RESEARCH ARTICLE Indian Journal of Agricultural Research, Volume 56 Issue 1: 33-37 (February 2022)

Effect of Integrated Weed Management on Weed and Yield of Direct Seeded Rice

Suryakanta Kashyap, V.P. Singh, S.K. Guru, Tej Pratap, S.P. Singh, Rakesh Kumar[1]

10.18805/IJARe.A-5775

ABSTRACT

Background: Weeds are the major threat to direct seeded rice and a single strategy of weed control may not be effective for season-long weed control. Intending to accomplish the long-term and sustainable weed management of direct seeded rice, the integration approach of weed management strategies seems a better alternative. The current field study was aimed to evaluate the impact of integration of different weed control methods on direct seeded rice under irrigated ecosystem on weed growth and rice yield.

Methods: The experiment was laid out in randomized block design with three replications and twelve treatments during 2017 at G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India. The twelve treatments included the combination of cultural, mechanical, physical and chemical weed management methods.

Result: Combination of stale seedbed technique integrated with pre-emergence application of pendimethalin with mechanical weeding at 25 DAS followed by 1 hand weeding at 45 DAS, *Sesbania* (line sowing) fb application of pendimethalin (PE) fb 1 mechanical weeding at 25 DAS fb 1 hand weeding at 45 DAS, stale seedbed with application of pendimethalin (PE) with *Sesbania* brown manuring supplemented with mechanical weeding (25 DAS) fb hand weeding at 45 DAS, mulching with wheat straw mulch along with post-emergence application of penoxsulam (20 DAS) fb 1 hand weeding at 45 DAS and application of pendimethalin (PE) fb penoxsulum (PoE) at 20 DAS fb 1 hand weeding at 45 DAS with a row spacing of 25 cm found to be similar in the suppression of weed population and weed density at 40 and 60 DAS and crop yields (4.3, 4.1, 4.2, 4.0 and 4.2 t/ha, respectively) were on par with weed free plot *i.e.* 4.4t/ha. Application of pendimethalin (PE) fb penoxsulum (PoE) at 20 DAS fb 1 hand weeding at 45 DAS with row spacing of 25 cm recorded 93.7%, 90.6% and 4.5% weed control efficiency, weed control index and weed index respectively, which was similar with above integrated weed management treatments. A negative correlation of the weed density and dry matter with the yield of rice was recorded.

Key words: Brown manuring, Mechanical weeding, Stale seedbed.

INTRODUCTION

Direct seeding of rice (DSR), being an alternative to the transplanted rice, is referred to as the process of establishing the rice crop from seeds directly sown in the main field instead of transplanting seedling from the nursery. In traditional transplanted rice, the early flush of weeds is suppressed due to anaerobic environments created through instant flooding. Conversely, in direct-seeded rice, the presence of aerobic soil conditions with the simultaneous appearance of difficult-to-control weeds are the major reasons for yield losses in DSR. Weeds compete with crop plants for growth factors like nutrients, soil moisture, light, space, *etc*. (Walia, 2006). These weeds adversely affect the yield, quality and cost of production in DSR (Singh, 2008). Possible yield loss in transplanted, direct-seeded in wet conditions and direct-seeded rice in dry soils are up to 48%, 53% and 74%, respectively, Ramzan (2003). The composition of weed flora was also modified within crop establishment, from transplanting to direct seeding (Singh *et al*., 2008). Herbicides are found effective and economically attractive against the management of these weeds. Looking to greater variability in the growth habit of different weeds in DSR, a single strategy of weed control may not be effective for season-long weed control. Intending to accomplish the long-term and sustainable weed management of DSR, the integration approach of weed management strategies seems a better alternative. Therefore, a current field study was conducted to evaluate the impact of integration of different weed control methods on direct seeded rice on weed growth and rice yield.

G.B. Pant University of Agriculture and Technology, Pantnagar-263 145, Uttarakhand, India.
[1]ICAR-National Dairy Research Institute, Karnal-132 001, Haryana, India.

Corresponding Author: Suryakanta Kashyap, ICAR-National Dairy Research Institute, Karnal-132 001, Haryana, India.
Email: suryakantakashyap@gmail.com

How to cite this article: Kashyap, S., Singh, V.P., Guru, S.K., Pratap, T., Singh, S.P. and Kumar, R. (2022). Effect of Integrated Weed Management on Weed and Yield of Direct Seeded Rice. Indian Journal of Agricultural Research. 56(1): 33-37. DOI: 10.18805/IJARe.A-5775.

Submitted: 26-03-2021 **Accepted:** 16-06-2021 **Online:** 04-08-2021

MATERIALS AND METHOD

A field experiment was conducted during *kharif* season of 2017 at N. E. Borlaug Crop Research Centre of GBPUA and T, Pantnagar (Uttarakhand) situated at an altitude of 243.84 m above mean sea level, 29°N latitude and 79.3°E longitudes lie at the foothills of “Shivalik” ranges of Himalaya, a narrow belt called “*Tarai*” where the climate is subtropical. The soil of the experimental site is clay loam texture. Rice variety ‘*Govind*’ with a seed rate of 40 kg/ha was sown manually in 25 cm row-row spacing in all treatments except PE *fb* PoE *fb* 1 HW (20 cm).

All 12 weed management treatments evaluated in the present study were *viz.* stale seedbed fb shallow tillage after 12 days fb PoE application of penoxsulum @ 22.5 g a.i./ha at 20 DAS (SSB fb PoE), Stale seedbed fb shallow tillage after 12 days PE application of pendimethalin @ 1 kg a.i./ha after sowing fb 1 hand weeding at 30 DAS (SSB fb PE fb 1 HW at 30 DAS), stale seedbed fb shallow tillage after 12 days fb PE application of pendimethalin @ 1 kg a.i. /ha after sowing fb 1 mechanical weeding at 25 DAS fb 1 hand weeding at 45 DAS (SSB fb PE fb 1MW fb 1HW), mulching fb PoE application of penoxsulum @ 22.5 g a.i. /ha at 20 DAS fb 1 hand weeding at 45 DAS (Mulch fb PoE fb 1HW), PoE application of penoxsulum @ 22.5 g a.i. /ha at 20 DAS fb 1 hand weeding at 45 DAS (PoE fb 1HW), Sesbania (line sowing) fb PE application of pendimethalin @ 1 kg a.i./ ha fb 1 mechanical weeding at 25 DAS fb 1 hand weeding at 45 DAS (SLS + PE fb 1 MW fb 1HW), Sesbania broadcasting fb PoE application of 2,4-D ethyl ester fb 1 hand weeding at 45 DAS [SBS(BM) fb 1 HW], Stale seed bed fb shallow tillage after 12 days fb line sown Sesbania with PE application of pendimethalin @ 1 kg a.i. /ha fb PoE 2,4-D @ 500 g a.i./ha at 25 DAS fb 1 hand weeding at 45 DAS (SSB fb SLS(BM) fb PE fb1 HW), PE application of pendimethalin @ 1 kg ai/ha fb PoE application of penoxsulum @ 22.5 g a.i./ha at 20 DAS fb 1 hand weeding at 45 DAS (PE fb PoE fb 1 HW), with row spacing of 20 cm PE application of pendimethalin @ 1 kg ai /ha fb PoE application of penoxsulum @ 22.5 g a.i./ha at 20 DAS fb 1 hand weeding at 45 DAS (PE fb PoE fb 1 HW (20 cm), weedy check and weed free.

The seeds of *Sesbania aculeata* were sown @ 40 kg/ha in as per treatments. The crop was fertilized with 120:60:40 kg N, P_2O_5 and K_2O/ha, respectively. Nitrogen was applied in 3 splits, the first 50% as basal dose and the rest two (25% each) at the time of active tillering and panicle initiation stage, respectively. The full quantity of phosphorous and potassium was applied as basal at the time of sowing.

The experiment was laid out in a randomized block design with three replications. All data were analyzed through analysis of variance (ANOVA) using standard variance techniques, as suggested by Gomez and Gomez (1984). Weed data were transformed to square root transformation ($\sqrt{x+1}$) prior to statistical analysis for improving the homogeneity of variance. Treatment means were separated using the critical difference (CD) at 5% level of significance ($P \leq 0.05$).

Similarly, weed-control efficiency (WCE), weed control index (WCI) and weed index (WI) were calculated as per Mani *et al.* (1973) and Das (2008).

$$\text{WCE (\%)} = \frac{WD_C - WD_T}{WD_C} \times 100$$

$$\text{WCI (\%)} = \frac{WDM_C - WDM_T}{WDM_C} \times 100$$

$$\text{WI (\%)} = \frac{Y_{WF} - Y_T}{Y_{WF}} \times 100$$

Where,

WD_T and WD_C, weed density (no./m^2) in treated and weedy check plot respectively; WDM_T and WDM_C, weed dry weight (g/m^2) in treated and weedy check plot respectively; Y_T and Y_{WF}, yield in treated and weed free plot respectively.

RESULTS AND DISCUSSION

Weed dynamics

The field trial was conscientiously monitored throughout crop growth stages and the presence of the following three types of weeds was found in the field *i.e. Echinochloa cruss-galli, Echinochloa colona* and *Leptochloa chinensis* among grassy weed; *Cyperus iria* and *Cyperus difformis* among sedges; *Ammania baccifera* and *Alternanthera sessilis* among broadleaf weeds. Similar composition of weed flora in direct-seeded rice was also reported by Singh *et al.* (2017) and Kashyap *et al.* (2019).

Weed density and weed dry matter

In our study, integrated weed management (IWM) practices had a remarkable influence on total weed density and weed dry weight at 40 and 60 DAS (Table 1). The highest and lowest weed density and dry weight at both stages were observed under weedy check and weed free conditions, respectively. However, among the integrated management of weeds, recommended practice *i.e.* PE fb PoE fb 1 HW at 20 cm row spacing resulted in the lowest weed density (no./m^2) and dry weight (g/m^2) during 40 DAS (10.7 and 8.8, respectively) and 60 DAS (7.1 and 12.3, respectively, which was on par with SSB fb PE of pendimethalin fb 1 HW at 30 DAS.

At 60 DAS, stale seedbed fb PE of pendimethalin fb 1MW fb 1HW at 45 DAS resulted in the lowest weed density among IWM practices and was similar to recommended practice under 25 cm spacing. While in both stages weed population and dry matter accumulation were statistically at par under remaining integrated weed management practices except in stale seedbed along with either alone post-emergence application of penoxsulam and SSB fb PE of pendimethalin fb 1 HW at 30 DAS. A similar result was also reported by Singh *et al.*, 2007 in which mulching of previous wheat crop residue at 4 t/ha reduced annual and broadleaved weed densities in dry-DSR compared with no mulch and *Sesbania* co-culture in rice reduced broadleaf and grass weed density by 76-83% and 20-33% respectively, and total weed biomass by 37-80% compared to the sole rice crop. Also, the brown leaves of *Sesbania* after the herbicide application served the purpose of mulch as well as smothering effect on the weed flora of rice (Gopal *et al.*, 2010). Also, stale seedbed with shallow tillage was found effective in controlling all early flush of weed seedlings above and below the soil surface (Singh *et al.*, 2018).

Weed control efficiency, weed control index and weed index

Weed control efficiency and weed control index varied with different weed management practices at 60 DAS (Table 2). Maximum and minimum WCE and WCI recorded in weed free and weedy check plots respectively. Among the weed management pendimethalin fb penxosulam fb 1 HW at 45 DAS with row spacing 20 cm recorded highest WCE (96.8%) and WCI (93.9%), but, the weed index was 15.9% which pointed out the relative yield loss over weed free, as a result of competition caused by closer spacing. These results were agreed with the findings of Kokilam *et al*. (2020). Stale seedbed fb application of pendimethalin fb mechanical weeding and hand weeding at 45 DAS recorded similar WCE, WCI and WI (93.7, 90.2 and 2.9, respectively) as that of the recommended practice of weed management with row spacing 25 cm.

Crop yield

The data perusal on grain yield (Table 2) showed that weed free recorded the highest grain yield (4.4 t/ha) which was at par with the following treatments; recommended practice with 25 cm row spacing, SSB fb application of pendimethalin fb 1 mechanical weeding at 25 DAS fb 1 HW at 45 DAS (4.3 t/ha), mulching with the application of penoxsulam (PoE) at 22.5 g/ha fb 1 HW at 45 DAS (4.1 t/ha), line sown *Sesbania* + application of pendimethalin (PE) fb 1 MW fb 1 HW (4.0 t/ha) and SSB with line sown *Sesbania* fb application of pendimethalin fb application of 2,4-D (PoE) fb 1 HW at 45 DAS (4.0 t/ha). Grain: straw ratio and harvest index of rice were not significantly influenced by the integrated weed-

Table 1: Effect of different weed management practices on total weed density (No./m^2) and total weed dry weight (g/m^2) at 40 and 60 DAS.

Treatment	Weed density (No./m^2)		Weed dry weight (g/m^2)	
	40 DAS	60 DAS	40 DAS	60 DAS
SSB fb PoE	7.8 (61.3)	8.9 (78.7)	7.7 (58.1)	8.7 (74.9)
SSB fb PE fb 1 HW at 30 DAS	2.9 (8.0)	8.2 (67.6)	2.9 (7.9)	8.2(66.9)
SSB fb PE fb 1MW fb 1HW	5.9 (34.7)	3.9 (14.2)	5.7 (31.3)	4.5 (20.3)
Mulch fb PoE fb 1HW	5.2 (27.3)	4.3 (17.8)	5.1 (25.3)	4.7 (21.3)
PoE fb 1HW	9.4 (88.0)	4.9 (23.1)	7.9 (61.2)	5.4 (28.6)
SLS + PE fb 1 MW fb 1HW	5.4 (28.0)	4.0 (14.7)	5.6 (30.0)	4.8 (22.1)
SBS (BM) fb 1 HW	9.5 (89.3)	4.9 (23.1)	7.8 (60.1)	5.3 (26.8)
SSB fb SLS (BM) fb PE fb1 HW	6.9 (46.7)	4.5 (19.6)	6.9 (47.0)	5.0 (24.5)
PE fb PoE fb 1 HW	4.8 (22.7)	3.9 (14.2)	4.8 (21.7)	4.5 (19.3)
PE fb PoE fb 1 HW (20 cm)	3.4 (10.7)	2.6 (7.1)	3.1(8.8)	3.6 (12.3)
Weedy check	13.9 (192.7)	15.9 (252.7)	15.2 (228.9)	14.4 (206.5)
Weed free	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)
CD (5%)	1.1	1.0	0.7	1.0
SEm±	0.38	0.33	0.25	0.33

*Original values are given in parenthesis, which were transformed to $\sqrt{x+1}$.

Table 2: Effect of different weed management practices on total WCE, WCI and WI (%) at 60 DAS, grain yield, grain to straw ratio and harvest index.

Treatment	WCE (%)	WCI (%)	WI	Grain yield (t/ha)	Grain: Straw ratio	Harvest index
SSB fb PoE	68.1	63.7	19.8	3.5	0.7	41.3
SSB fb PE fb 1 HW at 30 DAS	73.1	67.6	17.5	3.6	0.7	42.0
SSB fb PE fb 1MW fb 1HW	93.7	90.2	2.3	4.3	0.7	42.3
Mulch fb PoE fb 1HW	92.1	89.7	6.8	4.1	0.7	42.0
PoE fb 1HW	90.0	86.2	26.6	3.2	0.7	42.0
SLS + PE fb 1 MW fb 1HW	93.2	89.3	4.5	4.2	0.7	42.3
SBS (BM) fb 1 HW	90.0	87.0	28.0	3.2	0.6	39.7
SSB fb SLS (BM) fb PE fb1 HW	92.1	88.1	8.4	4.0	0.7	42.0
PE fb PoE fb 1 HW	93.7	90.6	4.5	4.2	0.7	42.3
PE fb PoE fb 1 HW (20 cm)	96.8	93.9	15.9	3.7	0.6	39.3
Weedy check	0.0	0.0	70.5	1.3	0.5	35.7
Weed free	100.0	100.0	0.0	4.4	0.7	43.0
CD (5%)	-	-	-	0.4	NS	NS
SEm±	-	-	-	0.12	0.04	1.98

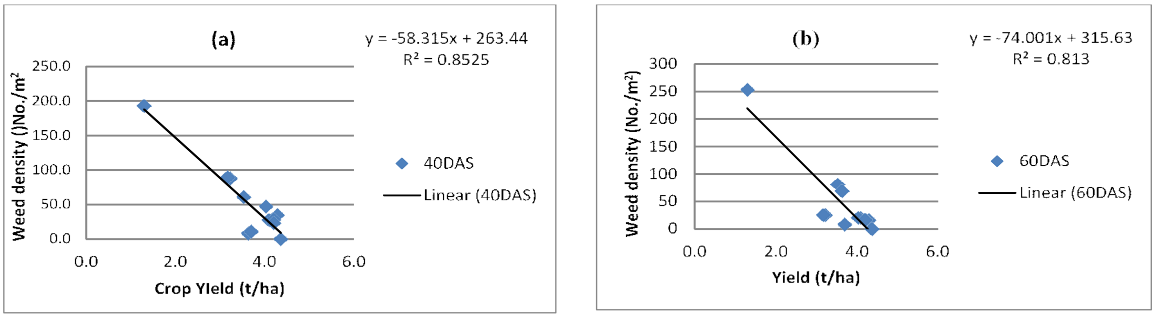

Fig 1: Relationship between yield and weed density (No./m^2) at 40 DAS (a) and 60 DAS (b).

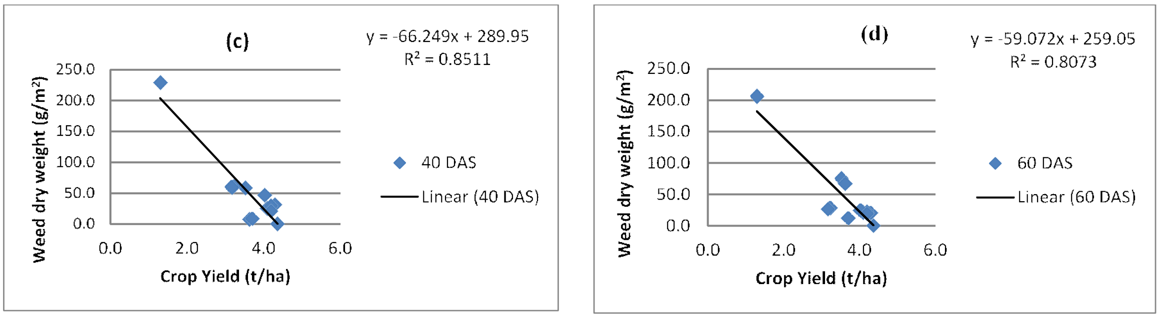

Fig 2: Relationship between yield and weed dry weight (g/m^2) at 40 DAS (c) and 60 DAS (d).

control treatments. This might be because of efficient weed control due to the integration of cultural, mechanical and chemical methods along with hand weeding which finally influenced weed population their biomass accumulation and yield. The similar result were also suggested by Gaire *et al.,* 2013 that *Sesbania* co-culture with rice helped in lowering the weed population by nearly about 50% with a supplementary effect on rice yield. Also addition of mechanical weeding by conoweeder to weed control option provided better weed control in inter rows as well as aeration to soil root zone ensuing superior crop yield (Kumar *et al.,* 2012). A negative correlation of the weed density and dry matter with the yield of rice was obtained (Fig 1 and 2). It implies that the grain yield of direct-seeded rice decreased proportionally with the increase in interference of weed and vice-versa. Comparable result between weeds and crop was also reported by Ganai *et al.* (2014), that high weed density and biomass resulted in significant reductions in the crop yield.

CONCLUSION

From the present study, it can be inferred that satisfactory integrated weed management option and similar rice yields can be achieved by either combination of stale seedbed technique integrated with pre-emergence application of pendimethalin with mechanical weeding at 25 DAS followed by 1 hand weeding at 45 DAS or *Sesbania* (line sowing) fb application of pendimethalin (PE) fb 1 mechanical weeding at 25 DAS fb 1 hand weeding at 45 DAS or stale seedbed technique with pre-emergence application of pendimethalin with co-culture of *Sesbania* and its incorporation with mechanical weeding (25 DAS) fb 1 hand weeding at 45 DAS or wheat straw mulch with post-emergence application of penoxsulam followed by 1 hand weeding at 45 DAS.

REFERENCES

Das, T.K. (2008). Weed Science: Basics and Applications, pp. 901. Jain Brothers, New Delhi, India.

Gaire, R., Dahal, K.R. and Amgain, L.P. (2013). Effect of different mulching materials on weed dynamics and yield of direct seeded rice in Chitwan, Nepal. Agronomy Journal of Nepal. 3: 73- 81.

Ganai, M.A., Hussain, A. and Bhat, M.A. (2014). Bio-efficacy of different herbicides in direct seeded rice (*Oryza sativa* L.) under temperate Kashmir valley conditions. Indian Journal of Agronomy. 59(1): 86-90.

Gomez, K.A. and Gomez, A.A. (1984). Statistical Procedures for Agricultural Research, edn 2, John Wiley and Sons, New York. pp. 680.

Gopal, R., Jat, R.K., Malik, R.K., Kumar, V., Alam, M.M., Jat, M.L., Mazid, M.A., Saharawat Y.S., McDonald, A. and Gupta, R. (2010). Direct dry seeded rice production technology and weed management in rice based systems. Technical Bulletin. International Maize and Wheat Improvement Center, New Delhi, India. pp 28.

Kashyap, S., Singh, V.P., Guru, S.K., Pratap, T., Singh, S.P. and Praharaj, S. (2019). Integrated weed control option for dry direct seeded rice under irrigated ecosystem. International Journal of Current Microbiology and Applied Science. 8(2): 315-323.

Kokilam, M.V., Rathika, S., Ramesh, T. and Baskar, M. (2020). Weed dynamics and productivity of direct wet seeded rice under different weed management practices. Indian Journal of Agricultural Research. 10.18805/IJARe.A-5586.

Kumar, J., Singh, D., Singh, B., Singh, R., Pawar, S. and Gupta, K. (2012). Sowing time and weed management practices to enhance yield of direct seeded rice. Indian Journal of Weed Science. 44(4): 207-209.

Mani, V.S., Malla, M.L., Gautam, K.C. and Bhagwndas. (1973). Weed killing chemicals in potato cultivation. Indian Farming, VXXII, pp17-18.

Ramzan, M. (2003). Evaluation of various planting methods in rice-wheat cropping system, Punjab, Pakistan. Rice Crop Rep. 4: 4-5

Singh, G. (2008). Integrated Weed Management in Direct- seeded Rice. In: Direct Seeding of Rice and Weed Management in the Irrigated Rice-wheat Cropping System of the Indo-Gangetic plains, [Singh, Y., Singh, V.P., Chauhan, B., Orr, A., Mortimer, A.M., Johnson, D.E. and Hardy, B (eds)], IRRI, Los Banos, Phillippines, pp. 161-175.

Singh, M., Bhullar, M.S. and Gill, G. (2018). Integrated weed management in dry-seeded rice using stale seedbeds and post sowing herbicides. Field Crops Research. 224: 182-191.

Singh, S., Ladha, J.K, Gupta, R.K., Bhushan, L., Rao, A.N, Sivaprasad, B. and Singh, P.P. (2007). Evaluation of mulching, intercropping with *Sesbania* and herbicide use for weed management in dry-seeded rice (*Oryza sativa*). Crop Protection. 26: 518-524.

Singh, V.P., Singh, G., Mortimer, M. and Johnson, D.E. (2008). Weed Species Shifts in Response to Direct Seeding in Rice. In: Direct Seeding of Rice and Weed Management in the Irrigated Rice-wheat Cropping System of the Indo-Gangetic plains, [Singh, Y., Singh, V.P., Chauhan, B., Orr, A., Mortimer, A.M., Johnson, D.E. and Hardy, B (eds)], IRRI, Los Banos, Phillippines, pp. 213-219.

Singh, V.P., Singh, S.P., Bisht, N., Kumar, A., Satyawali, K. and Paliwal, A. (2017). Assessment of post-emergence weed management in direct-seeded rice. Indian Journal of Weed Science. 49(3): 211-215.

Walia, U.S. (2006). Weed Management. New Delhi: Kalyani Publishers.