Evaluation of Front Line Demonstrations on Summer Rice through an Eco-Friendly Technology for Management of Yellow Stem Borer

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Paper Received on August 25, 2015, Accepted on October 03, 2015 and Published Online on October26, 2015

ABSTRACT

Rice (Oryza sativa L.), an important cereal crop in the world, provides a staple food for nearly half of the global population and like other crops rice also harbours numbers of insect pests amongst which yellow stem borer is major one. On the other hand, various technologies as well as extension tools are available to manage this pest effectively. However, the present study was undertaken with an objective to assess the impact of FLDs specifically single component demonstrations through an eco-friendly option i.e. application of Cartap hydrochloride 4G @ 18750 g/ ha to manage the pest in summer rice. The study was carried out by Howrah Krishi Vigyan Kendra during rabi-summer season from 2009-10 to 2012-13 for consecutive four years at randomly selected farmers fields of 4 adopted villages. In demonstration plots dead heart incidence was 2.6%, while in farmers' plots incidence was 19.0%. The white ear head incidence recorded was 3.8% in demonstration plots while in farmers' plots it was 28.0%. The average percentage increased in the yield over farmers' practices was 22.75%. The technology gap, extension gap and technology index calculated were 775 kg/ ha, 1125 kg/ ha and 11.23, respectively. Economic analysis says that net return as well as benefit cost ratio was higher under demonstrated technology as compared to farmers' plots.

Key word: *FLD, Impact, Rice, Yellow Stem Borer, Management;*

Rice (*Oryza sativa* L.), an important cereal crop in the world, provides a staple food for nearly half of the global population. Almost 90% of rice is grown and consumed in Asia. During 2012-13, rice is grown over an area of 42.41 million ha with the production of 104.4 million tonnes and the average yield is 2462 kg/ha in India (*Anon., 2013*). West Bengal is the richest reservoir of rice bio-diversity and the rice bowl of the country. The ecotypes of rice, spontaneously evolved in the state, are so diverse and different that scientists at one time coined them as *Oryza sativa* var. *beghalensis* (*Chatterjee et al., 2008*). Rice grows in the state in three different seasons viz. *Aus* (Autumn rice), *Aman* (Winter rice) and *Boro* (Summer rice). During the year 2010-11, the average productivity of summer rice in West Bengal is 3289.88 kg/ ha which is much higher than that of autumn rice or winter rice (*Anon., 2012a*). Howrah is a rice producing district in West Bengal and summer rice productivity in this district is even higher than that of state average. However, like other rice producing belts Howrah also faces insect pest problems in summer rice and the major one is yellow stem borer [*Scirpophaga incertulas* (Walker)]. The symptoms of damage of this pest are dead-hearts or dead tiller that can be easily pulled from the base during the vegetative stages, white ear heads during reproductive stage where the emerging panicles are whitish and unfilled or empty, tiny holes on the stems and tillers and frass or faecal matters inside the damaged stems. The pest can cause upto 19% yield loss in early planted rice crops and 38% to 80% yield loss in late-planted rice crops as reported in the district. As this

pest can complete three generations in a year in West Bengal condition, it is a serious threat for rice production especially in rice-rice cropping system which is common in Howrah district. Several initiatives were already taken with an objective to enhance summer rice production through minimizing the incidence of pest problems. Number of technologies has been evolved in the research stations to manage this pest effectively e.g. cultural control measures including proper timing of planting and synchronous planting, harvesting the crop at ground level, removing the stubbles and volunteer rice, ploughing and flooding, handpicking and destroying the egg masses, maintaining the proper height of irrigation water, cutting the leaf tops before transplanting, split application of nitrogenous fertilizer etc. biological control measures, the use of resistant varieties and chemical control measures. As per National Centre for Integrated Pest Management, application of Cartap hydrochloride 4G @ 18750 g/ ha is an effective option for management of this pest on rice both in nursery and in main field (*Prakash et al., 2014*). Cartap hydrochloride is an animal originated insecticide, safer to domestic animals, user-friendly and it is eco-friendly. In order to take this technology at the farmers' fields, a targeted and focused approach was initiated from 2009 by Howrah KVK through proven Front Line Demonstrations (FLD), which is one of the most important and powerful tools of extension. FLD is the new concept of field demonstration evolved by the Indian Council of Agricultural Research (ICAR) in the inception of the Technology Mission on Oilseed Crops during mid-eighties. The field demonstration conducted under the close supervision of Scientists of the National Agriculture Research System (NARS) is called frontline demonstrations because the technologies are demonstrated for the first time by the Scientists themselves before being fed into the main extension system of the State Department of Agriculture. The main objective of FLD is to demonstrate newly released crop production and protection technologies and its management practices in the farmers' fields, the scientists are required to study the factors as well as constraints of production and thereby generate production data and feedback information (*Ahmad et al., 2013*). Therefore, the present study was undertaken with an objective to assess the impact of FLDs specifically component demonstrations through an eco-friendly option to manage yellow stem borer in summer rice conducted by Howrah KVK.

METHODOLOGY

The present study was carried out by Howrah Krishi Vigyan Kendra under the guidance of Bidhan Chandra Krishi Viswavidyaya as well as ICAR (Zone-II) during *rabi*-summer season from 2009-10 to 2012-13 for consecutive four years at randomly selected farmers fields of 4 adopted villages viz. Jhingra, Jagatballavpur, Chandul and Chhit Santoshpur of Jagatballavpur block of Howrah district in West Bengal. The area under each demonstration is 0.13 ha (i.e. 1 *bigha*). In the demonstration, one control plot was also kept where farmers' practice was carried out. As a whole, 105 numbers of FLD were conducted in 14 ha area. Through survey, Participatory Rural Appraisal (PRA), farmers meeting and field diagnostic visit during the cropping period, low yield of summer rice was conceived due to improper management of yellow stem borer as one of the most important factors. Any FLD may be of two types; Single component i.e. using single technology and Muti-component i.e. using more than one technology. Therefore, in this experiment, a specific technology in each FLD i.e. single component demonstration regarding eco-friendly management of yellow stem borer of summer rice var. Shatabdi (IET-4786) has been followed viz. application of Cartap hydrochloride 4G @ 18750 g/ ha at 18-21 days after transplanting. Well before the conduction of FLD, training to the farmers of respective villages was imparted with respect to envisaged technological interventions. Time to time monitoring of FLD plots were carried out by the KVK scientists and farmers were advised to carry out operations accordingly. Firstly, for studying the efficacy of demonstrated technology, percent infestation of yellow stem borer in terms of dead heart and white ear head has been recorded during cropping period. After harvesting of the crop, the data on yield and cost of cultivation from both demonstration plots and control plots were collected and afterwards gross income, net income and benefit cost ratio have been computed. For the study, technology gap, extension gap and technology index were calculated as suggested by *Samui et al. (2000)*.

Technology gap = Potential yield – Demonstration yield

Extension gap = Demonstration yield – Farmers yield

$$\text{Technology index} = \frac{\text{Technology gap}}{Potential\ yield} \times 100$$

RESULTS AND DISCUSSION

Efficacy of demonstrated technology: The percent infestation of yellow stem borer is expressed in terms of dead hearts and white ear heads. Table 1 shows that in demonstration plots dead heart incidence ranged from 1.2% during 2012-13 to 5.0% during 2009-10 and the mean value was 2.6% for four years of FLD while in farmers' plots dead heart incidence varied from 11.5% (2012-13) to 24.0% (2009-10) and the average was 19.0%. In case of white ear head during maturity stage of the crop the incidence ranged from 2.7% (2009-10) to 5.7% (2012-13) in demonstration plots and the mean value was 3.8%, while in farmers' plots it varied from 24.0% (2009-10) to 32.0% (2011-12) and average value was 28.0%. This results clearly suggest that the demonstrated technology i.e. application of cartap hydrochloride granule had positive effect in minimizing the population of yellow stem borer. Similar type of results had been obtained earlier by Kandsamy and Ravikumar (1986) and Mamoon-ur-Rashid et al. (2013).

Yield: The average yield was much higher (6125 kg/ ha) in demonstration plots than as compared to average yields of farmers' practices (5000 kg/ ha) (Table 2). The average percentage increased in the yield over farmers' practices was 22.75% which indicated that the component demonstrations through management of yellow stem borer have provided a good impact over the farming community of demonstrated areas in

Table 1.Percent infestation of yellow stem borer on summer rice

Year	Dead heart (%)		White ear head (%)	
	Demonstrated technology	Farmers' practice	Demonstrated technology	Farmers' practice
2009-10	5.00	24.00	2.70	24.00
2010-11	2.40	19.00	3.20	27.00
2011-12	1.80	21.50	3.60	32.00
2012-13	1.20	11.50	5.70	29.00
Overall av.	2.60	19.00	3.80	28.00

Table 2. Grain yield, Extension gap, Technology gap and Technology index of component demonstrations on summer rice

Year	No. FLDs	Potential of (kg/ ha)	Demo. yield (kg/ha)	Farmers' yield yield (kg/ ha)	% practice	Ext. increase (kg/ ha)	Tech. gap (kg/ ha)	Tech. gap index
2009-10	15	6900	5800	4500	28.89	1300	1100	15.94
2010-11	18	6900	6200	5000	24.00	1200	700	10.14
2011-12	43	6900	6300	5300	18.87	1000	600	8.70
2012-13	29	6900	6200	5200	19.23	1000	700	10.14
Overall av.	26.25	6900	6125	5000	22.75	1125	775	11.23

Table 3. Economic analysis of component demonstrations on summer rice

Year	Gross Return (Rs./ ha)		Cost of Cultivation (Rs./ ha)		Net Return (Rs./ ha)		B:C ratio	
	Demo. tech.	Farmers' practice	Demo. tech.	Farmers' practice	Demo. techn.	Farmers' practice	Demo. tech.	Farmers' practice
2009-10	69900	57200	37800	34800	32100	22400	1.85	1.64
2010-11	77500	62500	42000	39000	35500	23500	1.85	1.60
2011-12	88200	58300	45000	43500	43200	14800	1.96	1.34
2012-13	89900	62400	46875	45000	43025	17400	1.92	1.39
Overall av.	81375	60100	42918.75	40575	38456.25			

Howrah district of West Bengal. This finding is in corroboration with the experiments of NCIPM in Odisha (*Anon., 2012b*) where one treatment was application of cartap granule among the four insecticidal treatments for rice pest management in IPM plots.

*Technology gap:*The technology gap in the demonstrated yield over potential yield was 775 kg/ ha (Table 2). This technological gap may be attributed to the selection of only one technology i.e. one component in this experiment amongst numbers of improved technologies involved in front line demonstrations for enhancing crop yield. The technology gap varied from 600 kg/ ha to 1100 kg/ ha in different years of study.

Extension gap: The highest extension gap of 1300 kg/ ha was recorded during 2009-10 followed by 1200 kg/ ha during 2010-11 and the gap was least (1000 kg/ ha) during last two years of study i.e. 2011-12 and 2012-13 (Table 2). On an average the extension gap recorded in this study was 1125 kg/ ha. This emphasized the need to educate the farmers through various means for adoption of improved technologies. The light of hope exists in decreasing trend of the extension gap with the continuity of the study in specific area of demonstration.

Technology Index: The technology index shows the feasibility of the evolved technology at the farmers' fields and the lower the value of technology index more is the feasibility of the technology (*Jeengar et al., 2006*). Table 2 shows the range of technology index from 8.70 during 2011-12 to 15.94 during 2009-10 and the average value was 11.23. During, 2010-11 and 2012-13 the values were same i.e. 10.14. The table clearly suggests that the values are in decreasing trend except for the last year which proves the feasibility of the technology demonstrated.

Economic analysis: The inputs and outputs prices of commodities prevailed during the study of demonstrations had been taken into consideration for calculating gross return and cost of cultivation and afterwards from these two parameters net return as well as benefit cost ratio had been computed and presented in Table 3. The cultivation of summer rice under demonstrated technology gave higher net return of Rs. 38,456.25/ ha as compared to farmers' practices (Rs. 19,525.00/ ha. Similarly, the benefit cost ratio calculated was also higher in demonstration plots (1.89) as compared to farmers' plots (1.49). This may be due to higher yields obtained under improved technologies compared to local practices (*Mokidue et al., 2011*).

CONCLUSION

From the study it can be concluded that yield potential of summer rice can be increased up to 22.75% by minimizing extension gap through reducing yellow stem borer infestation by applying Cartap hydrochloride 4G @ 18750 g/ ha at 18-21 days after transplanting and front line demonstration of this technology definitely has an impact on this aspect. The technology demonstrated here has been proved economically viable also.\

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