INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2000/02–1-2–141–143

Impact of Various Packages of Herbicides Use on Yield of Transplanted Rice

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ABSTRACT

To assess the comparative economic returns of various commercial herbicides on the transplanted rice, the experiment data generated at Ayub Agri. Research Institute Faisalabad during 1996-97 and 1997-98 was analyzed using partial budgeting technique. The results of the study showed that the herbicide Machete @ 2.25 L ha^{-1} was most appropriate in rice production, as it gives highest returns among the available herbicides.

Key Words: Herbicides; Yield; Rice

INTRODUCTION

Rice has predominant position in agrarian economy of Pakistan. It is not only an important component of diet of our population but also, an important source of foreign exchange earnings. It contributes 15 to 20% of the total foreign exchange earnings.

Despite its great importance in the economy, actual yield of rice is lower than its potential due to several reasons. Weeds alone are responsible for reducing total rice yield in the country by 11% (Majeed & Afzal, 1985).

The control of weeds in rice production is a serious problem in Pakistan's Agriculture. Weeds result in reduction of yield, increasing the cost of production and lowering the quality of products. The use of herbicides in Pakistan is just in the introductory stage and it is important that farmers in the use of herbicides behave rationally. However, economic conditions of farmers and the expected returns govern the magnitude of herbicide use. It is, therefore, essential that the use of herbicide for weed control in rice production increases return of the farmers.

The present study aims to assess gross and met benefits from the use of various herbicides used in rice production and to suggest an appropriate herbicide (s) and their levels of use at which increase in rice production is effective.

MATERIALS AND METHODS

The present study attempts to assess the benefits and costs of alternative herbicides used on rice. The experimental data were generated by the Ayub Agri. Research Institute, Faisalabad. The data contained the following treatments: T_1 = Control (No herbicide was applied); T_2 = Machete @ 2.0 L ha^{-1};.T_3 = Machete @ 2.25 L ha^{-1}; T_4 = Machete @ 2.50 L ha^{-1}; T_5 = Saturn @ 1 L ha^{-1}; T_6 = Saturn @ 1.2 L ha^{-1}; T_7 = Saturn @ 1.5 L ha^{-1}

T_2, T_3 and T_4 indicate various doses of herbicide applied on rice. Similarly T_5, T_6 and T_7 show the doses of Saturn herbicide applied on the crop.

Partial budgeting technique was used for the analysis of data. The technique involved selecting of those costs that vary with particular treatment being analyzed and the net benefits of each treatment.

The following sequence of steps was followed during the analysis of data.

1. Average yield of rice was calculated for each treatment.
2. The next step was to calculate adjusted yield to cover the difference in management practices between a researcher worker and common farmer. So the average yield was decreased by 15% to have adjusted yield.
3. Field price of output was taken to be procurement price of output or market price minus all tangible and intangible costs in bringing that particular output from the field to the market. It was estimated that field price of output was taken as 15% less as compared to market or procurement price. Then the adjusted yields were multiplied by the field price of output to arrive at gross field benefits.
4. Partial budgeting technique includes costs that vary. Cost that vary comprised two types of costs i.e. cash and opportunity costs. These costs were calculated separately and then added up to calculated total cost that vary for each treatment. Then these costs were subtracted from the total gross field benefits to arrive at net field benefits for each treatment.
5. At the next step, dominance analysis was done, In

this analysis, those treatments were dropped for further analysis for which net benefits decreased with increase in total costs that vary.

6. The marginal analysis was done by using the formula

$$\text{Marginal rate of return (MRR)} = \frac{\text{Incremental net benefits}}{\text{Incremental net costs}} \times 100$$

7. Then sensitively analysis was done to check risk factors which cause price variability. The analysis was done assuming costs over run by 20% keeping the benefits same, and then by assuming benefits reduction by 20%, keeping the costs same.

RESULTS AND DISCUSSION

The results of the data, analyzed by using partial budgeting technique have been presented in the form of partial budget. At the first step of the partial budgeting technique, average yield was calculated which have been presented in Table I. The yield was adjusted to cover the differences in management practices between research station and farmers fields. At the second step gross field benefits for each treatment were calculated. At the third step, total costs that were calculated.

To arrive at net field benefits of each treatment, total cost that vary were subtracted from gross fields benefits. The net field benefits were highest for T_3 (Machete @ 2.25 L ha^{-1}) (Table I).

At the next step marginal analysis was carried out, but before doing so unprofitable treatments were eliminated by making the use of dominance analysis. Thus eliminated treatments were T_6, T_7 and T_4 (Table II). For undominated treatments, return to investment was calculated by using the techniques of marginal analysis, which showed that while shifting from control treatment (i.e. T_1, without using any insecticide) to T_5, the MRR was 146.43%, 1337.95% and 699.89% for T_2, T_3 and T_5 respectively. Keeping in view the farmers risk, interest on capital and minimum acceptable rate of return to the farmer, the minimum acceptable rate of return was assumed to be 100%. Analysis showed that calculated rate of return of all alternative treatments was higher than minimum acceptable rate of return (Table III). However among all undominated treatments, rate return of T_3 (Machete @ 2.25 lit/ha) was highest (Table 3). Therefore, T_3 was accepted as best treatment and was recommended for farmers adoption. These findings were supported by results of Bajwa *et al.* (1985) and Singh *et al.*(1986) who found chemical weed control by the application of Machete to be the best. Finally, to check risk which may occur due to price variability for both inputs and outputs, sensitivity analysis was carried out.

Table I. Partial budget of average data from herbicide trails on paddy

(a) Gross field benefits of grains and straw combined

Treatment	–Experimental yield kg/ha–		———Adjusted yield———		————————Gross fields benefit————————		
	Grain	Straw	Grain*	Straw**	Grain***	Straw****	Total
T_1 Control	2334.93	3502.39	1797.90	2731.86	11866.11	628.33	12494.44
T_2 Machete 2.1 L ha^{-1}	3323.82	4985.73	2559.34	3888.87	16891.65	894.44	7786.09
T_3 Machete 2.25 L ha^{-1}	3533.67	5300.50	2720.93	4134.39	17958.11	950.91	18909.02
T_4 Machete 2.5 L ha^{-1}	3056.10	4584.15	2353.20	3575.64	15531.10	822.40	16353.50
T_5 Satrun 1.1 L ha^{-1}	3220.20	4830.30	2479.56	3767.64	1636.06	866.56	17231.62
T_6 Saturn 1.2 L ha^{-1}	3005.80	4508.71	2314.47	3516.80	15275.48	808.86	16084.34
T_7 Saturn 1.5 L ha^{-1}	3016.40	4524.09	2322.63	3528.79	15329.34	811.62	16140.96

*Grain field adjusted at the rate of 23% ; **Straw yield adjusted at the rate of 22%; ***Field price of grain Rs. 6.6/kg; **** Field price of straw Rs. 0.23/kg

(b) Gross field benefits, total costs that vary and net field benefits

Items	*Control	Machete @ 2.1 L ha^{-1}	Machete @ 2.25 L ha^{-1}	Machete @ 2.50 L ha^{-1}	Satrum @ 1.1 L ha^{-1}	Satrum @ 1.2 L ha^{-1}	Satrum @ 1.5 L ha^{-1}
A. Gross field benefits (Rs/ha)	12494.44	17786.09	18909.02	16353.50	17231.62	16084.34	16140.96
B. Costs that vary Rs/ha							
a. Cash costs							
1. Cost of herbicides	0	625	703.12	781.25	400	480	600
2. Cost of transportation	0	20	20	20	20	20	20
3. Sprayer rental cost (Rs/ha)	0	65	65	65	65	65	65
B. Opportunity cost (Rs/ha)							
1. Cost of labour 0 to apply herbicides (Rs/ha)	0	71.5	71.5	71.5	71.5	71.5	71.50
2. Cost of labour to haul water (Rs/ha)	0	35.75	35.75	35.75	35.75	35.75	35.75
Total costs that vary (Rs/ha)	0	817.25	895.37	973.5	592.25	672.25	792.25
Net Field Benefits (Rs/ha)	12494.44	16968.84	18013.65	15380.00	16639.37	15412.09	15348.71

*Net herbicide was applied

Table II. The dominance analysis of herbicide trials

Treatments	Cost that vary (Rs/ha)	Net field benefits (Rs/ha)
T_1	0	12494.44
T_5	592.25	16639.37
T_6	672.25	15412.09 D
T_7	792.25	15348.71 D
T_2	817.25	16968.84
T_3	895.37	18013.65
T_4	973.50	15380.00 D

The sensitivity analysis was done twice, firstly, assuming cost over run and secondly by assuming benefit reduction option. In the cost over run option, it was assumed that the field prices of input were increased by 10%, while net benefits remained unchanged. The results of sensitivity analysis of cost over run option are given in Table IV which showed that significance of treatment T_3 remained the same and T_3 was best among all alternatives.

Table III. The marginal analysis

Treatments	Total costs that vary (Rs/ha)	Marginal costs (Rs/ha)	Net field benefits (Rs/ha)	Marginal net field benefits	MRR = (V/III) x 100
I	II	III	IV	V	
T_1	-	-	12494.44	-	-
T_5	592.25	592.25	16639.37	4144.93	699.86%
T_2	817.25	225.00	16968.84	329.47	146.43%
T_3	895.37	78.12	18013.65	1044.81	1337.44%

Table IV. Sensitively marginal analysis for "Cost over Run Option"

Treatments	Total costs that vary	Marginal costs	Net field benefits	Incremental net field	MRR = (V/III)x100
I	II	III	IV	V	
T_1	-	-	12494.44	-	-
T_5	651.47	651.47	16599.35	4104.91	629.96%
T_2	898.97	247.56	16906.33	306.98	124.00%
T_3	984.90	85.93	17943.33	1037.00	1206.79%

Table V. Sensitivity for "Benefits Reduction Option"

Treatments	Costs that vary	Marginal costs	Net field benefits	Incremental net benefit	MRR = (V/III)x100
I	II	III	IV	V	
T_1	-	-	11244.99	-	-
T_5	592.25	592.25	14975.41	3730.42	629.87
T_2	817.25	225.00	15271.95	296.54	131.81
T_3	895.37	78.12	16212.28	940.33	1203.71

The results of second part of the sensitivity analysis pertain to the benefit reduction option. Here also it was assumed that there was 10% reduction in the net field benefits due to reduction in the price of output, while total cost that vary remained unchanged. The results showed that analysis did not alter the ranking of the treatment under consideration. Here also T_3 (i.e. Machete @ 2.25 Lit/ha) was the best among all the alternatives considered. Based on the analysis of experimental data, using partial budgeting technique, T_3 was highly stable. Therefore the use of the herbicide on transplanted rice for the control of weeds was recommended as economically the most feasible option in the use of herbicides.

SUGGESTIONS/CONCLUSIONS

1. Analysis of the data showed that Machete @ 2.25 lit/ha was most economical herbicide for rice growers. Therefore, government and other private enterprises should manage low cost production of this herbicide.
2. Government should ensure timely availability and good quality product because Machete is applied immediately after transplanting the rice.
3. Also arrangement should be made to educate the farmers about the application, time and dose of herbicide through media and extension workers, so that over doses or wrong timings of application of the herbicide are avoided.

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(Received 17 July 1999; Accepted 15 December 1999)