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Economics of Weed Control Methods in Transplanted Rice Fields in Mid-hill of Nepal

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Abstract

To assess economic of different weed control methods on transplanted rice, a research was conducted at farmers' fields, Bhanu-11, Rupakot, Nepal during the rainy season of 2017. The experiment was laid out using single factorial Randomized Complete Block Designs (RCBD) with three replications of ten treatments as one hand weeding at 21 Days After Transplanting (DAT) (T_1); two hand weedings at 21 and 42 DAT (T_2); three hand weedings at 21 42 & 63 DAT (T_3); single conoweeding at 21 DAT (T_4); double cono weedings at 21 &42 DAT (T_5); triple cono weedings at 21, 42 &63 DAT (T_6); butachlor as pre emergence (T_7); butachlor with single manual weeding at 21 DAT (T_8); butachlor with double manual weedings at 21 & 42 DAT (T_9) and weedy check (T_{10}). All collected data were subjected to analyzed by computer software R package. The results revealed that butachlor as pre-emergence (T_7), showed that significantly higher gross return (Rs. 167.51thousand/ha), net profit (Rs. 96.11thousand/ha) and higher benefit-cost ratio (2.346), which is economically viable and profitable and can recommend to the farmers for rainfed lowland condition.

Keywords: rice field, transplanting, weed control method butachlor, net profit, pre-emergence

1. Introduction

Rice (*Oryza sativa L*) is one of the world's most important food crops providing major source of the food energy for more than 3.7 billion people (International Rice Research Institute, 2017and Bhandari et al., 2019). In Nepal it is the most important cereal crops in agriculture and economy of Nepal. It shares 20.75% to the Agricultural Gross Domestic Product (AGDP) and accounts 53% of the total food grain production and covers more than 50% of the agricultural production area (Ministry of Agriculture Development, 2015). It is producing about 523027 Mt covering an area of 1552469 ha, with the productivity level of 3.37 t ha^{-1}(Agriculture Information and Communication Centre, 2018). Productivity of rice is low as compared to developed country. Various biotic (inset, pest, weed etc) and abiotic factors (drought, salinity etc) are mainly responsible to low productivity of rice in Nepal. Among biotic factors, weed infestation in rice field in different growing periods is a major problem especially in rainfed ecosystems (Kandel *et al*., 2019; Adhikari *et al*., 2019). Weeds grow in a field as an unwanted plant and rival with the main plant in the absorption of light, water and nutrients(Vakili, 2000; Nojavan, 2001 and Yaghoobi, 2008).Weed like *Echinocola colona*, *Eleusine indica,Cyperus rotundus,Cyperus difformis, Monochoria vaginalis, Ipomoea aquatic*, *Eleusine indica*, *Echinocola crus-galli*, *Ditilaria ciliaris*, *Echinochloa glabrescens*, *Fimbrystylis miliacea*, *Cyperus iria*, etc are the problematic weed flora found in rice field.

Uncontrolled weed growth in transplanted rice fields causes 33-45% loss in yield (Singh *et al*., 2007; Veeraputhiran and Balasubramanian, 2010; Manhas *et al*., 2012).Rice is a weak competitor against weeds and most of the farmers only have little options and resources available to control weeds effectively (Rodenburg and Johnson, 2009).There are different ways of weed management practices such as hand weeding, mechanical weeding, chemical weeding and combination of them, which has always been major input in production package and sustainable development. Effective control of the weed had increased the grain yield by 85.5% (Mukherjee and Singh, 2008). Effective weed control method must be economic, eco-friendly and less phytotoxicity to the plant. The main aim of this research was to analyze the economic condition of different weed management practices of rice fields in rainfed condition.

2. Materials and Method

2.1 Experiment Site

The experiment was conducted in Bhanu-11 Rupakot, Tanahun, Nepal at farmers' fields during rainy season in 2017. Better to put the map of the area. The experiment site is located about 45 km from Damauli, headquarter of Tanahun district. It is located at 28 7' to 28 10' North latitude and from 84 24' to 84 28' East longitude at an altitude of 800m above mean sea level (Kandel *et al*., 2019).

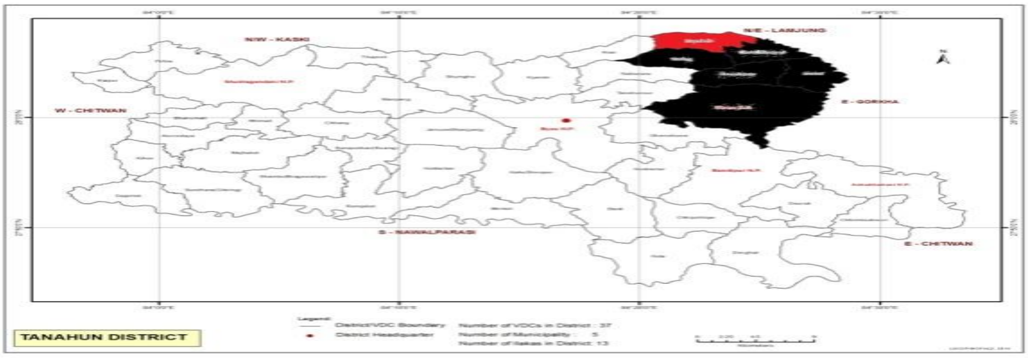

Figure 1. Location of experimental site

2.2 Climatic Condition of Research Site

The total annual rainfall of the experiment site is reported as 2800mm. The maximum temperature during crop cultivation period was 37.5^{0}C. The minimum temperature was 18.60^{0}C. The highest rainfall occurred in August 2nd week (437mm). Relative Humidity (RH) ranged from 76.07% in June first week to 90.94% in October 3rd week.

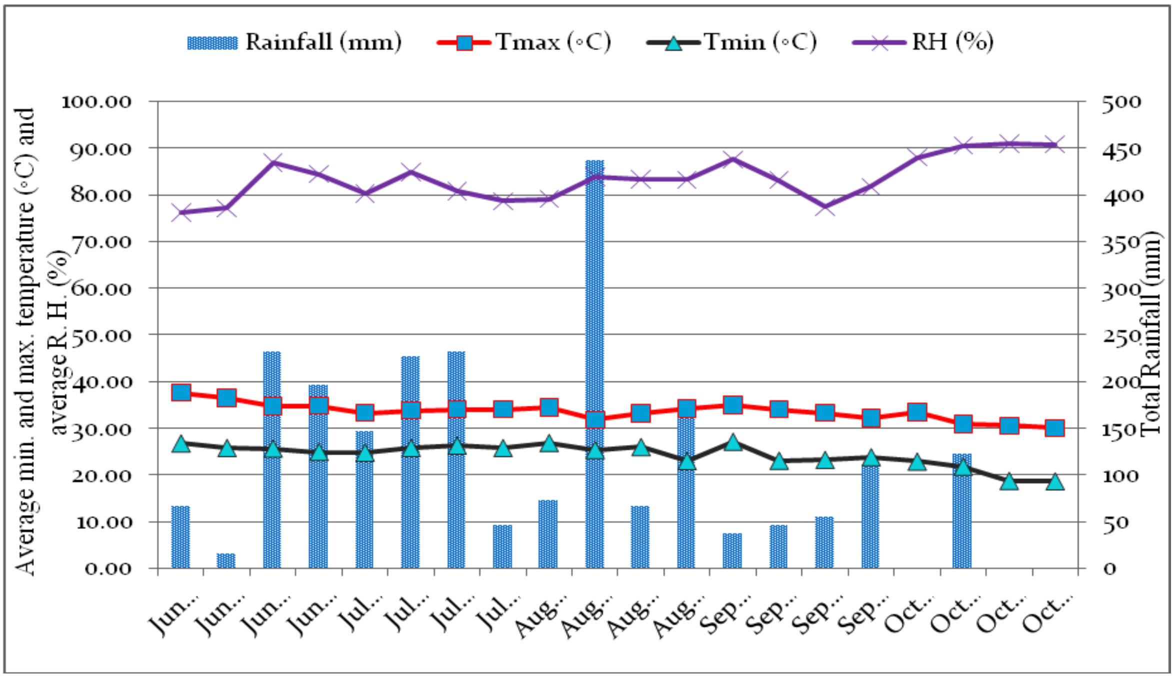

Figure 2. Climatic parameters during research period in experiment site

2.3 Experiment Details

The experiment was conducted using a Randomized Complete Block Design (RCBD) with 10 treatments and 3 replications. The dimensions of the individual plot were 3m length and 2m breadth (6m^2 area). The spacing was 20cm x 20cm row to row and plant to plant. The net plot size was determined by deducting 4.4 m^2. The total net plot area is 2.20m length and 2m of breadth (4.40m^2), 11 rows of 2m long. There was a bund accounting to 0.5m width between plots and also border having 0.5 m width. The 7th to 11th rows were treated as the net plot rows for harvesting, and the remaining 2nd to 5th rows were used for biometrical observations. Sukhadhan-3 (Farmers preferred rice variety) variety of rice was used in the experiment.

Table 1. Details of the treatments and their symbol in rice experiment at Bhanu-11, Tanahun, Nepal, 2017

Treatment	**Treatment combination**	**Symbol**
T_1	Single manual weeding (at 21DAT)	SMW
T_2	Double manual weeding (at 21 DAT + 42 DAT)	DMW
T_3	Triple manual weeding (at 21 DAT, 42 DAT, & 63 DAT)	TMW
T_4	Single cono weeding (at 21 DAT)	SCW
T_5	Double cono weeding (at 21 DAT and 42 DAT)	DCW
T_6	Triple cono weeding (at 21 DAT, 42 DAT, & 63 DAT)	TCW
T_7	Butachlor at 4 DAT (as pre emergence)	BPE
T_8	Butachlor at 4 DAT + Single manual weeding (21 DAT)	BSMW
T_9	Butachlor at 4 DAT + Double manual weeding (21 & 42 DAT)	BDMW
T_{10}	No weeding (Control check)	NW

2.4 Economic Analysis

2.4.1 Cost of Cultivation (Rs.)

Cost of cultivation was calculated on the basis of local charges for different agro inputs, viz., labour, fertilizer, compost, and other necessary materials.

2.4.2 Gross Return (Rs.)

Economic yield was converted into gross return (Rs. /ha) on the basis of local market price.

2.4.3 Net Return (Rs.)

This was calculated by subtracting the cost of cultivation from the gross return.

2.4.4 B: C Ratio

This was calculated by using the following formula from the procedure given by Benefit cost ratio = Gross return / Cost of cultivation

2.5 Statistical Analysis

All the data were recorded and tabulated based on replications and treatments with the help of MS Excel. Recorded data were managed and then subjected to analyze by using computer software R package.

3. Result and Discussion

3.1 Effect of Different Weed Management Practices of Rice Fields on Economic Analysis

Table 2. Effect of different weed control methods on economics of transplanted rice fields during 2017

Treatments	Cost of cultivation (NRs)	Gross revenue (NRs)	Net revenue (NRs)	B:C
T_1 SMW at 21 DAT	73727de	126227^{b}	52501^{b}	1.712^{b}
T_2 DMW at21 and 42 DAT	77327^{bc}	162924^{a}	85601^{a}	2.107^{ab}
T_3 TMW at 21,42& 63 DAT	86893^{a}	156685^{a}	69258^{ab}	1.802^{b}
T_4 SCW at 21 DAT	72827de	125315^{b}	52501^{b}	1.718^{b}
T_5 DCW at 21 &42 DAT	75493^{cd}	156685^{a}	74537^{ab}	2.076^{ab}
T_6 TCW at21,42& 63 DAT	78227^{bc}	152767^{ab}	69258^{ab}	1.953^{ab}
T_7 BPE as pre-mergence	71393^{ef}	167515^{a}	96122a	2.346^{a}
T_8 BSMW at 21 DAT	74860^{cd}	159112^{a}	84252^{a}	2.127^{ab}
T_9 BDMW at 21 DAT & 42 DAT	78960^{b}	162394^{a}	83434^{a}	2.056^{ab}
T_{10} Unweeded (check)	69460^{f}	90797^{c}	21337^{c}	1.307^{c}
F test (at 5%)	**	*	*	*
LSD (=0.05)	**312.1**	**27386.4**	**27291.1**	**0.38**
CV,%	**1.1**	**0.9**	**2.3**	**1.4**
Grand Mean	**75917**	**145989**	**70072**	**1.92**

1. Note: DAT, days after transplanting; *- Significant; **-highly significant. Treatment means followed by common letter(s) are not significantly different among each other based on DMRT at 5% level of significance.

3.1.1 Cost of Cultivation

The results in the Table 2 show that, in general, triple manual weeding (T_3) (Rs 86.89 thousand/ha) required the highest cost of cultivation per hectare while unweeded check plot (T_{10}) (Rs 69.460) thousand/ha) required the lowest cost of cultivation. Tabatabaekoloo et al. (2012) also reported hand weeding has its high cost, hard work and worker restriction in the required time, is not useful, which is accordance to our findings. Second high cost incurred in butachlor with double manual weeding (T_9) (Rs. 78.96 thousand/ha) which is at par with triple cono weeding (T_6) and double manual weeding (T_2).

3.1.2 Gross Return (Rs./ha)

The gross return was significantly influenced by weed control method. The results in the Table 2 show that average gross return was Rs. 167.55 thousand/ha and it ranging from Rs. 90.79 to 167.55 thousand/ha for all treatments depending up on weed control method. The gross return was significantly influenced by weed control method. There was significantly higher gross return (Rs. 167.51thousand/ha) at butachlor as pre emergence ($_{T7}$) and lowest (Rs. 90.79 thousand/ha) at unweeded check plot (T_{10}). The higher gross return was obtained from butachlor pre emergence (T_7). This weed control method can be used for better economic return in rice production.

3.1.3 Net Profit (Rs,/ha)

The analyzed data indicate that the average net profit was Rs. 70.72 thousand/ha and it ranged from Rs. 21.33 to 96.11 thousand/ha for all trials depending upon the weed control method. The higher net profit (Rs. 96.11thousand/ha) obtained with butachlor pre emergence (T_7) which was at par with double manual weeding (T_2) (85.6 thousand/ha), triple manual weeding (T_3) (69.25 thousand/ha), double cono weeding (T_5) (74.53 thousand/ha) , triple cono weeding (T_6) (69.2 thousand/ha), butachlor with single manual weeding (T_8) (84.25 thousand/ha) and butachlor with double manual weeding (T_9) (83.43thousand/ha). Unweeded check (T_{10}) plot recorded the lower net profit of Rs. 21.33 thousand/ha. Singh and Singh (2017) reported lowest net return from unweedy plot in summer Mungbean, which was accordance to our findings. Thus, it can be mentioned butachlor at pre emergence (T_7) be used for better net return for rice cultivation.

3.1.4 Benefit Cost Ratio (B: C)

Benefit cost ratio is the ratio of gross return to cost of cultivation which can also be expressed as returns per rupee invested. The analyzed data Table 2 revealed that the average benefit cost ratio was above 1.920 and it ranged from 1.30 to 2.34. Butachlor as pre emergence (T_7) recorded higher benefit cost ratio (2.346) while unweeded check (T_{10}) recorded the lower benefit cost ratio (1.30). Butachlor as pre emergence (T_7) (2.34) was at par with double manual weeding (T_2) (2.107), double cono weeding (T_5) (2.076), butachlor with single manual weeding (T_8) (2.127) and butachlor with double manual weeding (T_9) (2.056). Tabatabaekoloo et al. (2012) reported herbicide application (Butachlor) at 5 DAT gave higher B:C ration,which is accordance to our result. Any value greater than 2 is considered safe as the farmer get Rs. 2.00 for every rupee invested (Reddy and Reddi, 2002). On the other hand, minimum benefit cost ratio of 1.5 has been fixed for an enterprise in the agricultural sector to be economically viable. Therefore, any agricultural enterprise must maintain a 1.5 benefit cost ratio to be economically sustainable (Bhandari, 1993).

4. Conclusion

Butachlor as pre emergence (T_7) recorded the highest gross return, net return and benefit cost ratio among different method of weed management practice. The cost of cultivation was also found low and statistically similar with unweedy check (T10).So it is concluded that butachlor as pre emergence must be economic viable and profitable weed management practice in rainfed rice ecosystem.

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