmers to the lack of knowledge behind the importance of balanced dose of fertilizer in pulse crop. Seed is to be treated by bio-fungicide i.e. *Trichoderma* and *Rhizobium* culture for wilt management and better nodulations (nitrogen fixation), respectively. The analysis reveals that the farmers were not using recommended seed treatment technique and they were not also followed weed management practices. The chickpea crop suffers from severe narrow and broad leaf weed infestation and it also provides shelter for insect pest and diseases which cause in drastic reduction in grain yield. Therefore, it is advisable to keep the field free from weeds. One and two hand weeding should be done for better crop growth. It is because of lack of knowledge about seed treatment and losses in productivity due to weed infestation in chickpea crop. Wilting and pod borer are also major constraints of reduction in productivity of chickpea crop. As regards plant protection measure, the data revealed that farmers were not using plant protection measures. The lack of knowledge about IPM practices in chickpea crop was the important reason behind this. The present findings are supported by Singh *et al.* (2011) [10].

Table 1: Comparison between improved management package and farmers practices under OFT on chickpea.

Sl. No.	Particulars	Improved management package	Farmers Practices
1	Variety	GNG 1581	Local
2	Seed rate	80 Kg/ha	50-60 kg/ha
3	Sowing method	Line sowing with seed drill (30x 10 cm), 8-10 cm. deep	Broadcasting
4.	Situation	Rainfed	Rainfed
5.	Fertilizer dose	100 kg DAP (18 kg N: 46 kg P_2O_5) and 20 kg sulphur/ ha	Nil
6	Seed treatment	*Trichoderma* @ 5 g/kg seed and *Rhizobium* culture @ 200 g/10 kg seed	No seed treatment
7	Weed management	One to two hand weeding	No weeding
8	Plant protection measure	Need based biological and chemical insecticide spray	No spray of insecticide

IPM practices and yield performance

The incidence of pod borer during rabi 2017-18 and 2018-19 was compared (table 2) in terms of mean percentage plant/m^2 and pod damage per plant. The effect of treatments on affected plants, pod damage, grain yield and per cent increase in yield indicated that mean percentage affected plants and pod damage was inversely correlated with grain yield. The performance of improved technology was found most effective in controlling least number of affected plants/m^2 as well as least number of pods/plants. The average per cent

reduction in affected plant/m^2 and per cent reduction in affected pod/plant were recorded 43.65 and 48.42 in chickpea. The average yield was 17.28 q/ha in demonstrated plots as well as control plot was 12.06 q/ha. The results clearly speak of the positive effect of the demonstration over existing practice towards enhanced the yield of pulses in demonstrated area. Similar findings were reported by Singh *et al.*, (2011) [10] and Dwivedi, *et al.*, 2013 [4].

Table 2: Performance of on-farm trial on chickpea for pod borer management during 2017-18 to 2018-19

Year	% reduction in affected plant/m2	% reduction in affected pod/plant	Yield (q/ha)		% increase in yield
			Demo.	Farmers practice	
2017-18	42.86	52.00	18.73	12.36	51.53
2018-19	44.44	44.83	15.83	11.75	34.72
Average	43.65	48.42	17.28	12.06	43.13

Economic performance

The data obtained regarding the economic analysis for assessed technology was presented in table 3. The data revealed that, monetary returns were directly influenced by the market price of chickpea seed and cost of production during the successive years of technology assessment. Different variables like seed, proper tillage, line sowing and inter cropping with coriander/linseed, fertilizers, seed treatment and chemical pesticides were considered as a component of IPM practices. The inputs and outputs of commodities prevailed during each year of assessment were taken for calculating cost of cultivation, net return and benefit cost ratio. The average cost of cultivation increased by 21.12% in chickpea with use of IPM components as compared to farmers practice. The profitability of chickpea crop revealed that it produced maximum average gross monetary return i.e. Rs. 69120/ha as compare to farmers' practice (Rs. 48220/ha). The gross monetary returns received by 43.13% more over farmers practice by application of IPM practices in chickpea for pod borer management. IPM practicesalso gave average higher net income of Rs 48437/hawhich was 55.12 per cent more over farmers practices with benefit cost ratio of 3.34. The data indicated that the positive effect of IPM technology over the existing practices towards increasing the yield of chickpea crop in Gorakhpur district of Uttar Pradesh. Farmers reactions about use of IPM practices was good and highly appreciable due to most effectiveness and higher benefit cost ratio as well as eco-friendly nature. So, it is clear that improved crop production technology and application of IPM practices for pod borer management was better and economical, it was also much encouraging for the farmers to adopt these technologies. The on-farm trial produced a significant positive result and providing potential and profitability of the improved technology under real farm situation which they have been advocating for a long time. The present results are in agreement with the findings of Singh and Yadav (2007) [11] and Patil *et al.*, 2017 [9].

Table 3: Economic analysis of on-farm trial on chickpea

Year	Cost of cultivation (Rs./ha)		CoC increased over farmers practice (%)	Gross returns (Rs./ha)		GMR increase over farmers practice (%)	Net return (Rs./ha)		Net returns increase over farmers practice (%)	BCR	
	Demo.	Farmers practice		Demo.	Farmers practice		Demo.	Farmers practice		Demo.	Farmers practice
2017-18	21171	17253	22.71	74920	49440	51.54	53749	32187	66.99	3.54	2.87
2018-19	20195	16895	19.53	63320	47000	34.72	43125	30105	43.25	3.14	2.78
Average	20683	17074	21.12	69120	48220	43.13	48437	31146	55.12	3.34	2.83

Demo. = Demonstration; CoC= Cost of cultivation; GMR= Gross monetary returns; BCR= Benefit cost ratio

* Cost of grain yield has been estimated at prevailing market rate i.e. Rs. 4000=00 per quintal in2017-18 and 2018-19

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