



Integrated Weed Management in Transplanted Rice (*Oryza sativa* L.): An Experimental Investigation

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment entitled Integrated Weed Management in transplanted rice (*Oryza sativa* L.)" was conducted at Shradhay Bhagwati Singh Agriculture Research Farm, Hajipur, Chandra Bhanu Gupta Post Graduate College, B.K.T., LUCKNOW (U.P.) during Kharif season of 2022-2023. The treatment comprised of 9 weed management practices. Weedy check till maturity, Weed free upto 60 DAT, Pretilachlor 50 % EC @ 1.25 kg a.i/ha (PE), Pendimethaline 30 % EC @1.0 kg a.i/ha (PE), Pendimethaline 30 % EC @ 1.0 kg a.i/ha + 1 hand weeding at 30DAT, Pendimethaline 30 % EC @1.0 kg a.i/ha (PE) + Bispyribac Sodium 10 % SC @ 25 g a.i/ha (POE), Pretilachlor 50 % EC @1.0 kg a.i/ha + 1 hand weeding At 35DAT, Two hand weeding at 20 and 40 DAT, Pretilachlor 50 % EC @ 1.0 kg a.i/ha (PE) + Bispyribac sodium 10% SC @ 25 g a.i/ha (POE). Weed free up to 60 DAT

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resulted in significantly higher growth, yield attributes and yield over result of the treatments. The highest weed control efficiency was recorded with weed free up to 60 DAT. However, the highest weed Index was recorded with weedy check and lowest being with weed free up to 60 DAT. The highest net returns (Rs. 58, 218.31/ha) was recorded by weed free up to 60 DAT and highest B:C ratio was recorded by Pretilachlor 50 % E C @ 1.0 kg a.i/ha (PE) + Bispyribac Sodium 10% SC @ 25 g a.i/ha (POE).

Keywords: Integrated weed management; growth; yield; economics and rice.

1. INTRODUCTION

Rice (*Oryza sativa* L.) belongs to poaceae family. It is the staple food for more than 60% of the world population and its cultivation secures a livelihood for more than 2 billion people. Rice is widely cultivated in India and other parts of Asia such as China, Japan and Indonesia etc. Rice is one of the most important dietary carbohydrates in the world.

“Globally, India is being second large area under rice after China. During 2020-21, globally rice is cultivated on an area of 164.19 million hectares with an annual production of around 499.6 million tons and average productivity of 3042 kg/ha. In India, Rice is grown on 45 million hectares area with production of 120 million tons with average productivity of 2600 kg/ha” [1]. “Uttar Pradesh is the largest rice growing state after West Bengal where rice is grown on 5.81 million hectares with annual production of 13.27 million tons with average productivity of 22.83 q/ha which is considered to be low as compared to the productivity of Punjab 43.66 q/ha, Haryana 31.81 q/ha and West Bengal 29.26 q/ha” [2].

Integrated weed management system basically an integration of effective, dependable and workable weed management practices that can be used economically by the producers as a part of effective farm management system. This approach entirely takes into account the need to increase agriculture production and reduce economical losses without any risk to human health simultaneously improving safety and quality of environment. The integrated weed management (IWM) this plays a vital role in transplanted rice cultivation, in order to reduce dependence on excessive chemical use, avoid environmental pollution and reduce weeding cost. There is therefore need to find out economically viable and widely accepted integrated weed control method under transplanted rice.

“Weeds are competed with rice by their higher adaptability and fast growth, dominate the crop habitat and reduces the yield potential of rice. Weeds are major biotic constraint to reduce rice productivity in world wide. Control of weeds during the critical period of competition is essential for obtaining optimum rice yield. Prevention of weed competition and keeping weed free environment at critical period of rice growth is necessary for successful rice production” [3]. “Weed competition is one of the prime yield limiting constraints in rice resulting in yield reduction of 28-45 %” [4]. “Uncontrolled weed growth during early stage (20 – 45 DAT) led to reduction in yield was upto 25-53 %. Herbicides offer the most effective, economical and way of weed management” [5]. Hence, spray of herbicides are the best option to control the mixed population of weeds in rice crop.

2. METHODS AND MATERIALS

A field experiment was carried during kharif season of 2022-2023 at Shradhya Bhagwati Singh Agriculture Research Farm (Hajipur), Chandra Bhanu Gupta Post Graduate College, Bakshi ka talab, Lucknow, (U.P.) during kharif season 2022-2023. The experimental site is situated at 26.50° North latitude and 80.50° East longitude with an altitude of 123 meters above mean sea level. The soil of experimental field was silty-loam texture, slightly alkaline in reaction (8.00 pH), medium in organic carbon (0.70%) and urea (326 kg/ha), phosphorus (173 kg/ha) and potassium (100 kg/ha). Nine treatments comprised of different method of weed management practices with three replications. Nitrogen were applied through urea in which half dose of Nitrogen as per treatment was applied at the time of sowing and rest half does of nitrogen was applied at 30 DAT. A common dose of Phosphorus (80 kg P₂O₅ /ha) and potash (60 kg K₂O/ha) was applied at transplanting time to all

plots. The Paddy variety (Rustum D 575) was sown in June, using 100 kg/ha seed at 20 cm apart rows and harvested in first week of October. All improved packages of practices were followed to raise the crop. The data on plant height and tillers were recorded from the area already marked by tagged. Sample for dry matter accumulation was recorded by cutting of plants. The fresh samples were first sun dried and then kept in electric oven at 65-70°C till the constant dry weight attained. Yield attributes were recorded from 5 panicle selected randomly from each plot. Grain and straw yields of paddy were recorded at harvest the harvest index was calculated as grain yield divided by total biological yield and multiplied by hundred. The uptake of nutrients was calculated as nutrient content in grain and straw multiplied by respective yield. Economics of different treatments was worked out on the basis of prevailing market prices. The data so obtained on various parameters were analysed as per standard statistical procedures. The content of N, P, and K in grain and straw was determined using standard laboratory procedures.

3. RESULTS AND DISCUSSION

3.1 Weed Studies

The different weed growth attributing characters as influenced by different treatment were presented in Table No 1, in which Weed free up to 60 DAS recorded significantly lowest weed density and weed dry weight over rest of the treatments. While the highest weed density and weed dry weight was observed in weedy check at all stages of crop growth as compared to rest of the treatments. Highest Weed Control efficiency (77.17%) was recorded with weed free up to 60 DAS was mainly due to reduction in the weight of the weed as compared to weedy check which, recorded the lowest Weed Control efficiency (0.00 %). But, The lowest weed index under all weed management treatment over weed free up to 60 DAS was recorded due to efficient control of weeds and higher grain yield, however the lower grain yield and higher weed dry weight caused higher weed index in weedy check. These results were in conformity with Abbassi Sh et al. [6] and Survase et al. [7] and Carter and Lvany [8].

3.2 Growth Parameters

“The different growth attributing characters as influenced by different treatment were presented in Table No 2. The significantly highest values of all growth characters viz. plant height, number of tillers, dry matter accumulation and leaf area index at harvest were recorded with weed free up to 60 DAS were significantly superior over rest of the treatments. This was might be due to effective weed control which reduces the weed crop competition ultimately higher growth of crop. The significantly lowest values of all growth characters were registered with weedy check treatment as weedy check plots having high intensity of weeds which suppressed growth of Paddy”. Mirza et al. [9], Ali et al. [10] and Nayak et al. [11].

3.3 Yield Parameters

The data presented in Table no. 3 indicate that all the weed management practices were significantly affected and the yield contributing characters of paddy crop viz. No.of effective tillers (474.33 m⁻²), length of panicle (26.76 cm), panicle weight (5.20 g), number of grains/panicle (187.00), grain weight/panicle (5.16) and Test weight (24.30 g) were significantly higher in weed free upto 60 DAS treatment. This may be due to good growth of paddy reflects in yield attributing characters as these treatments have controls weeds effectively. Weedy check treatment recorded significantly lowest values of yield contributing characters than rest of treatments. Similar result were recorded by Hasanuzzaman et. al. [12] and Bhurer et.al. [13].

3.4 Yield Studies

The data presented in Table no. 3 indicate that the grain yield and straw yield were recorded significantly highest in weed free upto 60 DAS (48.10 q/ha and 58.23 q/ha) over rest of treatments. Effective weed control achieved in these treatments resulted in enhancing various growth and yield contributing characters of wheat and finally gave significantly higher grain yield and straw yield over weedy check. However weedy check recorded significantly lowest grain yield and straw yield (25.05 q/ha and 49.03 q/ha) as compared to rest of the treatments. Similar findings were recorded by Naik et. al. [14].

Table 1. Effect of integrated weed management on weed growth parameters of paddy

Treatments	Weed density (At harvest)	Weed dry weight (At harvest)	Weed control Efficiency (%)	Weed index (%)
T1 : Weedy check till maturity	51.65	131.69	0.00	92.01
T2 : Weed free upto 60 DAT	20.20	30.06	77.17	0.00
T3 : Pretilachlor 50% EC@ 1.25kga.i/ha (PE)	39.13	85.43	35.12	45.31
T4: Pendimethaline 30% EC@ 1.0kga.i/ha(PE)	42.10	87.13	33.83	60.11
T5 : Pendimethaline 30%EC@ 1.0kg a.i/h + 1hand weeding at 30 DAT	31.13	77.16	41.40	14.25
T6 : Pendimethaline 30%EC @1.0kga.i/h (PE) + Bispyribac 10% SC@25ga.i/h (POE)	36.06	81.20	38.34	23.14
T7 : Pretilachlor 50% EC@1.0kg a.i/h + 1hand weeding at 35DAT	30.30	67.23	48.94	11.62
T8 : Two hand weeding at 20 and 40 DAT	29.23	34.26	73.98	3.97
T9 : Pretilachlor 30%EC @1.0kg a.i/h (PE) + Bispyribac 10% SC@25ga.i/h (POE)	35.26	79.63	39.53	17.14
SEm±	0.50	0.82	-	-
CD(P = 0.05)	1.52	2.52	-	-

3.5 Nutrient Uptake

The data presented in Table 4 indicate the nutrient uptake by crop in which weed free upto 60 DAS recorded significantly highest uptake of N, P and K through grain (62.04, 17.79 and 13.94 kg/ha) and through straw (25.62, 16.30 and 68.71 kg/ha) respectively. However, among the herbicides treatments, the higher uptake of N, P and K through grain (56.66, 17.24 and 13.54 kg/ha) and straw (24.99, 15.75 and 66.28 kg/ha) was recorded by pretilachlor 30%EC @1.0kg a.i/h (PE) + Bispyribac 10% SC @ 25 g a.i/h (POE), while the lowest N,P and K uptake by through grain (38.32, 11.52 and 10.27 kg/ha) and straw (23.53, 15.68 and 62.26 kg/ha) was recorded by weedy check. Similar findings were recorded by Satapathy et. al. [15] and Chakraborti et. al. [16].

3.6 Economics.

The data presented in Table 5 indicate the economics of crop in which weed free up to 60 DAS accrued the maximum gross income (121,416.00 Rs/ha) followed by two hand weeding at 20 and 40 DAT. However, the highest net income (58,218.31 Rs/ha) was recorded with weed free up to 60 DAS followed by two hand weeding at 20 and 40 DAT. The BCR recorded maximum (1.21) with pretilachlor 30% EC @1.0kg a.i/h (PE) + Bispyribac 10% SC @25ga.i/h (POE) followed by pendimethaline 30% EC @1.0kg a.i/ha (PE) + Bispyribac 10% SC @25g a.i/ha (POE) when applied was mainly attributed to higher grain and straw yield proportionately lower cost incurred. However, lower grain and straw yield resulted lower gross income, net income and BCR with weedy check. Similar results were recorded by Nivetha et. al. [17] and Jagtap et. al. [18,19-23].

Table 2. Effect of integrated weed management on growth parameters of paddy

Treatments	Plant height (cm) (Atharvest)	Number of tillers m⁻² (Atharvest)	Dry matter accumulation(At harvest)	Leaf area index(At harvest)
T1 : Weedy check till maturity	110.33	478.00	688.33	6.00
T2 : Weed free upto 60 DAT	118.60	529.00	703.76	7.52
T3 : Pretilachlor 50% EC @ 1.25kga.i/ha(PE)	113.30	519.00	700.63	6.52
T4: Pendimethaline 30% EC @ 1.0 kg a.i/ha(PE)	112.66	518.00	699.43	6.44
T5 : Pendimethaline 30%EC @ 1.0kg a.i/h +1 hand weeding at 30 DAT	115.43	526.00	702.60	6.88
T6 : Pendimethaline 30%EC @1.0kga.i/h (PE) + Bispyribac 10% SC @ 25ga.i/h (POE)	114.20	523.00	701.20	6.62
T7 : Pretilachlor 50% EC @1.0kg a.i/h +1hand weeding at 35DAT	117.50	527.00	702.80	7.33
T8 : Two hand weeding at 20 and 40 DAT	117.66	528.00	703.50	7.46
T9 : Pretilachlor 30%EC @1.0kg a.i/h (PE) + Bispyribac 10% SC@25ga.i/h (POE)	115.23	524.00	701.66	6.73
SEm±	0.60	0.63	0.61	0.16
CD = P (0.05)	1.82	1.93	1.84	0.48

Table 3. Effect of integrated weed management on yield parameters of paddy

Treatments	No. of effective tillers(m ⁻²)	Panicle length (cm)	Panicle weight (g)	No. of grains/panicle	Grain weight /panicle(g)	Test weight	Grain yield (q/ha)	Straw yield (q/ha)
T1 : Weedy checktill maturity	422.00	15.60	3.20	86.00	2.15	19.74	25.05	49.03
T2 : Weed free upto 60 DAT	474.33	26.76	5.20	187.00	5.16	24.30	48.10	58.23
T3 : Pretilachlor50% EC @ 1.25kg a.i/ha (PE)	463.00	17.83	4.34	122.00	2.47	20.62	33.10	51.10
T4: Pendimethaline30% EC @ 1.0 kg a.i/ha (PE)	462.00	17.30	4.20	96.00	2.28	20.20	30.04	50.13
T5 : Pendimethaline 30%EC @ 1.0kg a.i/h + 1 hand weeding at 30DAT	470.00	23.40	4.84	154.00	3.64	22.90	42.10	54.40
T6 : Pendimethaline30%EC @ 1.0kg a.i/h (PE) + Bispyribac 10%SC @ 25ga.i/h (POE)	467.00	19.33	4.54	139.00	2.50	21.40	39.06	53.08
T7 : Pretilachlor50% EC @ 1.0kg a.i/h + 1hand weeding at 35DAT	472.00	24.16	4.95	173.00	3.94	22.96	43.09	55.03
T8 : Two hand weeding at 20 and 40 DAT	473.00	25.30	5.05	181.00	4.26	23.73	46.26	56.06
T9 : Pretilachlor30%EC @ 1.0kg a.i/h (PE) + Bispyribac 10%SC @ 25ga.i/h (POE)	468.00	19.56	4.73	144.00	2.91	21.79	41.06	54.33
SEm±	0.58	0.63	0.28	0.48	0.12	2.36	0.58	0.57
CD = P (0.05)	1.75	1.93	0.86	1.45	0.36	0.78	1.75	1.73

Table 4. Effect of integrated weed management on nutrient uptake (Kg/ha) by crop

Treatments	GRAIN			STRAW		
	N	P	K	N	P	K
T1 : Weedy check till maturity	38.32	11.52	10.27	23.53	15.68	62.26
T2 : Weed free upto 60 DAT	62.04	17.79	13.94	25.62	16.30	68.71
T3 : Pretilachlor 50% EC@ 1.25kga.i/ha (PE)	49.31	14.56	12.90	24.01	15.70	63.87
T4:Pendimethaline 30% EC @ 1.0 kg a.i/ha(PE)	45.36	13.51	12.01	23.56	15.69	63.16
T5 : Pendimethaline 30%EC@ 1.0kg a.i/h + 1hand weeding at 30 DAT	57.67	17.26	13.64	25.02	15.77	66.31
T6 : Pendimethaline 30%EC @1.0kga.i/h (PE) + Bispyribac 10% SC @ 25ga.i/h (POE)	54.68	16.79	13.28	24.94	15.71	65.81
T7 : Pretilachlor 50% EC @1.0kg a.i/h + 1handweeding at 35DAT	58.17	17.32	13.70	25.25	15.95	66.53
T8 : Two hand weeding at 20 and 40 DAT	60.60	17.57	13.87	25.56	16.25	66.71
T9 : Pretilachlor 30%EC @1.0kg a.i/h (PE) +Bispyribac 10% SC@25ga.i/h (POE)	56.66	17.24	13.54	24.99	15.75	66.28
SEm±	0.19	0.22	0.20	0.25	0.19	0.31
CD = P (0.05)	0.58	0.68	0.63	0.76	0.55	0.93

Table 5. Effect of Integrated weed management on Economics

Treatments	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B : C ratio (Rs/Re invested)
T1 : Weedy check till maturity	45,197.69	70,714.00	25,516.31	0.56
T2 : Weed free upto 60 DAT	63,197.69	121,416.00	58,218.31	0.92
T3 : Pretilachlor 50% EC@ 1.25kga.i/ha(PE)	46,422.69	87,964.00	41,541.31	0.89
T4:Pendimethaline 30% EC @ 1.0 kg a.i/ha(PE)	46,897.69	81,333.60	34,435.91	0.73
T5 : Pendimethaline 30%EC@ 1.0kg a.i/h +1 hand weeding at 30 DAT	55,297.69	107,644.00	52,346.31	0.94
T6 : Pendimethaline 30%EC @1.0kga.i/h(PE) + Bispyribac 10% SC @ 25ga.i/h (POE)	48,210.69	100,914.40	52,703.71	1.09
T7 : Pretilachlor 50% EC @1.0kg a.i/h +1hand weeding at 35DAT	54,697.69	109,915.60	55,217.91	1.00
T8 : Two hand weeding at 20 and 40 DAT	58,697.69	116,794.40	58,096.71	0.98
T9 : Pretilachlor 30%EC @1.0kg a.i/h (PE) + Bispyribac 10% SC@25ga.i/h (POE)	47,610.19	105,494.40	57,884.21	1.21

4. CONCLUSION

It can be concluded from the present investigation that to get the higher growth, yield and net and gross monetary returns, paddy crop should be kept weed free. Weed free treatment control the weeds most efficiently, it reduced the weed dry matter resulted in increase in weed control efficiency. But from economic point of view weed free treatment is not feasible to the farmers because of having a greater number of labours and high cost of cultivation which results in less benefit cost ratio. Whereas, among integrated weed management treatment pretilachlor 30%EC @1.0kg a.i/h (PE) + Bispyribac 10% SC @ 25ga.i/h (POE) is effective with higher benefit: cost ratio (1.21) and can be used in paddy crop.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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