Efficacy of herbicide versus manual extraction of weeds on yield attributes of rain-fed paddy *(Oryza sativa* L.*)* in Far Western Nepal

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Abstract: Field investigations were carried out during 2004-2005 to evaluate the efficacy of herbicides and manual extraction of weeds in two varieties of rainfed paddy (Radha-4 & Neemai). Field experiments were conducted at farmers' agricultural fields at Tilachaur in Mahendranagar, Nepal. A total of four experiments were laid down in randomised block design (RBD) with three replications each. Hand weeding was done twice at 25 and 50 days after broadcasted paddy sowing, and proved to be better than herbicide treatment in the controlling weeds and improving yield attributes of paddy. The mean maximum grain yield was 52.2 q ha^{-1} in Radha-4 and 46.4 q ha^{-1} in Neemai in weed-free conditions. In twice hand-weeded plots the grain yield was lower than the maximum by 9.6% in variety Radha-4 and 2.2% in Neemai. In herbicide treated plots the yield being 12.1% and 4.1% lower than weed-free plots. Weeds resulted in 42.3% and 34.7% loss in paddy yield in Radha-4 and Neemai as evident from the comparison of the unweeded and weed-free plots. The mean maximum paddy height attained in Radha-4 and Neemai was better in weed-free (TT) plots (105.1 and 133.9 cm, respectively) compared to 91.2 and 129.7 cm in unweeded plots (T_0).
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Introduction:

Nepal is primarily an agricultural country with about 65.6% of its population engaged in agriculture. Approximately 2.32 million ha of land is cultivated of which 1.7 million ha of land is rainfed. Nepal being a mountainous country, only 17% of the total surface area can be termed as plain. The remaining 83% of the country is hilly or mountainous. In Himalayan mountain region people are among the poorest in Nepal with lowest per capita income. The rainfed paddy is the most important staple crop of Nepal but the productivity is affected due to climate, edaphic and economic factors in the foothills of Nepal. In hills and mountains, agriculture is still practiced in its traditional style. The traditional way of agriculture as practiced by majority of farmers is supposed to be one of the important factors for the poor performance of the agricultural sector in the country. Weed management is as old as agriculture itself. It continues to be of immense interest and utmost concerns to researchers and farmers alike in the continuing struggle for maximizing crop production to meet the needs of growing population (Rao 1992). Many weed species have almost identical growth and requirements as paddy. The practices that benefit rice also benefit weeds, while the practices that harm rice also harm weeds (De Datta & Baltazar 1996).

In developed and developing countries herbicides are becoming increasingly popular as the method of weed control in rice (Pandey & Singali 1996). But in Nepal, in general, it is still at the initial stage. The problem of weeds in upland rainfed rice during kharif is extremely severe and causes substantial 45-85% reduction in yield (Moody 1982). The physical method of weed control though effective is expensive, tedious and time consuming requiring intensive human labour. Different herbicides are used alone or in combinations to eliminate weeds, but their efficiency varies because of their narrow spectrum of weed control. Most of the pre-emergence herbicides are effective only up to 20 days after sowing (Balusamy & Pothiraj 1989). The use of chemicals to control weeds has been found less effective but economical (Prasad & Rafey 1996). Keeping in mind the above studies present investigation was undertaken to evaluate the efficacy of herbicides and manual extraction of weeds in yield

attributes of upland rainfed paddy in Mahendranagar, Far Western, Nepal.

Materials and Methods

The field experiments were conducted during the *kharif* season of 2004-2005 at farmers' agricultural field at Tilachaur in Mahendranagar (28°32' N latitude-80°33' E longitude, and 300 m amsl). The soil is silty clay in texture with 6.5 pH. Climate is humid tropical with three distinct seasons in a year, *viz*. monsoon, winter and summer. Total annual rainfall during the study period was 1642.8 mm of which 90% was recorded during the monsoon months of the year.

The experiment was laid out in RBD block design with three replicates of plots sized 5m × 5m. The four treatments applied were: weed-free (TT), unweeded (T_0), manured plus twice hand-weeded on 25 and 50 days after broadcasting (T_1) and chemical fertilizer plus butachlor (1.5 kg ha^{-1}) (T_2). Rice seeds (*viz*. Radha-4 & Neemai) were sown on the basis of farmers' practices using a seed rate of 80 kg ha^{-1} in the first week of June with the arrival of pre-monsoon. The pre-emergence herbicide treatment was applied 3 days after sowing. A fertilizer dose of N, P and K was applied @ 100:30:40 kg ha^{-1} respectively in TT, T_0 and T_2 plots. Full dose of P and K and half of N were applied as the basal dose and remaining N was top-dressed in two equal splits at tillering and panicle initiation stage. In T_1 treatments farmyard manure (15 t ha^{-1}) was applied. Weed-free and unweeded treatments were kept for comparisons. The crop was harvested in the second week of October. For the observation of weeds, three quadrats (30 cm × 30 cm) were randomly sampled within treatments and ten randomly selected paddy plants in each treatment were taken for determining yield attributes of paddy. Data were statistically analysed by using the standard method of analysis of variance (ANOVA) at P = 0.05% significance level.

Results

Effect of treatments on weeds

Weed population was lowered by all the treatments in comparison to unweeded plots. Weed population drastically increased when paddy was not weeded out during the early stage of growth period (Table 1). The dry weight of weeds varied according to competition period. Maximum (516.4 g m^{-2}) dry weight of weeds was observed in unweeded plots and minimum (169.3 g m^{-2}) dry weight was observed in twice hand-weeded plots. The dry weight of weeds decreased by 38.7% in butachlor used plots compared to unweeded plots (Table 1).

Effect of treatments on paddy

The yield attributes under herbicide and manual extraction treatments were better than unweeded plots in both the varieties. Plant height was affected due to crop weed competition in both the years of experiments. Maximum plant height was 105.1 and 133.9 cm in weed-free plots of Radha-4 and Neemai, respectively. The percentage reduction in plant height compared to weed-free plots was 13.2, 0.7, and 2% in T_0, T_1 and T_2 treatments, respectively in Radha-4 and 3.1, 0.7, and 1.3% in T_0, T_1 and T_2 treatments, respectively in Neemai. The plant height was more or less similar in twice hand-weeded and butachlor used plots in both the varieties. The maximum grain yield in Radha-4 and Neemai was in weed-free (TT) plots 52.2 and 46.4 q ha^{-1} compared to 30.1 and 30.3 q ha^{-1} in unweeded plots (T_0), grain loss being 42.3% and 34.7% because of weeds in Radha-4 and Neemai varieties. Compared to weed-free plots the grain yield was 9.6% and 2.2% lower in twice hand-weeded plots (T_1 and 12.1% and 4.1% in herbicide treated plots (T_2) in Radha-4 and Neemai. The effect of manual weeding and herbicidal treatment significantly ($P<0.001$) increased the grain yield compared to unweeded plots of both varieties (Table1). The weight of 1000 grains was 27.6 and 25.6 g in Radha-4, and 20.8 and 18.7 g in Neemai in weed-free and unweeded plots, respectively. Whereas, the weight of 1000 grains was 27.2 and 26.2 g in Radha-4, and 20.3 and 19.6 g in Neemai in twice hand-weeded and butachlor used plots, respectively. Compared with weed-free plots the weight of 1000 grains, panicle weight, and straw yield reduction due to weeds in various treatments in the present study were in order: $T_0>T_2>T_1$ in both varieties (Table 1). The present study showed that Neemai variety of paddy suffered less in comparison to Radha-4 variety due to weed infestation.

Table 1. Effect of weed control practices on yield attributes, weed density (m^{-2}), weed dry weight (g m^{-2}), plant height (cm), panicle weight (g), weight of 1000 grains (g), straw yield (qha^{-1}) and grain yield (qha^{-1}) in rainfed broadcast paddy *cv*. Radha-4 and Neemai (mean±SE). The values are mean of 3 samples for weeds and 10 samples for paddy. The data are average of two years (2004-05).

Treatments	Weed density (m^{-2})		Weed dry weight (g m^{-2})		Plant height (cm)		Panicle weight (g)		1000 grains weight (g)		Straw yield (q ha^{-1})		Grain yield (qha^{-1})	
	Radha-4	Neemai	Radha-4	Neemai	Radha-4	Neemai	Radha-4	Neemai	Radha-4	Neemai	Radha-4	Neemai	Radha-4	Neemai
TT	-	-	-	-	105.1 ±0.73 (0.0)	133.9 ±0.94 (0.0)	3.6 ±0.05 (0.0)	3.2 ±0.07 (0.0)	27.6 ±0.22 (0.0)	20.8 ±0.07 (0.0)	69.0 ±0.48 (0.0)	70.5 ±0.39 (0.0)	52.2 ±0.28 (0.0)	46.4 ±0.36 (0.0)
T_0	240 ±2.4 (0.0)	236.0 ±2.1 (0.0)	516.4 ±3.85 (0.0)	437.6 ±5.71 (0.0)	91.2 ±1.03 (13.23)	129.7 ±0.92 (3.14)	2.4 ±0.04 (33.33)	2.1 ±0.05 (33.38)	25.6 ±0.12 (7.25)	18.7 ±0.05 (10.1)	47.9 ±0.56 (32.28)	48.3 ±0.13 (31.56)	30.1 ±0.75 (42.33)	30.3 ±0.18 (34.71)
T_1	73.3 ±3.3 (69.58)	72.0 ±2.4 69.49)	169.3 ±9.94 (67.21)	192.3 ±6.4 (56.1)	104.2 ±0.68 (0.86)	133.0 ±0.93 (0.67)	3.4 ±0.04 (5.56)	3.1 ±0.07 (3.13)	27.2 ±0.18 (1.45)	20.3 ±0.06 (2.40)	68.4 ±0.50 (2.13)	69.2 ±0.43 (1.90)	47.2 ±0.31 (9.58)	45.4 ±0.43 (2.16)
T_2	156.0 ±2.4 (35.0)	146.0 ±4.7 (38.14)	244.5 ±6.14 (52.65)	268.4 ±2.94 (38.66)	103.0 ±0.43 (2.0)	132.1 ±0.73 (1.34)	3.2 ±0.05 (11.1)	2.8 ±0.09 (12.5)	26.3 ±0.17 (4.71)	19.6 ±0.07 (5.77)	66.1 ±0.59 (5.38)	67.8 ±0.31 (3.81)	45.9 ±0.28 (12.07)	44.5 ±0.34 (4.10)
'F'test	*	*	*	*	*	*	*	*	*	*	*	*	*	*

'F' test was applied * indicate significant at P<0.001. Values in the parentheses indicate percentage reduction
Treatments: TT = Weed-free, T_0 = Unweeded, T_1 = Manured plus twice hand-weeded at 25 and 50 days after broadcasted, T_2 = Chemical fertilizer plus butachlor.

Discussion

In Nepal people depend critically on rainfed paddy, which is the most important staple crop of Nepal, and follow traditional agriculture methods. Infestation of weeds in the paddy crops is considered to be a principal cause of grain loss (Moody 1982). Manual weeding is still the method of weed control generally being practiced by the farmers of Nepal. Two times weeding at 25 and 50 days after broadcasted is the best approach in weed management and crop production, though it is somewhat impractical because it is difficult to distinguish between young grassy weeds and rice plants, and rice plants may be destroyed in the process. Herbicides are considered to be a more practical way of weed control in direct seeded rice because under the current trend of modernization, labour is either costly or not available. Under such a situation herbicide use is an easy and cheap method for weed control, which can be economically sustained by the farmers.

The minimum dry weight of weeds was recorded under twice hand-weeded plots at 25 and 50 days after broadcasted followed by butachlor plus chemical fertilizer used plots. The present findings are in agreement with those of Singh and Singh (1994), Tuteja *et al.* (1995), Rao and Singh (1997) and Thapa and Jha (2003). Panicle weight, test weight of grains, straw yield and grain yield were higher in weed-free plots than other treated plots. Such types of results were given by Singh and Bhan (1986). In twice hand-weeded plots gives marginally higher yield attributes compared to butachlor used plots.

From the current study it is evident that the loss in grain yield due to weeds was 42.3% in Radha-4 variety and 34.7% in Neemai compared to unweeded plots. Hence it is essential to identify the paddy variety and treatments by which this grain loss can be reduced. In twice hand-weeded plots the reduction in yield was 9.6% and 2.2% and in herbicide treated plots 12.1% and 4.1% in Radha-4 and Neemai varieties. The study clearly indicates that in Neemai variety of paddy the grain loss due to weeds is significantly less than in Radha-4. The twice hand-weeded method gives a marginally higher yield than the herbicidal treatments.

In the present study the grain yield in unweeded plots of both varieties was close to the national average grain yield. Twice hand-weeded plots showed a reduction of 9.6% grain yield in Radha-4 and of 2.2% in Neemai as compared to weed-free plots. Butachlor alone gave 12.1% grain yield reduction in Radha-4 and 4.1% in Neemai. The pre-emergence herbicide alone was less effective in increasing grain yield because it controls only early grassy weeds and failed to control the late emerging dicots and monocots weeds (Gogoi 1995).

From the present investigation it can concluded that all the yield attributes of paddy were better in twice hand-weeded plots than in butachlor alone used plots. However, economically where labour is either costly or not available the use of herbicide can be a substitute for manual weeding.

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References

1. De Datta S.K. and Baltazar A.M. 1996. Weed control technology as a component of rice production systems. In: *Weed management in Rice* (eds.) Auld B.A. and Kim K.U., FAO Plant Protection and Production Paper **139**: 25-47.
2. Moody, K. 1982. The status of weed control in rice in Asia. *Improving weed management.* FAO Plant Production and Protection paper. Food and Agriculture Organization of the United Nations, Rome, Italy **44**:114-125.
3. Pandey, S. and Singali P.L. 1996. Economic aspects of weed management in rice. In: *Weed management in Rice* (eds.) Auld B.A. and Kim K.U.. FAO Plant Production and Protection Paper. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy **139**:55-73.
4. Prasad, K. and Rafey A. 1996. Chemical methods of weed management in lowland rice (*Oryza sativa*). *Indian J. Agric. Sci.* **66** (**1**): 73:74.
5. Rao, A.S. and Singh R.P. 1997. Effect of herbicide mixtures and sequential application on weed control in transplanted rice (*Oryza sativa*). *Indian J. Agron.* **42** (**1**): 77-81.
6. Rao, V.S. 1992. Principles of weed science Oxford and IBH publishing Pvt. Ltd. New Delhi 540p.
7. Singh, G. and Singh O.P. 1994. Herbicidal control of weed in transplanted rice (*Oryza sativa*) in rainfed lowland condition. *Indian J. Agron*. **39 (3):** 463-465.
8. Singh, O.P. and Bhan V.N 1986. Effects of herbicides and water submerged leaves of control of weeds in transplanted rice. *Indian J. Weed Sci.* **18**(**4**): 226-230.
9. Thapa, C.B. and Jha P.K. 2003. Effects of herbicide and manual weeding on the yield of transplanted paddy in Pokhara, Nepal. *Ecoprint* **10**(**1**): 35-41.
10. Tuteja, S.S., Chandrakar B.L. and Tripathi R.S. 1995. Economic feasibility of different herbicides on direct seeded lowland rain fed rice. *Indian J. Agron*. **40** (**2**): 286-287.

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