EFFICACY OF DIFFERENT WEED MANAGEMENT PRACTICES ON GROWTH AND YIELD OF SPRING RICE UNDER SYSTEM OF RICE INTENSIFICATION (SRI) IN BARA, NEPAL

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ABSTRACT

A field experiment was conducted during the spring season of 2022 to determine the effects of various weed management practices on production and productivity of transplanted spring rice under System of Rice Intensification (SRI) at Kolhabi, Bara, Nepal. The experiment was laid out in a single-factorial Randomized Complete Block Design (RCBD) with five treatments and four replications. The treatments consisted of pretilachlor 50% EC (dose: 500 g a.i. per ha) as pre-emergence herbicide, pretilachlor 50% EC (dose: 500 g a.i. per ha) plus hand-weeding at 20 and 40 DAT, hand weeding at 20 DAT, 40 DAT & 60 DAT, conoweeding at 20, 40 & 60 DAT and weed-free or control. The plot treated with conoweeding recorded a significantly higher plant height (108.90cm), higher number of tillers/m^2 (486.19), and higher number of grains per panicle (211.19) at 90 DAT. The sterility percentage and the number of grains per panicle were not affected by the weed management practices. Conoweeding was found statistically superior in terms of grain yield (7.12 mt/ha) and straw yield (9.77 mt/ha). The experiment concluded that the weed management practices affect the grain yield of transplanted spring rice. Though herbicide is considered as the economical and effective source of weed management practices, higher yield was obtained in the cono-weeded plots.

Key words : Cono-weeding, herbicide, pretilachlor, spring rice

INTRODUCTION

Rice (*Oryza sativa L.*), as the staple food for over half of the global population, plays a crucial role in ensuring food security, particularly in Asia, which is home to 55 percent of the world's population and producer of 92 percent of the world's rice (Wilson & Talbot, 2009). That is why; it is said "Rice brings the Asians together" (Basnet, 2008). Nepal, considered one of the origin centres of rice, heavily depends on rice cultivation for both sustenance and livelihoods, with rice covering approximately 50.56% of the cultivated area (MoALD, 2021). However, rice production in Nepal lags behind its potential, with production and productivity of 5,621,710 mt and 3.82 mt/ha, respectively, considered relatively low (MoALD, 2021). Bara, one of the major rice-producing districts in Nepal, cultivates rice on a large scale, with a total rice production area of 66,495 ha (MoALD, 2021). Spring rice, grown in 325 ha, exhibits promising results with a production of 1,435 mt and an average productivity of 5.10 mt/ha surpassing the national average for spring rice (MoALD, 2021).

Rice cultivation in Nepal encompasses diverse ecosystems, ranging from irrigated and shallow lowlands to mid-deep lowlands, deep water, and uplands (Patel & Ghosh, 2019). However, weed infestation poses a significant biotic constraint to rice production, especially in developing countries like Nepal, where subsistence farming is prevalent. Weeds compete with rice for nutrients, light, water, and space, causing approximately one-third of the crop loss. The dominance and rapid growth of weeds reduce the crop's yield potential, resulting in an annual loss of 15 million tonnes due to weed competition (Patel & Ghosh, 2019). According to Veeraputhiran & Balasubramanian, 2014, 45-51% yield reduction was caused by weeds in transplanted rice. Therefore, prevention of weed competition and provision of weed free environment at critical period of rice growth is necessary for successful rice production.

To address these challenges, the system of rice intensification (SRI) has been introduced as an alternative technology and resource management strategy. SRI emphasizes early transplanting of young seedlings, wider spacing between seedlings, mechanical weeding with a rotary push weeder, appropriate water management, and reduced reliance on chemical fertilizers (Thura, 2010). In Nepal, many rice growers employ mechanical weeding two or three times per season, incurring labor costs and facing issues of labor availability (Roder, 2001). As an emerging alternative, cono-weeding has gained attention as an efficient weed management method, proven useful in removing weeds between rows of paddy crops effectively. (Roder, 2001). While chemical herbicides offer an effective and practical solution for weed management, their widespread use raises sustainability concerns such as herbicide-resistant weed development and changes in weed flora (Duary, 2008). It is advisable to rotate the herbicide combination in each year for delaying the development of herbicide resistance in weeds and integrate chemical herbicides with other weed management practices like hand-weeding and cono-weeding to minimize environmental risks (Beckie & Reboud, 2009).

Since, weed control in transplanted rice by mechanical and cultural method is expensive, especially at the time of peak period of labour crisis when sometimes weeding becomes delayed causing drastic reduction in grain, herbicides offer a better solution. However, with the onset of development of herbicide resistant weeds, chemical method also has taken a big hit (Duary, 2008). Addressing all of the above issues, this experiment was carried out to identify an efficient weed management practice for spring rice under the System of Rice Intensification (SRI), compare the yield and yield attributes of spring rice planted under SRI with different weed management practices in Bara district and determine the weed management practice that demonstrates superior performance and higher grain yield.

MATERIALS AND METHODS

Research Site

The research was conducted in Khaira, Kolhabi municipality which is commanded by Rice block under the Prime Minister Agriculture Modernization Project (PMAMP). The Rice block (Kolhabi municipality) is located in north east part of Bara district. It lies at latitude of 27˚11'42” N and longitude of 85˚16’87’’E with the total coverage of 157 sq.km. Being one of the most important areas for rice production, this study was carried out to address the weed management problems faced in transplanted spring rice by the local people. Fig. 1 shows the map of research site.

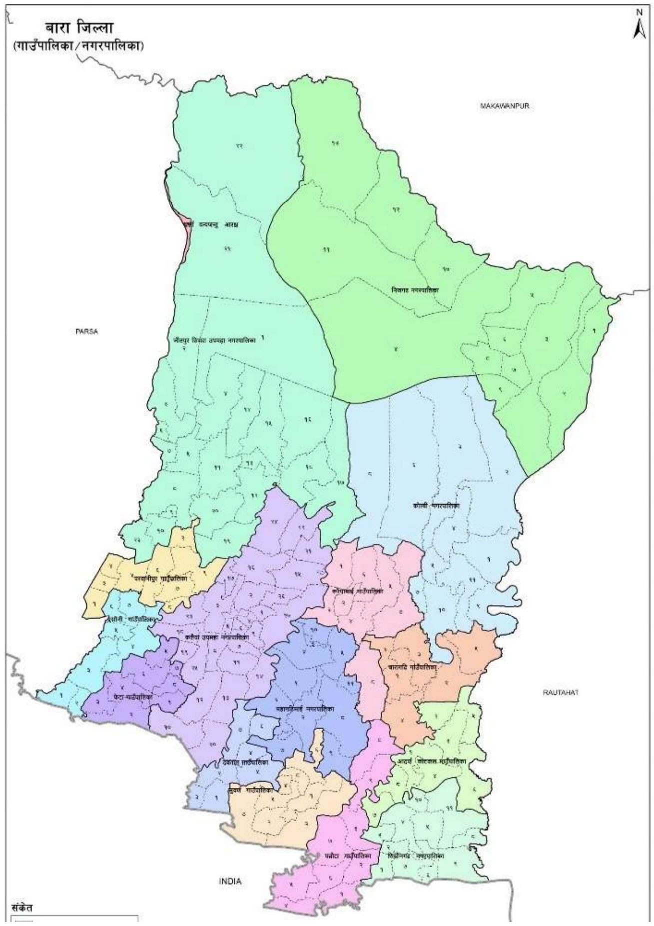

Fig. 1. Map of study area in Bara district, Nepal.

Agro-Meteorological Features

The experiment site was located in the tropical region of Nepal where summer is very hot and winter is mild cold. It received most of the rainfall during monsoon season. The maximum temperature recorded within the study period was 34 °C at the time of harvesting, while the minimum temperature was 16 °C in February. The maximum relative humidity recorded was 69% in June while the minimum relative humidity record was 33% in March.

Variety Used in Experiment

The major experimental material used in the present study was Hardinath-1 variety of rice. Hardinath-1 was recommended as a spring rice variety in the year 2060 BS. It is recommended for Terai, inner terai and river basin up to 800 masl. It takes 120 days to ripen and the average productivity is 4.03 mt/ha. (AITC, 2021).

Machinery Used

Tractor was used in ploughing and harrowing operations to make the soil ready for transplantation. Cono-weeder was used to remove weed at 20, 40 and 60 DAT. The cono-weeder is operated by pushing action. The orientation of rotors creates a back-and-forth movement in the top 3 cm of soil and helps in uprooting the weeds.

Experimental Design

The experiment was carried out on Randomized Complete Block Design (RCBD) with five treatments including control, and each treatment was replicated four times. The individual plot size was 3 m × 3 m maintaining the row to row spacing of 25 cm and plant to plant distance of 25 cm. The spacing between replications was 1 m and between treatments was 1 m. The total field experimental area was 357 m^2. The outside field border was also 1m from each plot.

Details of Treatment

The treatments consisted of pretilachlor 50% EC (dose: 500 g a.i. per ha) as pre-emergence herbicide, pretilachlor 50% EC (dose: 500 g a.i. per ha) as pre-emergence herbicide plus hand-weeding at 20 and 40 DAT, Hand weeding at 20 DAT, 40 DAT and 60 DAT, cono-weeding at 20 DAT, 40 DAT and 60 DAT and weed free or control as shown in Table 1.

Table 1. Details of treatment used in research

Treatment	Treatment details
T1	Control
T2	Hand weeding at 20 DAT, 40 DAT, 60 DAT
T3	Cono-weeding at 20 DAT, 40 DAT, 60 DAT
T4	Pre emergence herbicide pretilachlor 50 EC (500 g per ha)
T5	Pre emergence herbicide pretilachlor 50 EC (500 g per ha) plus hand weeding at 20DAT, 40DAT

Cultivation practices

Nursery Preparation

The nursery bed was ploughed with rotavator and levelled. Muriate of potash (MOP), diammonium phosphate (DAP) and urea was applied basally in the nursery bed at the rate of 0.5 kg, 0.7 kg and 3 kg, respectively. The soaked seeds were sown after puddling in the morning. Second dose of the Urea was applied after 8-10 DAS. The seedlings were ready for transplanting at 14-20 DAS.

Main Field Preparation

To get good tilth of the soil for sowing, the field was ploughed three times followed by planking and puddling before transplanting the rice seedlings.

Fertilizer Application

Nitrogen, Phosphorus and Potassium were applied at the dose of 100:30:30 kg NPK per ha. One-third of nitrogen, the full dose of phosphorus and potassium was applied as basal dose in all treatments. Remaining two-third dose of Nitrogen was applied on standing crop by top dressing into two equal splits at the tillering stage and the panicle initiation stage of the crop.

Seed Rate and Sowing

The seeds were sown on slightly raised puddled seedbed with at least 1cm thickness of water. The seeds were sown by the broadcasting method at the rate of 40-50 kg per ha. After 15 DAS, seedlings were transplanted into the main field at the spacing of 25 cm × 25 cm. The seeds were first treated with salt (250 g salt in one-litre water). Manual labour was used in transplanting process.

Irrigation

Rice requires more quantity of water compared to other crops. The wrong concept of waterlogged condition in rice in farmers is a big problem. Rice requires more water at critical stages; vegetative, panicle initiation and grain filling stage. The rice field was irrigated at 1 week interval from nearby water canal following the principle of Alternate Wetting and Drying (AWD).

Weeding and Inter-Cultural Operation

The weed infestation is higher in spring rice under System of Rice Intensification (SRI)s as compared to main season rice. The weed control will be done as per the treatment using manual, mechanical and chemical implements. Weeds were allowed to grow along with the rice crop throughout the crop cycle without any management in control plots.

Observation Recorded on Rice

Biometrical Observations

Plant Height (cm)

Randomly selected and tagged 10 plants from different alternate rows i.e., one plant from 2nd, another from 4th row and so on except border row and the destructive row was used for the measurement of plant height. Plant height was measured at 15-days interval from 30 DAT up to 90 DAT. The average of 10 plants was expressed as plant height. It was measured from base to tip of the flag leaf of the main stem.

Number of Tillers / sq m

Tiller per square meter was counted from the plants taken from destructive sampling rows at 15-days interval from 30 DAT up to 90 DAT and mean was recorded. One metre row length was marked in the third row of each plot for counting the number of tillers

Yield Attributing Characters of Rice

Number of Effective Tillers / sq m

The observation regarding the effective tillers per square meter was recorded within each plot from one full length of rows just before harvesting the crop and the average values were used to obtain the effective tillers per square meter. The tillers having filled grains were recorded as effective tillers.

Length of Panicle (cm)

The randomly selected 20 panicles from each hill were taken to measure the length of the panicle. This was done just before harvesting and the mean was calculated.

Number of Grains per Panicle and Sterility Percentage

It was counted and weighted in electronic balance by taking grains from 20 panicles just before harvesting (panicles which were selected for length measurement). At the same time, the number of filled and unfilled grains was counted to determine the number of filled grains per panicle and sterility percentage. Sterility percentage was calculated using the following formula.

Sterility percent = (Number of unfilled grains per panicle/ Total number of grains per panicle) x 100

Thousand-Grain Weight (TGW) (g)

Thousand grains were counted from the randomly selected grains of net plot of 1 m^2 and weighed with the help of electronic balance at exact moisture content and mean was calculated and expressed in gram at 14% moisture level.

Grain and Straw Yield (kg/ha)

The crop from the net plot was harvested to record the grain yield. Grain yield and straw yield were taken at harvest of the crop from each net plot. The crop was dried, threshed, cleaned and again sun-dried and final weight was taken. Moisture was measured with the help of moisture meter at 14% moisture using the following formula.

$$\text{Grain yield (kg/ha) at 14\% moisture} = \frac{\text{(100-MC) x Plot yield (kg) x1000 } (m^2)}{\text{(100-14) x Net plot area } (m^2)}$$

Harvest Index

Harvest index (HI) was computed by dividing grain yield at 0% moisture with the total dry matter yield (grain yield at 0% moisture and straw dry weight) as per the following formula.

$$\text{Harvest index (HI)} = \frac{\text{Grain yield (Economic yield)}}{\text{Biomass yield (Biological yield)}}$$

Statistical Analysis

The recorded data on various observed parameters were compiled and arranged treatment-wise systematically in four replications. MS-Excel was used for simple statistical analysis, construction of graphs and tables. Compiled data were subjected to analysis of variance (ANOVA) and data related to weed species was transformed by square root transformation before analysis of variance. R-studio was used for data analysis.

RESULTS AND DISCUSSION

Plant height

The study revealed that the plant height was significantly influenced by weed management practices. The average plant height varied from 51.34 cm (30 DAT) to 106.58 cm (90 DAT) and increasing up to 90 DAT. At 30 DAT, plant height was statistically at par in all the treatments except control. The plot treated with pretilachlor plus hand-weeding at 20, 40 DAT had the taller plant height (54.50 cm) as compared to others and it was statistically similar with other plots except the control one. At 45 DAT, plant height was longest (72.41 cm) in the plot treated with cono-weeding and the lowest plant height (62.50 cm) was found in the control plot. There was no significant difference between plant height in the control plots and the plots with hand weeding.

At 60 DAT, plant height was found longest (81.44 cm) in the plot treated with pretilachlor plus hand-weeding at 20, 40 DAT which was statistically similar with other plots except the control one where lowest plant height (76.71 cm) was recorded. Similarly, at 75DAT, the longest plant height (102.75

cm) was observed in the plots treated with cono- weeding at 20, 40, 60 DAT and the plant height at control plots was found to be the lowest (96.95 cm). At 90 DAT, the longest plant height (108.90 cm) was observed in the plot treated with cono-weeding at 20, 40, and 60 DAT and the lowest plant height (103.52 cm) was observed in the control plots as shown in Table 2.

This result inclined to cono-weeding as the superior method for taller plant heights as compared to other weed management methods.

Table 2. Plant height influenced by different weed management practices at Kolhabi, Bara, 2022

Treatment	Plant height (cm)				
	30 DAT	**45 DAT**	**60 DAT**	**75 DAT**	**90 DAT**
Control	47.49[c]	62.50[d]	76.71[d]	96.95[e]	103.52[c]
Hand-weeding at 20, 40, 60 DAT	51.52[b]	63.27[d]	77.12[cd]	98.79[d]	104.67[c]
Cono- weeding at 20, 40, 60 DAT	51.83[b]	72.41[a]	80.36[b]	102.75[a]	108.90[a]
Pretilachlor 50 EC (500 g per ha)	51.37[b]	67.49[c]	77.99[c]	100.34[c]	108.53[ab]
Pretilachlor 50 EC (500 g per ha)+ hand- weeding at 20, 40 DAT	54.50[a]	68.66[b]	81.44[a]	101.39[b]	107.27[b]
SEm (±)	0.25	0.33	0.28	0.28	0.41
F probability	<0.001	<0.001	<0.001	<0.001	<0.001
LSD (0.05)	0.82	1.09	0.94	0.92	1.35
CV (%)	1.04	1.05	0.77	0.60	0.82
Grand Mean	51.34	66.86	78.73	100.05	106.58

DAT: Days after transplanting, SEm: Standard error of mean, LSD: Least significant differences, CV: Coefficient of variation, cm: centimetres, %: Percentage, the treatment means with same letters do not differ significantly at 5% level of significance.

Number of Tillers per Unit Area

The number of tillers/sq m was significantly influenced by different weed management practices. The average number of tillers/sq m of rice in the experiment varied from 425.93 (30 DAT) to 426.03 (60 DAT) (Table 3). The number of tillers/sq m increased from 30 DAT to 60 DAT and then decreased towards maturity. A similar result was obtained by (Dangol *et al.*, 2020). At 30 DAT, the number of tillers per square meter of rice in the plots treated with pretilachlor plus hand weeding at 20, 40 DAT was statistically higher (593.08) than the rest of the plots. The lowest number of tillers (292.19) in rice was found in control plots. At 45 DAT, the number of tillers/sq m of rice in the plots treated with pretilachlor plus hand-weeding at 20, 40 DAT was found to be highest (878.36) and the lowest (319.71) was found at the control plots (Table 3).

At 60 DAT, maximum number of tillers/sq m (705.94) was found in the plots treated with pretilachlor plus hand-weeding at 20, 40 DAT and minimum number of tillers/sq m (585.96) was found in the control plots. Similarly, at 75 DAT, maximum number of tillers/sq m (586.15) was found in the plots treated with cono-weeding and minimum number of tillers/sq m (445.93) was found in the control plots. At 90 DAT, maximum number of tillers/sq m (486.19) was found in the plots treated with cono- weeding at 20, 40, 60 DAT while minimum number of tillers/sq m (367.07) was found in the control plots. This result inclined to cono-weeding as the superior method for higher tiller density as compared to other weed management methods. Reduced weed competition at critical crop growth stages results in increased availability of nutrients, water and light to the crops resulting in higher number of tillers/sq m.

Table 3. Number of effective tillers/sq m influenced by different weed management practices at Kolhabi, Bara, 2022

Treatments	Number of tillers/sq m				
	30 DAT	**45 DAT**	**60 DAT**	**75 DAT**	**90 DAT**
Control	292.19[e]	319.71[e]	585.56[e]	445.93[e]	367.07[e]
Hand-weeding at 20, 40, 60 DAT	389.55[d]	486.22[d]	658.30[d]	485.08[d]	395.55[d]
Cono- weeding at 20, 40, 60 DAT	417.08[c]	734.80[c]	686.250[c]	586.150[a]	486.19[a]
Pretilachlor 50 EC (500 g per ha)	437.75[b]	868.76[b]	694.71[b]	526.68[c]	406.60[c]
Pretilachlor 50 EC (500 g per ha)+ hand- weeding at 20, 40 DAT	593.08[a]	878.36[a]	705.94[a]	557.74[b]	474.73[b]
SEm (±)	4.22	2.75	1.49	1.44	0.95
F probability	<0.001	<0.001	<0.001	<0.001	<0.001
LSD 005	13.78	8.98	4.87	4.69	3.11
CV (%)	2.09	0.88	0.47	0.58	0.47
Grand mean	425.93	657.57	666.15	520.31	426.03

DAT: Days after transplanting, SEm: Standard error of mean, LSD: Least significant differences, CV: Coefficient of variation, cm: centimetres, %: Percentage, the treatment means with same letters do not differ significantly at 5% level of significance

Yield attributing characters

Panicle Length, Number of Grains per Panicle, 1000-Grain Weight and Sterility Percentage

The weed management practices had a significant impact on panicle length where the average panicle length was 25.56 cm. The plots treated with pretilachlor plus hand-weeding at 20, 40 DAT had the longest panicle length of 27.64 cm the lowest panicle length (23.42cm) was observed in the control plots, which was found statistically similar with the plots treated with hand-weeding (Table 4). The remaining readings were found to be statistically similar to each other. Shorter panicle length in the control plots might be the draining of nutrients by weed. A similar result was obtained by (Dubey *et al.*, (2017) and (Dangol *et al.*, (2020) where plots treated with a herbicide demonstrated a longer panicle as compared to plots treated with other weed management methods.

Number of Grains per Panicle

The weed management practices had no significant effect on the number of grains per panicle at 5% level of significance. The number of grains per panicle ranged from 188.67 in control plots to 211.19 in the plots treated with cono-weeding at 20, 40, 60 DAT with an average of 189.10 as shown in Table 4. Control plots produced a lower number of grains per panicle due to presence of weeds throughout the crop cycle which caused the depletion and less absorption of nutrients by the crop, especially during grain filling period. In an experiment, results corresponding to this experiment were obtained by (Dubey *et al.*, (2017) and (Dangol *et al.*, (2020). The highest number of grains per panicle in pretilachlor plus hand-weeding treated plots might be due to the effective suppression of weeds.

Thousand Grain Weight (g)

The mean 1000-grain weight in the experiment was 21.537 g. The effect of weed management practices was found non-significant on 1000-grain weight. Among the weed management practices, pretilachlor plus hand-weeding at 20, 40 DAT produced the highest (22.64 g) 1000-grain weight and the control plots produced the lowest 1000-grain weight (20.12 g) as shown in Table 4.

Sterility Percentage

Weed management practices had a significant effect on sterility percentage as shown in Table 4. The average sterility percentage during the experiment was observed to be 22.61% ranging from 26.74% in the control plots to 19.54% in pretilachlor alone treated plots, which was found statistically similar with the plots treated with pretilachlor and hand weeding. Sterility percentage in the control plots was found statistically similar with the plots treated with hand-weeding at 20, 40 and 60 DAT. Lower sterility percentage corresponded to the use of herbicide (pretilachlor).

Table 4. Yield attributes influenced by different weed management practices at Kolhabi, Bara, 2022

Treatments	Yield attributing characters			
	Panicle length (cm)	Number of grains per panicle	Sterility percentage (%)	1000 grain weight (g)
Control	23.42[d]	188.67[d]	26.74[a]	20.12[c]
Hand-weeding at 20, 40, 60 DAT	24.82[cd]	193.53[c]	26.03[a]	21.12[bc]
Cono- weeding at 20, 40, 60 DAT	25.46[bc]	211.19[a]	20.84[b]	21.55[ab]
Pretilachlor 50 EC (500 g per ha)	26.44[ab]	204.96[b]	19.54[c]	22.25[ab]
Pretilachlor 50 EC (500 g per ha) + hand- weeding at 20, 40 DAT	27.64[a]	192.51[c]	19.88[bc]	22.62[a]
SEm (±)	0.49	0.40	0.35	0.36
F probability	<0.001	<0.001	<0.001	<0.001
LSD 0.05	1.60	1.31	1.14	1.19
CV (%)	4.07	0.43	3.29	3.61
Grand mean	25.56	198.17	22.61	21.53

DAT: Days after transplanting, SEm: Standard error of mean, LSD: Least significant differences, CV: Coefficient of variation, cm: centimetres, %: Percentage, the treatment means with same letters do not differ significantly at 5% level of significance.

Grain and Straw Yield (mt / ha)

The mean grain yield of the experiment was found to be 5.66 mt/ha. The grain yield was significantly influenced by weed management practices. The grain yield is the function of some yield attributing characters like effective tillers, filled grains per panicle, test weight, panicle length, panicle weight etc. The highest grain yield (7.12 mt/ha) was observed in cono-weeding treated plots as compared to other treatments followed by Pretilachlor plus hand weeding at 20, 40 DAT, pretilachlor alone, hand-weeding at 20, 40, 60 DAT and control (weed free plots) as shown in Table 5. The lower yield (4.51 mt/ha) in control plots might be due to the competition imposed by weeds which reduced leaf area index (LAI) and allowed less light transmission in the rice leaf ultimately reducing the bio-synthetic products.

Significant differences in straw yield were observed with mean straw yield of 8.05 mt/ha. The highest straw yield (9.77 mt/ha) was recorded at cono-weeding treated plots and lowest straw yield (6.31 mt/ha) was observed in control plots.

The average harvest index in the experiment was observed as 41.27 %. It was not significantly influenced by weed management practices as shown in Table 5. Highest harvest index (42.17 %) was observed in the plots treated with cono-weeding and lowest harvest index (40.41 %) was observed in the pretilachlor treated plots which was statistically similar to the plots treated with pretilachlor plus hand weeding as shown in Table 5.

Table 5. Grain yield (mt/ha) and harvest index (%) as influenced by different weed management practices at Kolhabi, Bara, 2022

Treatments	Grain yield (mt/ha)	Straw yield (mt/ha)	Harvest Index (HI, %)
Control	4.51^{d}	6.31^{e}	41.65^{ab}
Hand-weeding at 20, 40, 60 DAT	5.04^{c}	7.10^{d}	41.53^{b}
Cono- weeding at 20, 40, 60 DAT	7.12^{a}	9.77^{a}	42.17^{a}
Pretilachlor 50 EC (500 g per ha)	5.52^{c}	8.14^{c}	40.41^{c}
Pretilachlor 50 EC (500 g per ha) + hand- weeding at 20, 40 DAT	6.12^{b}	8.96^{b}	40.58^{c}
SEm (±)	0.15	0.21	0.18
F probability	<0.001	<0.001	<0.001
LSD 0.05	0.50	0.69	0.60
CV (%)	5.73	5.58	0.95
Grand mean	5.66	8.05	41.27

DAT: Days After Transplanting, SEm: Standard error of mean, LSD: Least significant differences, CV: Coefficient of variation, cm: centimetres, %: Percentage, the treatment means with same letters do not differ significantly at 5% level of significance

CONCLUSIONS

Weeds are the major constraints to the rice production and its management is a dire need. Weed density was significantly reduced by weed management practices in the transplanted spring rice in Bara, Nepal. Cono-weeding was found superior in terms of yield and economy as compared to other weed management practices for transplanted rice under System of Rice Intensification (SRI). This might be due to square planting of seedlings with wider spacing which made the operation of cono-weeder convenient. Cono-weeder was proved to be the best method of weed management since it can uproot weeds, incorporate them in the field along with disturbing the puddled land that in turn increased the aeration to roots. All the other weed management practices significantly improved grain yield as compared to the control one. Hand weeding alone was proved to be expensive method and was found to be statistically and economically at par with control plots. So, it would be better to follow three cono-weedings at 20, 40 and 60 DAT as weed control practice for rice cultivation along with the other elements for crop management under the SRI where there are assured facilities for irrigation and drainage. These findings need to be tested across the wide range of climatic and soil conditions of all major agro-ecological regions (Terai and Inner Terai, Hills and Mountains) of Nepal, for further verification and wider adaptability among farmers, researchers, policy makers, and development workers. It is also necessary to integrate different weed management approaches as possible to acquire effective, sustainable and long-term weed control in transplanted spring rice under SRI. In Nepal, further research should be conducted according to the particular ecological niches with the integrated application of all weed management practices in a best possible way. Moreover, Nepal should focus on the integration of mechanical weed management practices (the use of machinery implements) with other suitable weed management options including herbicide application timing and combinations for better results.

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