



Research Article

Performance of Dry Direct Seeded Rice and Weeds on *Sesbania* Brown Manuring as Compared to Farmers' Practice and Chemical Control Method

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Abstract

The research was conducted to study the comparison of farmers' weed management practice in rice with chemical control and *Sesbania* co-culture. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications and five different weed management practices. The five treatments were Farmers' practice (two hand weeding first at 28 DAS and another at 40 DAS), Chemical practice (Bispyribac sodium as post emergence @ 25 g a.i. ha⁻¹ at 25 DAS), *Sesbania* co-culture (100 kg *Sesbania* ha⁻¹ and knocking down at 28 DAS), Weed free (Hand removal of weeds at 10 days' interval) and Weedy check (No weed management). The individual plot size was 5 x 4 m². The *Sesbania* co-culture and farmers' practice were found more or less similar performance for all observed parameters but as better as compared to weedy check and chemical treatment. *Sesbania* co-culture was found less costly than farmers' practice for weed management. The experiment clearly demonstrated the importance of brown manuring on effective control of weeds in rice field under dry direct seeded rice.

Keywords: Brown manuring; dry direct seeded rice; grain yield; *sesbania*, weed

Introduction

Rice is one of the most important cereal crops of the world, and more than half of the world's population depends on rice for their daily sustenance (Chauhan and Johnson, 2011). Various types of changes are being occurred for the rice production system and the shifting from transplanted to direct seeding is one out of those. It is suggested that alternate method of planting i.e. Dry-DSR is gaining popularity regarding its high water use, labor use and energy use efficiencies (Kumar and Ladha, 2011). Thus being cost

effective the dry direct seeding method also allows early sowing of wheat. The effective weed management is a major challenge for farmers when adopting dry DSR because of weed flora shifts toward more difficult-to-control and competitive grasses and sedges. Higher weed infestation is a major problem in dry-DSR causing major loss to rice production worldwide. The diverse weed populations compete with rice and causing severe yield losses ranging from 12 to 90% (Rao et al., 2007; Singh et al., 2009).

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Sesbania co-culture is different from other types of weed management practices. It overcomes the cost associated with manual and herbicidal weeding along with removal of negative impact of chemical herbicide to the soil condition and plant or human life. *Sesbania* followed by 2,4-D was more effective in suppressing broad leaves and sedges and less effective on grasses (Kumar and Ladha, 2011). *Sesbania rostrata* is a small semi-aquatic leguminous plant which forms a symbiotic relationship with Gram-negative rhizobia and leads to the formation of nitrogen fixing nodules on both stem and roots. This technology can reduce the weed population by nearly half without any adverse effect on rice yield (Kamboj et al., 2012). Growing of *Sesbania* as an intercrop with direct seeded rice upto 30 DAS reduced the weed infestation by 30% (Singh, Johnson, Mortimer, & Orr, 2003). The atmospheric nitrogen fixation and facilitation of crop emergence in areas of soil crust formation are other benefits of this technique in addition to weed suppression (Gopal et al., 2010; Singh et al., 2009). It helps in adding about 15 kg N ha⁻¹ along with smothering of weeds and conserving moisture (Gaire, Dahal, & Amgain, 2013). Thus, the major part is to evaluate its effect on weeds and on the performance of dry direct seeded rice through this experiment.

Materials and Methods

The experiment was carried out at Agronomy Farm of Agriculture and Forestry University (AFU), Rampur, Chitwan. The site is located 9.8 km South-West from Bharatpur, headquarter of Chitwan district. This location is situated at 27° 37' N latitude and 84° 25'E longitude with the elevation of 256 m above mean sea level (Thapa and Dangol, 1988). Rice variety "US-312" via line sowing and seed of *Sesbania rostrata* via broadcasting were sown together manually on 7th of June, 2014. The soil of experimental plot was sandy loam which had medium type of total N (0.2%), available P (46.62 kg ha⁻¹) and organic carbon (1.9%) but low in available K (82.8 kg ha⁻¹). Five treatments were tested in Randomized Complete Block Design and replicated three times. The treatments were Farmers' practice (two hand weeding first at 28 DAS and another at 40 DAS), Chemical practice (Bispyribac sodium as post emergence @ 25 g. a.i. ha⁻¹ at 25 DAS), *Sesbania* co-culture (100 kg *Sesbania* ha⁻¹ and knocking down at 28 DAS), Weed free (hand removal of weeds at 10 days' interval), and Weedy check (No weed management). Each 20 m² plot had 20 rows of 5m length, with an inter-row spacing of 0.2 m. The fertilizer was applied in the form of urea, di-ammonium phosphate (DAP), and murate of potash (MOP) whereas the recommended dose of NPK in each experimental plot was 150:80:80 kg ha⁻¹. One third of nitrogen, full dose of phosphorus and potash were applied as basal dose at final land preparation. Remaining two third dose of Nitrogen was applied at tillering stage and panicle initiation stage in equal split. Zinc sulphate @ 25 kg ha⁻¹

was also applied at final land preparation for correction of zinc deficiency in soil.

Results and Discussions

Weed Management Practices and Weed Index

The major weeds infesting in dry DSR during experiment were grasses like *Cynodon dactylon*, *Echinochloa colona*, *Setaria glauca*, *Paspalum scrobiculatum* and Paragrass, broad-leaf weeds like *Melochia corchorifolia*, *Aeschynomene indica*, *Polygonum hydropiper* and *Commelina diffusa* and Sedges like *Cyperus iria* and *Fimbristylis miliacea*, etc. The mean weed index was found 24.57% and there recorded significant effect of weed management practices on weed index (Fig. 1). The weed index ranged from lowest (7.27%) in *Sesbania* co-culture to highest (90.55%) in weedy check. The trend of weed index in farmers' practice and chemical practice was seen increasing respectively followed by weedy check. The weed index in weed free plot was zero because the weeds were completely removed at each 10 days' interval. Weedy check produced higher weed index as compared to other treatments due to presence of invasive number of weeds as never removed from the plot. *Sesbania* co-culture had lower weed index in comparison of both the farmers' practice and post emergence application of bispyribac sodium @ 25 g a. i. ha⁻¹. The fast growing *Sesbania* suppress the population of weed species at early growth stage acting as a cover crop which causes lower weed population in co-cultured plot as corroborates with the findings of Ravisankar et. al. (2008), Joseph et al. (2008), Sharma and Ghosh (2000) and, Angadi et al. (1993).

Effect on Yield Attributes of Dry DSR

Weed free plot had the highest number of effective tillers per square meter (286) which was statistically similar with the two-hand weeding but greater than the other treatments (Table 1). Two hand weeding and the *Sesbania* co-culture had also statistically similar effective tillers per square meter. The plot treated with bispyribac sodium @ 25 g a. i. ha⁻¹ had been found longer panicle length (25.37 cm) as compared to others and it was statistically similar with all the treatments except weedy check where weedy check had shorter panicle length (22.57 cm). In spite of statistically similar patterns except in weedy check, the highest number of grains per panicle (121.77) was found in *Sesbania* co-culture (Table 1). Two hand weeding produced highest TGW (19.05 g) as statistically similar with the result of remaining treatments but was found significantly different with weedy check (16.93 g). TGW was recorded to all the treatments except weedy check (Table 1).

Shorter panicle length (22.57 cm) was recorded on weedy check plot which might be due to draining of nutrients by weeds. Among all the treatments, the co-culture of *Sesbania* produced highest panicle weight (2.45 g) which might be due to addition of required nutrients by the activity of

Sesbania before and after knocked down. The reason behind the highest number of grains per panicle to *Sesbania* co-culture was the effective suppression of weeds through decomposed leaves of *Sesbania* acting as mulch which provide more nutrients release and hence absorption by crop during grain filling period. The result agreed with the findings of Gill and Wallia (2014). IRRI (1985) also reported that the *Sesbania* leaflets degrade rapidly in moist soil and release 50% of their N within four weeks of

incorporation. Hasanuzzaman et al. (2008) reported that thousand grain weights remained statistically unchanged in different weed management practices. The weedy check had lowest thousand grain weight (16.93 g) because of the unfavorable environment created by weeds throughout the crop cycle. The lowest sterility percentage was recorded in weed free and statistically similar with other treatments except weedy check.

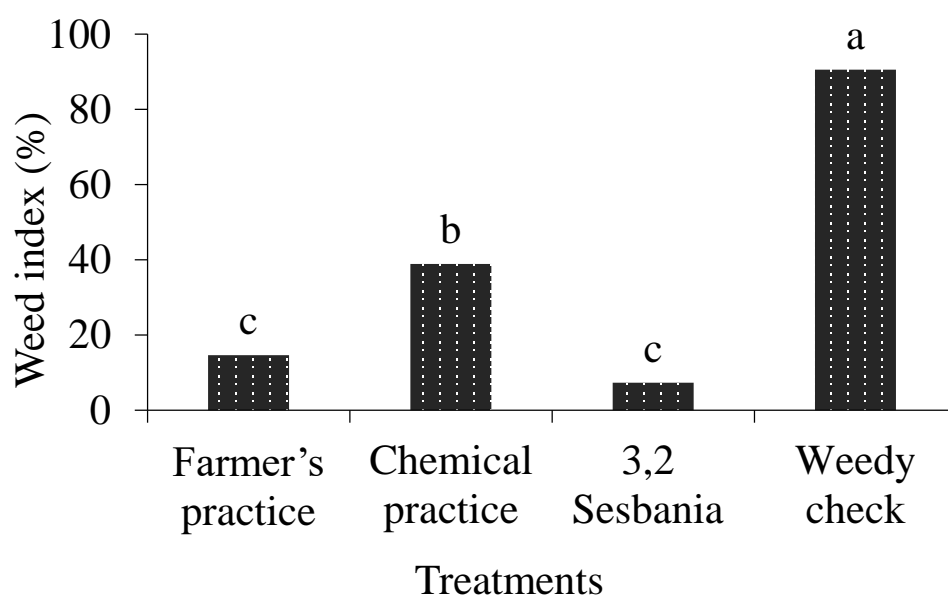


Fig. 1: Weed index (%) as influenced by the different weed management practices at Agronomy Farm, AFU Rampur, Chitwan, Nepal, 2014 (mean separated by DMRT with same letter (s) are non-significant at 5% level of significance)

Table 1: Yield attributes influenced by the different weed management practices at Agronomy Farm, AFU, Rampur, Chitwan, Nepal, 2014

Treatments	ET	PL	PW	FGPP	TGW	STRL
Two Hand weeding	250.67 ^{ab}	25.19 ^{ab}	2.02 ^{ab}	101.64 ^a	19.05 ^a	15.93 ^{ab}
Bispyribac sodium	181.67 ^c	25.37 ^a	2.05 ^{ab}	100.73 ^a	18.89 ^a	12.98 ^b
<i>Sesbania</i> co-culture	223.67 ^b	25.15 ^{abc}	2.45 ^a	121.77 ^a	18.72 ^a	13.03 ^b
Weed free	286.00 ^a	24.59 ^{abcd}	1.87 ^{bc}	110.37 ^a	18.14 ^{ab}	9.65 ^b
Weedy check	40.67 ^d	22.57 ^{bd}	1.53 ^c	62.03 ^b	16.93 ^b	20.69 ^a
SEm ±	12.94	0.78	0.13	6.94	0.45	2.05
LSD _{0.05}	40.79	2.46	0.42	21.86	1.41	6.45
CV, %	11.40	5.50	11.70	12.10	4.20	24.50
Grand mean	196.53	24.57	1.98	99.31	18.35	14.45

Note: Mean separated by DMRT and columns represented with same letter (s) are non-significant at 5% level of significance. DAS, days after sowing; ET, effective tillers; PL, panicle length; PW, panicle weight; GPP, grain per panicle; TGW, thousand grain weight; STRL, sterility percentage.

Table 2: Grain yield (kg ha⁻¹), Straw yield (kg ha⁻¹), Above ground biomass (kg ha⁻¹) and harvest index as influenced by the different weed management practices at Agronomy Farm, AFU Rampur, Chitwan, Nepal, 2014

Treatments	Grain yield	Straw yield	AGBM	HI
2 hand weeding	4112.16 ^a	6502.44 ^a	10038.90 ^a	0.35
Chemical practice	2929.60 ^b	5997.76 ^a	8230.67 ^b	0.27
<i>Sesbaniaco</i> -culture	4309.13 ^a	5498.59 ^a	9204.43 ^{ab}	0.40
Weed free	4823.27 ^a	6764.17 ^a	10654.18 ^a	0.37
Weedy check	440.96 ^c	999.47 ^b	1378.70 ^c	0.76
SEm ±	282.20	534.6	465.5	0.29
LSD _{0.05}	889.2	1684.6	1466.9	Ns
CV, %	14.7	18	10.2	118.90
Grand mean	3323.02	5152.49	7901.38	0.43

Note: Mean separated by DMRT and columns represented with same letter (s) are non-significant at 5% level of significance. AGBM, above ground biomass; HI, harvest index.

Effect on Grain Yield, Straw Yield, Above Ground Biomass and Harvest Index of Dry DSR

The highest grain yield (4823.27 kg ha⁻¹) was observed in weed free plot as compared to other treatments and statistically similar with the yield of two hand weeding and *Sesbania* co-culture (Table 2). The weedy check had been found lower grain yield (440.13 kg ha⁻¹). The co-culture of rice and *Sesbania* had produced significantly more grain yield as compared to bispyribac sodium @ 25 g a. i. ha⁻¹ and weedy check. Similarly, the straw yield was found highest (6764.17 kg ha⁻¹) with weed free plot as statistically similar with all other treatments except weedy check.

The above ground biomass on *Sesbania* co-culture treatment was found statistically similar with the two hand weeding and weed free plot and also with the application of bispyribac sodium @ 25 g a. i. ha⁻¹. There were not significant differences among the weed management treatments to the harvesting index. Despite statistically similarity, brown manuring in dry direct seeded rice recorded 4309.13 kg ha⁻¹ which was 4.78 % higher than that of farmers' practice/two hand weeding. The lower yield (440.96 kg ha⁻¹) in weedy check might be due to competition from weeds which reduced LAI and allowed less light transmission producing less biosynthate and ultimately low dry matter production.

Conclusion

From the co-culture experiment of Rice and *Sesbania*, was found rather better than that of the farmer's practice and chemical control practice. It can be concluded that the practice was best because the *Sesbania* being an aquatic plant helped to suppress most of the weeds and provided the needed nutrients to the crop Rice, and Both the yield and yield attributing characters of rice were found to be better in case of brown manuring than that of farmers practice and

chemical practice. In conclusion it can be notify that if this practice of Rice and *Sesbania* can be continued then it would help in controlling more and more weeds at low cost and will have better yield of rice via providing the adequate nutrients through the *Sesbania* both before and after it is knocked down at appropriate time. So, it will be better to continue finding of this research in order for the proper yield of rice crops over the farmer's and chemical control practice of weeds in dry direct seeded rice.

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