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Research Paper

EFFECT OF WEED MANAGEMENT PRACTICES ON DIRECT SOWN UPLAND RICE THROUGH FRONT LINE DEMONSTRATION

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Abstract

The study was carried out through front line demonstrations consecutively for three years during *kharif* season of 2009, 2010 and 2011 in three adopted villages of Angul district in Odisha on farmers field with the active participation of farmers with an objective to evaluate the performances of improved technology with pre emergence application of Butachlor @1.0 kg *a.i* ha^{-1} at 2 DAS followed by one hand weeding at 30 DAS as compared to the farmers practices(Local check) of one hand weeding at 30 DAS in direct sown upland rice. The dry weed biomass at (66.2 g m^{-2}) and the weed control efficiency (78.3 %) at 60 DAS was higher in application of Butachlor @1.0 kg ha^{-1} with one hand weeding than farmers practices of one hand weeding over the years of study . The improved technology also produced grain yield(28.5 q ha^{-1}) which is 19.7% higher than local check with harvest index (46.5%) & effective tillers $plant^{-1}$(11.3) . The improved technology of weed management with herbicides in combination with hand weeding recorded higher gross return of Rs. 30140 ha^{-1} with a benefit cost ratio of 1.82 and additional net return of Rs.4174 ha^{-1} as compared to local check .The improved technology with extension gap 4.67 q ha^{-1} was horizontally spread to 24 hectares during first year and expands to 60 hectares and adopted by 230 farmers in 60 villages during second year. Hence the existing farmers practices of hand weeding can be replaced by integrated weed management which was more effective and economic for controlling the grassy weeds & some broadleaved weeds and results better weed control with higher productivity and income.

Key words: *Butachlor, Extension gap, FLD, Hand weeding, Rice*.

INTRODUCTION

Rice (*Oryza sativa* L.) is the predominant crop of the state with a total coverage of 4.0 million hectare which is about 65% of the total cultivable area of the state. Area under rice crop in Angul district is 0.08 million hectare with a productivity of 9.89 q ha^{-1} which is 48% less than that of state[1]. In future, there is no scope for further

expansion in rice area and to achieve this goal, conventional breeding methods need to be supplemented with the innovative techniques. Achieving self-sufficiency in rice production and maintaining price stability are important political objectives in low-income countries because of the importance of this crop in providing national food security and generating employment and income for low-income people [2].

Economic factors and development of rice production technology are the major drivers that have led to the adoption of direct seeding rice establishment in place of transplanting in Asia[3]. Manual weeding is expensive, laborious and time consuming and is very difficult in early stage of crop growth. Application of pre-emergence herbicides has been found effective in early stage, but second flush of weeds after 25-30 DAS becomes problematic. Hence, integrated weed management practices are the only alternative[4].

Cultivation practices comprised under FLD showed increase in yield of rice from 17.34 % to 53.52% over local check. Technology gap was lowest (555 kg/ha) and highest(1900 kg/ha) in summer season. The extension gap inKarjat-3 and Sahyadri hybrid was higher as compared to technology gap[5].

The percentage increase in the rice yield over local check was 21.6 with higher gross return of Rs.17212 /ha, net return of Rs.9567 /ha and benefit cost ratio 2.7 as compared to local check (Rs.14034 /ha, Rs. 7331/ha and benefit cost ratio 2.5, respectively. By conduction of front line demonstrations on farmer's field there was significant increase in knowledge level of the farmers and majority of farmer's showed high level of satisfaction about demonstrated technologies[6] .

The available technology should reach the farmers, the ultimate users through KVK activities and adoption of the technology by the farmers will reflect the feasibility of the technology[7].

Keeping in view such problems and after detailed survey the KVK, Angul made an attempt with an objective to evaluate the performances of improved technology of application of Butachlor@1.0kg *a.i* ha^{-1} followed by one hand weeding as compared to the farmers practices of one hand weeding under direct seeded upland rice .

MATERIALS AND METHODS

The study was carried out through front line demonstrations consecutively for three years(2009 to 2011) during *kharif* season in rainfed upland on farmers field under mid central table land zone of Odisha at three adopted villages of Krishi Vigyan Kendra *viz.* Rautala, Nuasahi and Baragaunia. The soil of the study area was sandy loam in texture with slightly acidic in reaction(pH-5.2 -5.8), medium organic carbon content (0.45-0.60 %), medium in available nitrogen(284-312 kg ha^{-1}), low in phosphorus(9.2-11.4 kg ha^{-1}) and medium in potassium(145-186.4 kg ha^{-1}) content. Thirty different farmers each having 0.25 hectare of land cultivated the HYV upland rice *cv*.Khandagiri with recommended package of practices. They were supplied with herbicide(Butachlor) for application at 2 DAS. Besides farmers practice of one hand weeding at 30 DAS was selected as local check. A weedy check plot was selected for comparison of weed control efficiencies. The rice crop was sown during 2^{nd} week of June and harvested during 3^{rd} week of September in all the years of demonstrations. The required quantities of herbicides were applied with manually operated knapsack sprayer using a spray volume of 500 litres water per hectare. A thin film of water was maintained in the field at the time of application of herbicide. Weed counts per m^{-2} was sampled randomly at ten places with the help of one square meter quadrates at 60 DAS

and weed dry weight per m^{-2} were recorded. The weed control efficiency was worked out through following formula:

$$WCE = \frac{(DWC - DWT)}{DWC} \times 100$$

Where: DWC = Dry weight of weeds under control plot; DWT = Dry weight of weeds under treated plot.

Observations on different yield parameters were taken and economic analysis was done by calculating cost of cultivation, gross return, net return and B:C ratio. Final crop yield (grain & straw) were recorded and the gross return were calculated on the basis of prevailing market price of the produce. Harvest index is the relationship between economic yield and biological yield [8].

It was calculated by using the Following formula:

$$\text{Harvest index (\%)} = \frac{\text{Economic yield}}{Biological\ yield} \times 100$$

For the introduction of the technology, different extension approaches through regular field visit & interpersonal communication were made by the scientists of Krishi Vigyan Kendra, Angul. Trainings on farmers and farm women were conducted for the awareness among the farmers and field days were celebrated for the horizontal spread of technology. Also leaflets and pamphlet on integrated weed management in upland paddy were distributed among the farmers in the villages. Further study on extension gap was calculated by the formula as suggested by [9].

Extension gap = Demonstration yield-Farmers yield

Tabular analysis involving simple statistical tools like mean was done by standard formula to analyze the data and draw conclusions and implications.

Details of Technology

Pre-emergence application of Butachlor @ 1.0 kg *a.i* ha^{-1} at 1-2 DAS followed by one hand weeding at 30 DAS effectively controls annual grasses and some broad leaved weed in rainfed upland direct sown upland paddy. Keeping this in view the technology has been recommended for weed control in district.

RESULTS AND DISCUSSION

Weed density

The floristic composition of the study area was dominated with grasses *i.e Digitaria sanguinalis , Cynodon dactylon* and broad leaved weeds *i.e Cleome viscose*, *Ageratum conyzoides* and sedges *i.e Cyperus rotundus* over the years. At 60 DAS grasses , broadleaved and sedges on an average constituted 36.7, 53.9 and 9.4 per cent of total weed population respectively(Table 1). The front line demonstration at 60 DAS recorded the population of grassy weeds (19.2 to 88.5 m^{-2}), broad leaved weed (27.8 to 126.7 m^{-2}) and sedges(4.8 to 22.2 m^{-2}). However, at 60 DAS Butachlor @ 1.0 kg *a.i* ha^{-1} at 2 DAS with one hand weeding at 30 DAS recorded the minimum weed density (51.8 m^{-2}). This was due to application of herbicides which might have prevented the germination of susceptible weed *spp* and also reduced the growth of germinated weeds by inhibiting the process of photosynthesis[10]. Weedy check recorded the maximum weed density (237.4 m^{-2}) at 60 DAS followed by farmers practices of one hand weeding (65.6).

Dry weed biomass and Weed control efficiency

The dry weed biomass at 60 DAS in weedy check was maximum (305.4 g m^{-2})which was higher than Farmers practices and Improved technology because of

higher weed intensity and its dominance in utilizing the sunlight, nutrients, moisture *etc*. The lowest dry weed biomass (Table-2)was found in Butachlor@ 1.0 kg ha^{-1} at 2 DAS with one hand weeding at 30 DAS (66.2 g m^{-2}) where as farmers practice recorded the dry weed biomass(83.4 g m^{-2}). This may be due to effective control of weeds during early stages of crop growth by herbicides and in later stages removal of both intra and inters row weeds by hand weeding.

The weed control efficiency (WCE) at 60 DAS was higher with Butachlor@1.0kg *a.i* ha^{-1} followed by one hand weeding at 30 DAS(78.3 %) and lower with Farmers practice of one hand weeding (72.7 %) .This might be due to effect of weed during initial stages of crop growth with herbicide application.

No of effective tillers plant^{-1}, grain yield, straw yield and harvest index

Results of 30 front line demonstrations conducted during *kharif* seasons (2009 to 2011) in 7.5 hectares in farmers field of three villages indicated that the improved technology of application of Butachlor@1.0kg *a.i* ha^{-1} followed by one hand weeding recorded grain yield 28.5q ha^{-1} which is 19.7 % higher as compared to the farmers practices of one hand weeding(Table 3) .This might be due to the production of higher number of effective tillers $plant^{-1}$ (11.3) due to effective control of weeds in early stage which was in conformity with [11]. The improved practices also produced the higher straw yield(32.8 q ha^{-1}) with harvest index (46.5%) as compared to local check. Thus the FLD might have a positive impact on farming community in the district over local check.

Extension gap

The front line demonstration recorded the mean extension gap over the years of study 4.67 q ha^{-1} with highest (8.00 q ha^{-1}) during 2009 and lowest(3.0 q ha^{-1}) during 2010 & 2011 (Table 3). More and more use of latest production technologies will subsequently change this alarming trend of galloping extension gap. The new improved technologies will eventually lead to the farmers to discontinue the traditional practice and to adopt new technology. Similar results were reported by [12]. Extension gap reflected that there is a need to educate farmers for adoption of improved technology to reverse the trend. Wider adoption of a technology may reduce the extension gap[13] .

Economics

The improved practice of pre emergence application of Butachlor @1.0 kg *a.i* ha^{-1} at 2 DAS with one hand weeding at 30 DAS recorded the higher gross return of Rs.30140 ha^{-1} with additional net return of Rs.4174 ha^{-1} over local check (Table 4). Higher B:C ratio(1.82) was found in improved technology due to higher net return as compared to local check(1.60) . This was due to higher yield with use of herbicide in the early growth stage. These finding are similar with the findings of [14, 15] .

Technology Transferred

For weed management in direct sown upland paddy, different extension approaches were made and Interested farmers were supplied with herbicide by Krishi Vigyan Kendra, Angul. During *kharif*' 2010, the area under weed management with herbicides(Butachlor) followed by hand weeding expanded horizontally to 12 hectares from a mere 2.5 hectares during first year of introduction and during *kharif*' 2011 it was expands to 60 hectares and adopted by 230 farmers in 115 villages(Table 5). Due to efforts of KVK scientists field visit, interpersonal communication and individual efforts of the farmers, the technology could spread to more than 50 hectares of the district[16] .

Reason of low yield of upland rice at farmer's field

Heavy infestation of weeds during the early stage of the crops. Labour scarcity Delay sowing due to irregular onset of monsoon and non availability of quality seed of suitable variety cause yield reduction in rice. Injudicious application of fertilizers and hand weeding by the farmers also cause the lower yield in rice.

Constraints with marginal and small farmers

Small holding: Small and marginal farmers are resource poor having less risk bearing ability and do not dare to invest in the costly input which is a obstacle in adoption of proven technology.

Farm implements and tools: Traditional implements and tools of poor working efficiency are still in practice due to small holding . The lack of modern implements and tools for small holding also a hindrance to the adoption of improved technology.

Farmers Feedback

Application Butachlor @1.0 kg *a.i* ha^{-1} at 2 DAS followed by one hand weeding at 30 DAS effectively controls the grassy weeds and some broadleaved weeds in direct sown upland paddy for higher productivity and income.

Impact of the front line demonstration

The study over three years shows that Extension/ horizontal spread of area from 12 hectare in 2010 to 60 hectare in 2011 under improved technology. It Improves weed control practices and enhances productivity of upland rice . Besides it recorded higher yield & increased B:C Ratio over local check proves that application of Butachlor with hand weeding is economically viable .

Thus , the existing weed management practices can be replaced with improved practice of pre emergence application of Butachlor @1.0 kg ha^{-1} at 2 DAS with one hand weeding at 30 DAS because of effective weed control methods with higher productivity and income and found to be suitable as it had been appreciated by the farmers.

Table 1: **Effect of front line demonstration on weed composition m^{-2} at 60 DAS**

(Pooled data over 3 years)

Sl no	Weed species	**Improved practices**	**Local check**	**Control**
	Grasses			
1	*Cynodon dactdylon*	5.1	7.4	22.2
2	*Digitaria sanguinalis*	7.6	11.8	36.8
3	*Eleusine indica*	3.4	0	14.3
4	*Echinochloa colona*	3.1	3.2	15.2
	Total monocot	19.2	22.4	88.5
	Broad leaved weed			
1	*Ageratum conyzoides*	9.2	13.8	43.8
2	*Cleome viscosa*	12.1	14.8	51.4
3	*Chrozoffera rottleri*	6.5	8.2	31.4
	Total dicot	27.8	36.8	126.7
	Sedges			
	Cyperus rotundus	4.8	6.4	22.2
	Grand total	**51.8**	**65.6**	**237.4**

Table 2: **Effect of front line demonstration on weed density, dry weed biomass and weed control efficiency** (Pooled data over 3 years)

Front line demonstration	Weed density m^{-2} at 60 DAS			Dry weed biomass at 60 DAS ($g\ m^{-2}$)	Weed control efficiency at 60 DAS (%)
	M	D	S		
Butachlor@1.0kg *a.i* ha^{-1} followed by one hand weeding at 30 DAS	19.2	27.8	4.8	66.2	78.3
One hand weeding (at 30 DAS)	22.4	36.8	6.4	83.4	72.7
Weedy check	88.5	126.7	22.2	305.4	

M=Monocot, D= Dicot, S=sedges, DAS=Days after sowing

Table 3. Effect of front line demonstration on effective tillers plant^{-1} , grain yield, increase in grain yield, straw yield, harvest index and Extension gap

Year	Area (ha)	No of Farmers	No of effective Tillers $plant^{-1}$		Grain Yield ($q\ ha^{-1}$)		% of increase in grain yield local check	Straw Yield ($q\ ha^{-1}$)		Harvest index (%)		Extension gap ($q\ ha^{-1}$)
			Improved technology	Local check	Improved technology	Local check		Improved technology	Local check	Improved technology	Local check	
2009	2.5	10	12	9	31.0	23.0	34.8	36.3	27.1	46.1	45.9	8.0
2010	2.5	10	11	8	28.0	25.0	12.0	31.4	29.8	47.1	45.6	3.0
2011	2.5	10	11	8	26.5	23.5	12.8	30.7	27.3	46.3	46.3	3.0
Mean	-	-	11.3	8.3	28.5	23.8	19.7	32.8	28.1	46.5	45.9	4.67

Table 4. Effect of front line demonstration Cost of cultivation , Gross return, Net return and B:C ratio.

(pooled data over 3 years)

Year	Additional cost of input (Herbicide + Labour) (Rs)	Additional Net return ($Rs ha^{-1}$)	Cost of cultivation ($Rs\ ha^{-1}$)		Gross return ($Rs ha^{-1}$)		Net return ($Rs\ ha^{-1}$)		B:C ratio	
			Improved technology	Local check	Improved technology	Local check	Improved technology	Local check	Improved technology	Local check
2009	710	7750	17500	16790	32815	24355	15315	7565	1.88	1.45
2010	760	2320	16250	15490	29570	26490	13320	11000	1.82	1.71
2011	810	2360	15800	14990	28035	24865	12235	9875	1.77	1.66
Mean	760	4174	16516	15756	30140	25205	13623	9449	1.82	1.60

**Sale price of paddy seed Rs.1000 $q^{-1}$and paddy straw Rs.50q^{-1} for the year 2009, 2010 & 2011*

Table 5. Effect of front line demonstration on transfer of technology

Year	Area (ha)	No of Farmers	Horizontal spread of technology				
			No of villages adopted	No of farmers adopted	Area (ha)	% of adoption of Technology	Extension gap ($q\ ha^{-1}$)
2009	2.5	10	-	-	-	-	8.0
2010	2.5	10	25	90	12	0.2	3.0
2011	2.5	10	90	140	48	0.4	3.0
Mean	-	-	115	230	60	0.3	4.67

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REFERENCES

[1]. Anonymous, 2011, Odisha Agriculture Statistics 2011-12, Directorate of Agriculture and Food production, Govt of Odisha.
[2]. Ghosh, R.K., Sharma, L., Barman, S. and Dolai, A.K., 2009, System of rice Intensification, The alternate approach for increasing production of field crops. Journal of Crop and Weed, 5,63-67.
[3]. Pandey, S., and L.Velasco, 2002, Economics of direct seedling in Asia: Pattern of adoption at research priorities., IRRN, 24,6-11.
[4]. Mishra, S.S., Mishra, M.M., Mishra, K.N. , Kar, B.B., and Mohanty, S.K,2009, Weed management in direct seeded upland rice under coastal regions of Orissa. Extended summaries-symposium on Resource management in crops and cropping systems underchanging climate:7-8, May,2009 , Indian society of Agronomy,OUAT, Bhubaneswar, pp.41-43.
[5]. Mandavkar, P.M., Sawant, P.A., and Mahadik, 2012, Evaluation of Front line demonstration trial on rice in Raigad district of Maharastra. Rajstan Journal of Extension Education, 20:4-6.
[6]. Raj, A.D.,Yadav,V., and Rathod, J.H,2014, Evaluation of Front Line Demonstration on yield of Pigeonpea(*Cajanus Cajan* L.)in Tribal Region of Gujarat. Research Journal of
Agricultural Sciences, 5(1), 94-96.
[7]. Mazumder, G., Das, J.K., Mazumdar, D., and Ghoshal, R, 2012, Assessment of yield in KVK programme: A multivariate approach, J. Crop Weed, 8,102-08.
[8]. Gardner, F.P., Pearce, R.B., and Mistecell, R.I., 1985, Physiology of Crop Plants, Iowa State Universit,. Press, Iowa, 66.
[9]. Samui, S. K., Maitra, S., Roy, D. K., Mondal. A. K., and Saha, D, 2000, Evaluation on front line demonstration on groundnut(*Arachis hypogea* L.), Journal of Indian Society Coastal Agricultural Research, 18, 180-183
[10]. Muzik, J.J.,1970, Chemical use for weed control, weed biology and control, Mc. Graw Hill Book Company, New York.
[11]. Maiti, S., Narzari, N., and Pal, S, 2003, Response of high yielding and hybrid rice to varied level of Nutrition, Environment and Ecology ,21, 296-300.
[12]. Sharma, P., Khar, S., Kumar, S., Ishar, A., Prakash, S., Mahajan, V., and Jamwal, S. 2011,Economic impact of front line demonstrations on cereals in Poonch district of Jammu and Kashmir, Journal of Progressive Agriculture, 2,21-25.
[13]. Mitra, B., Mookherjee, S., and Biswas, S,2014, Promotion of short duration rice variety Gotra Bidhan-1 (IET 17430)through frontline demonstrations in terai region of West
Bengal, Journal of Crop and Weed, 10(1),111-114.
[14]. Ram, M.,Kumar, Hari Om. Suresh., and Dhiman, S.D,2004, Chemical weed control in direct seeded rice with or without sequential application of 2, 4, D(EE). Indian Journal of
Agronomy,49, 108-110.
[15]. Balai, C. M., Bairwa, R. K., Roat, B. L., and Meena, B. L, 2013, Impact of front line demonstration on maize yield improvement in tribal belt of Rajasthan. Research Journal

of Agricultural Sciences, 4(3), 369-371.

[16]. Dwibedi, S.K., Dhal, A., and Sangramsingh, S. P., 2009, Varshadhan: A suitable variety for medium deep waterlogged ecosystem. Extended summaries-symposium on Resource
management in crops and cropping systems under changing climate:7-8, May,2009 , Indian society of Agronomy, OUAT, Bhubaneswar. pp100-10.