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Ecological Engineering: A Potential Way for Controlling Pests and Improving Paddy Productivity

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ABSTRACT

Paddy (*Oryza sativa* L.) is an important food crop cultivated over 40,000 ha in Erode district. Attempts were made to control the pests in paddy by adopting recent techniques called Ecological Engineering. The technologies comprised of seed treatment with pseudomonas and azospirillum, growing of bund crops like sunflower, aster, urd, mung for attracting the natural enemies, installation of traps for monitoring the pest population, plant protection by using plant extracts and bio pesticides were demonstrated in the farmers' field. The results showed that, adoption of ecological engineering methods reduced the pest infestation percentage to 9.75 per cent over compared practices of 23.12 per cent. The natural enemies' population of 16.65 numbers was recorded in demonstrated plot/m^2 and in farmers' practice on an average 2.6 natural enemies observed. The results showed that the higher grain yield of 4620 kg/ha compared to 4196.5 kg/ha in farmers practice with the yield advantage of 10.12 per cent. The average extension gap, technology gap and technology index were 423.5 kg/ha, 480 kg/ha, and 9.41 per cent, respectively. The result reveals that the adoption of ecological engineering practices in paddy cultivation reduces the pest infestation and improves the productivity in an eco friendly manner.

Keywords: Ecological Engineering, Paddy, Pests

INTRODUCTION

The world population is projected to increase 40 per cent by the year 2020 and grain cereals such as rice and wheat are expected to assume a larger role in providing the basic daily dietary requirement for human growth and development. This is especially true for rice as this cereal provides the dietary calories of about 50 per cent of the world's population, most of whom live in Asia. With current Asian population growth rate of 1.8 per cent per annum, the demand of rice is expected to increase by 70 per cent by 2025 (Saravanakumar *et al*., 2007). To sustain the present food sufficiency and to meet out the future food requirements, new methods of rice cultivation must be identified to increase water productivity. Asian countries account for 90 per cent of the world's production and consumption of rice. The continuous increase in population and reduction of land for agricultural production demand further yield increase. In Erode, Paddy is cultivated more than one lakh ha area with average production of 4.4 t/ha. 35-40 per cent of the total cost of cultivation is mainly incurred for managing pests and diseases as this area is prone to stem borer and leaf folder incidence. The abundant and imbalance use of chemicals not only reduced the soil fertility, induced acidification and also polluted the environment. Ecological engineering for pest management has recently emerged as a paradigm for considering pest management approaches that rely on the use of cultural techniques to effect habitat manipulation and to enhance biological control. The cultural practices are informed by ecological knowledge rather than on high technology approaches

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such as synthetic pesticides and genetically engineered crops. Natural enemies may require food in the form of pollen and nectar for adult natural enemies, Shelters such as overwintering sites, moderate microclimate etc. and alternate hosts when primary hosts are not present. Due to enhancement of biodiversity by the flowering plants, parasitoids and predators (natural enemies) number also will increase due to availability of nectar, pollen, fruits, insects, etc. To overcome this situation Krishi Vigyan Kendra planned to demonstrate the ecological engineering pest management technologies in paddy cultivation in farmers' field.

METHODOLOGY

Frontline demonstration (FLD) is the concept evolved by Indian Council of Agricultural Research (ICAR) with the objective of demonstrating newly released varieties and technologies in the farmer's field in order to show the production potential of this particular variety or technology to the specific agro climatic conditions. Demonstration on pest management in paddy by using Ecological engineering techniques were laid out by Krishi Vigyan Kendra during 2013-14 and 2014-15 in selected farmers field. Each demonstration was conducted in an area of 0.4 ha and adjacent to the farmers' fields in which the crop was cultivated with farmers' practice/variety. Scientific interventions under frontline demonstrations were taken as mentioned in Table 1. The selected progressive farmers were trained on all scientific paddy cultivation aspects before starting of frontline demonstrations. The demonstrated fields were regularly monitored and periodically observed by the scientists of KVK. At the time of harvest yield data were collected from both the demonstrations as well as farmers' practice.

Identifying the numbers of pests and beneficial insects helps the farmers to make appropriate pest management decisions. Sweep nets, visual counts were adopted to arrive the number of pests and defenders. The P:D ratio vary depending on the feeding potential of natural enemy as well as the type of pests and general rule to be adopted for management decisions relying on the P:D ratio is 2:1. To study the impact of frontline demonstrations, data from FLD and farmers practices were analyzed. The extension gap, technology gap and technology index were calculated using the standard formula as suggested by Samui *et al.* (2000).

RESULTS AND DISCUSSION

The results of natural enemies population and pest infestation percentage has been indicated in Table 2 and shows that the adoption of ecological engineering pest management practices drastically increased the natural enemies population of 16.65/m^2 as compared to that of

Table 1: Intervention points for low yield of black gram and their recommended improved practices

Intervention points	Recommended improved practices
Variety	Aduthurai-39
Seed rate	30 kg/ha
Seed treatment	Treat the seeds with *Pseudomonas fluorescens* @ 10 g/kg seed. Followed by the seeds are treated with 600 gram of azospirillum culture
Spacing	22.5 x 10 cm
Manures and fertilizers	12.5 ton Farm Yard Manure and need based fertilizer application
Weeding	Manual weeding on 15th and 30th Days after sowing
Growing of bund crops	Sunflower, aster, urd and mung
Above ground level	Traps installation for monitoring pestsApplication of neem and pungam based oils as precautionary measuresEnhances the biodiversity by growing flower crops
Below ground level	Application of *Pseudomonas fluorescence* @ 2 kg/haApplication of neem cake @ 80 kg /ha

Table 2: Natural enemies presence and pest infestation percent

Year	Natural enemies population /m² area		Pest infestation percent	
	Demo	Check	Demo	Check
2013 – 14	16.4	2.8	10.2	24.10
2014 – 15	16.9	2.4	9.3	22.13
Average	16.65	2.6	9.75	23.12
Std. Dev	0.35	0.28	0.64	1.39

Table 3: Yield of paddy as influenced by Ecological engineering techniques over local practices in farmer's fields

Year	Variety	FLD (Nos.)	Yield (kg/ha)				Percent increase over farmer practice
			Demonstrated field			Local check	
			Maximum	Minimum	Average		
2013-14	ADT - 39	10	4631	4437	4530	4185	8.30
2014- 15	ADT - 39	20	4878	4568	4710	4208	11.93
Total	30	9509	9005	9240	8393	20.23	
Average	15	4754.5	4502.5	4620	4196.5	10.12	

Table 4: Yield, Extension gap, Technology gap and Technology index of the demonstration

Variables	Yield (kg/ha)	Extension gap (kg/ha)	Technology gap (kg/ha)	Technology index (%)
Farmer practice	4196.5			
Ecological engineering techniques	4620	423.5	480	9.41

2.6 numbers observed in farmers' practice. The lowest pest infestation per cent of 9.75 per cent recorded in demonstrated plot whereas 23.12 per cent recorded in farmers' practice. Similarly, the yield data are presented in table 3. The result reveals that the adoption of ecological engineering pest management practices recorded the average grain yield of 4620 kg/ha with the highest grain yield of 4878 kg/ha and the lowest yield of 4437 kg /ha with an yield advantage of 10.12 per cent over the farmers practices. The findings of the present study are in line with Bhati *et al*. (2018); Jyothiswaroopa *et al*. (2016) and Rai *et al*. (2015).

Technology gap, extension gap and technology index

The technology gap shows the gap between the potential yields of the crop over demonstrated yield. The technology gap was recorded as 480 kg/ha (Table 4). The extension gap shows the gap between the demonstration yield and local yield and it was recorded as 423.5 kg/ha. The observed extension gap and technology gap may be attributed to dissimilarities in soil fertility levels, pest and disease incidence, improper usage of manures and fertilizers in this region (Mukherjee, 2003). More and more use of latest technologies in pest management practices will subsequently change this trend. The new technologies will eventually lead the farmers to discontinue the old technologies and to adopt of new technologies. Technology index shows the feasibility of the variety at the farmers' field. The lower the value of the technology index, more is the feasibility. Table 4 revealed that the technology index value was 9.41 per cent. These findings are in line with the findings of Mansoor Hussain *et al.* (2018); Hiremath and Nagaraju (2009) and Sreelakshmi *et al*. (2012).

CONCLUSION

The study indicated that, adoption of ecological engineering pest management practices drastically reduced the pest population in paddy crops and

considerably increased the presence of natural enemies in the paddy eco system. The technology index for the study showed the viability and sustainability of the technology at farmers' field level. More focus need to be given to train the extension officials in the state department on ecological engineering pest management strategies to manage paddy pests and further spread of the technology in larger scale of the district.

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