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Efficacy of new generation herbicides in combination and integrated application on weed control efficiency, production potential and economics in direct seeded rice (*Oryza sativa* L.)

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Abstract
Results of the experiment revealed that application of pendimethalin + pyrazosulfuron ethyl @ 920 g ha^{-1} as pre emergence at 1 to 2 DAS with manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence at 35 DAS was found to be effective in controlling weeds and enhancing the weed control efficiency. The growth, yield attributing characters like productive panicle m^{-2}, grains $panicle^{-1}$ and 1000 grain weight and grain yield of direct seeded rice was remarkably enhanced in pendimethalin + pyrazosulfuron ethyl @ 920 g ha^{-1} as pre emergence at 1 to 2 DAS with manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence at 35 DAS without any crop injury. The same treatments were found economically viable. Unweeded control resulted in reduction of grain yield to 61.2 %.

Keywords: Efficacy, new generation herbicide combination, integrated application, weed control efficiency, production potential, direct seeded rice

1. Introduction

Rice is cultivated in India in a very wide range of ecosystems from irrigated to shallow lowlands, mid-deep lowlands and deep water to uplands. Transplanting is the major method of rice cultivation in India. However, transplanting is becoming increasingly difficult due to shortage and high cost of labour, scarcity of water and reduced profit. Thus, direct-seeding is gaining popularity among farmers of India as in other Asian countries. The upland rice area is around 5.5 million hectares which accounts or 12.33% of the total rice area of the country. Irrespective of the method of rice establishment, weeds are a major impediment to rice production through their ability to compete for resources and their impact on product quality. Weeds are responsible for heavy rice yield losses, to the extent of complete crop loss under extreme conditions (Singh et al., 2014) [6]. Out of the losses due to various biotic stresses, weeds are known to account for nearly one third. Uncontrolled weeds reduced the grain yield by 75.8, 70.6 and 62.6% under dry-seeded rice (DSR), wet seeded rice and transplanted rice (TPR), respectively (Singh et al., 2005) [8]. Thus, weed control is major prerequisite for improved rice productivity and production using different methods of rice establishment. Proper weed management technologies if adapted can result in an additional rice production. Thus weed management would continue to play a key role to meet the growing food demands of increasing population in India. As the weed problems are multi-pronged, a holistic multi-disciplinary integrated approach would be imperative. In this context, integrated weed management (IWM) with new generation herbicides was tested to provide a more sustainable approach to rice production.

2. Materials and Methods

An experiment was conducted at Agricultural College Farm, Bapatla during *Kharif* 2016. The soil of the experimental field was sandy loam in texture with pH of 7.9. The soil is low in organic carbon (0.48%) and available nitrogen (189.4 kg ha^{-1}), medium in available phosphorus (24 kg ha^{-1}) and high in available potassium (281.8 kg ha^{-1}). A rainfall of 469.4 mm was received during crop growth period in 19 rainy days. The experiment was laid out in a randomized block design with twelve treatments as described in table and replicated thrice.

A recommended dose of 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} was applied through urea, single super phosphate and muriate of potash, respectively. Entire quantity of phosphorus and potassium and one third of nitrogen were applied at the time of final land preparation. At active tillering stage, one third of the N was applied through urea. The remaining one third of the N was top dressed at panicle initiation stage. The rice variety sambamahsuri (BPT 5204) was sown at a row spacing of 20 cm with continuous seeding in rows. The pre emergence and post emergence herbicides were applied as per the treatments through knap-sack sprayer using a spray volume of 500 l ha^{-1}. The data on dry weight were recorded at 30, 60 DAS and at harvest were subjected to square root transformation $\sqrt{x+0.5}$ before statistical analysis to normalize their distribution (Panse and Sukhatme, 1978). The growth and yield attributes were recorded at the time of maturity.

3. Results and discussion
3.1 Effect on Weeds
The experimental field was predominantly infested with *Echinochloa colonum, Cynodon dactylon, Digitaria sanguinalis, Dactyloctenium aegyptium, Paspalum conjugatum, Leptochloa chinensis* and *Chloris barbata* among grasses; *Cyperus rotundus, Cyperus iria* and *Scirpus articulate* among sedges*; Eclipta alba, Euphorbia hirta* and *Bergia capensis* among broad leaved weeds.
All the weed control treatments significantly reduced the weed dry weight over unweeded check at all the stages of observations **(**Table 1). The lowest weed dry matter production and higher weed control efficiency was recorded with pre emergence application of pendimethalin + pyrazosulfuron ethyl @ 920 g $ha^{-1}$with manual weeding at 20 DAS *followed by* halosulfuron @ 35 g ha^{-1} as post emergence (T_{10}) which was on par with other integrated weed management practices. Treatments included application of both pre and post emergence herbicides in sequence without manual weeding and pre emergence herbicides only once were significantly inferior to application of herbicides with manual weeding.The integration of herbicides with one hand weeding practice resulted in broad spectrum weed control over the other treatments due to the fact that pre emergence herbicides eliminated the early emerged weeds while the hand weeding practice and post emergence herbicides controlled the later germinated weeds thereby reduced weed population resulted in lowest weed dry weight. This may be attributed to least competition as a result of effective supression of sedges and broad leaved weeds thereby enabling plants to exhibit full potential in a competition free environment as evident by higher weed control efficiency in T_{10}. The results were corroborating with the findings of Singh and Singh (2014) [7]. This indicates that one cannot rely on herbicides for the weed control and at least only one hand weeding is needed along with herbicidal treatments. These results are in line with the findings of Bhurer *et al.* (2013) [1]. Better weed control efficiency and season long broad spectrum control of these integrated weed management practices resulted in reduced weed index significantly. These results were supported by Maity and Mukherjee (2008).

3.2 Effect on Crops
The dry matter production was significantly influenced by the weed management practices at all the growth stages of crop (Table 2). The highest dry matter production in crop was recorded in pendimethalin + pyrazosulfuron ethyl @ 920 g ha^{-1} with manual weeding at 20 DAS *followed by* halosulfuron @ 35 g ha^{-1} which was at par with other herbicides treatments supplemented with manual weeding and manual weeding twice. All the weed management practices either applied alone or in combination significantly enhanced the yield attributes and yield of direct-seeded rice over weedy check (Table 2 and 3). The pre emergence application of pendimethalin + pyrazosulfuron ethyl @ 920 g ha^{-1} with manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence recorded the maximum yield components like productive panicles m^{-2}, grains $panicle^{-1}$ and 1000 grain and weight followed by pretilachlor + pyrazosulfuron ethyl @ 615 g ha^{-1} with manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1}.
Weedy check recorded the lowest yield (2.16 t ha^{-1}) with 61.2% reduction in yield due to severe weed competition. The highest grain yield (5.56 t ha^{-1}) was recorded with the integrated application of herbicides along with hand weeding practices, *viz.*, pre emergence application of pendimethalin + pyrazosulfuron ethyl @ 920 g ha^{-1}supplemented with manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence and it was at par with all herbicides integrated manual weeding and significantly superior one time application of pre emergence herbicides and sequential treatments without manual weeding. The increased grain yield could be attributed to cumulative effect of lower weed dry weight and higher weed control efficiency. Integrated application of pre and post emergence herbicides with one hand weeding practice reduced the weed competition which enabled the rice crop for better utilization of nutrient and growth factors which ultimately resulted in higher grain yield. These results are in agreement with the findings of Singh *et al.* (2010) [9] and Mishra *et al.* (2012) [4].

3.3 Economics
Pre-emergence application of pendimethalin + pyrazosulfuron ethyl @ 920 g ha^{-1} with manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence registered the highest benefit : cost ratio (2.20) and net return (Rs 66652 ha^{-1}). This revealed that amid increasing wage rate and labour scarcity , integrated weed management through pendimethalin + pyrazosulfuron ethyl @ 920 g ha^{-1} as pre emergence with manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence resulted best alternative for manual hand weeding practices giving higher net return and benefit : cost ratio. These results are in close conformity with the findings of Bhurer *et al.* (2013) [1] and Joshi *et al.* (2015) [2].

4. Conclusion
Weed management practices significantly reduced the dry weight of weeds at all stages of observation when compared to weedy check. The lowest dry weight of weeds and highest weed control efficiency were recorded with application of pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} as pre emergence with manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence. Integrated application of pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} at 1 to 2 DAS with manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} at 35 DAS was found to be superior with increased dry matter production, more number of productive panicle m^{-2}, filled grains $panicle^{-1}$ and highest grain yield to sequential application of pre and post emergence herbicides and one time application of pre emergence herbicides. Economic of various weed management treatments revealed that the better growth and yield performance of rice crop was achieved with

pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} at 1 to 2 DAS *fb* manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} at 35 DAS which resulted in the highest net returns (Rs. 66,652 ha^{-1}) and benefit: cost ratio (2.20). Hand weeding was comparable with integrated weed management practices, however, hand weeding was not economically feasible owing to higher labour cost involved in weeding.

Table 1: Weed dry weight and weed control efficiency as influenced by integrated weed management practices in direct seeded rice

Treatments	Weed dry weight (g m^{-2})			Weed control efficiency (%)		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T_1 :Weedy check	*11.6 (134.4)	17.5 (307.0)	13.7 (186.6)	-	-	-
T_2 :Manual weeding twice at 20 and 40 DAS	4.0 (15.8)	7.1 (50.3)	6.0 (36.3)	88.2	83.7	80.7
T_3 :Pretilachlor + pyrazosulfuron ethyl @ 615 g ha^{-1} (1 to 2 DAS)	8.6 (73.6)	13.1 (173.4)	11.3 (128.2)	44.7	43.8	31.2
T_4 :Pendimethalin + pyrazosulfuron ethyl @ 920 g ha^{-1} (1 to 2 DAS)	8.3 (68.8)	12.9 (167.7)	11.1 (123.8)	48.5	45.2	33.0
T_5 : T3 *fb* halosulfuron @ 35 g ha^{-1} as post emergence (25 DAS)	6.9 (47.0)	10.3 (106.5)	9.0 (81.7)	64.6	65.0	56.5
T_6:T4 *fb* halosulfuron @ 35 g ha^{-1} as post emergence (25 DAS)	6.4 (41.4)	10.1 (102.5)	8.7 (75.1)	68.9	66.4	59.6
T_7 :T3 *fb* propanil @ 3.75 kg ha^{-1} as post emergence (25 DAS)	7.4 (55.6)	11.2 (119.7)	9.8 (95.7)	59.0	60.8	48.9
T_8 : T4 *fb* propanil @ 3.75 kg ha^{-1} as post emergence (25DAS)	7.3 (53.3)	11.1 (117.2)	9.6 (91.1)	59.8	61.54	50.7
T_9 : T3 *fb* manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} (35 DAS)	3.7 (13.2)	6.9 (46.9)	5.9 (34.3)	90.1	84.6	81.5
T_{10} :T4 *fb*manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1}(35 DAS)	3.5 (12.4)	6.7 (45.3)	5.6 (32.1)	90.7	85.2	82.9
T_{11} :T3 *fb* manual weeding at 20 DAS *fb* propanil @ 3.75 kg ha^{-1} (35 DAS)	4.3 (18.1)	7.4 (54.9)	6.4 (40.2)	86.5	82.2	78.5
T_{12} :T4 *fb*manual weeding at 20 DAS *fb* propanil @3.75 kg ha^{-1} (35 DAS)	4.2 (17.1)	7.3 (53.4)	6.3 (39.7)	87.3	82.5	78.9
SEm±	0.38	0.41	0.38	4.01	2.66	3.81
CD (P=0.05)	1.1	1.2	1.1	11.7	7.8	11.2

*The data are $\sqrt{X+0.5}$ transformed. The figures in parentheses are the original values.

Table 2: Growth and yield attributes as influenced by different weed management practices in direct seeded rice

Treatments	Drymatter production (t ha^{-1})			Productive panicle m^{-2}	Grains $panicle^{-1}$	1000 grain weight (g)
	30 DAS	60 DAS	90 DAS			
T_1 :Weedy check	91	0.99.	3.47	140	85	14.1
T_2 :Manual weeding twice at 20 and 40 DAS	0.20	2.26	6.63	299	147	15.3
T_3 :Pretilachlor + pyrazosulfuron ethyl @ 615 g ha^{-1}(1 to 2 DAS)	0.14	1.59	4.01	173	100	14.4
T_4 :Pendimethalin + pyrazosulfuron ethyl @ 920 g ha^{-1}(1 to 2 DAS)	0.16	1.67	4.09	184	103	14.5
T_5 : T3 *fb* halosulfuron @ 35 g ha^{-1} as post emergence (25 DAS)	0.17	1.86	4.98	238	123	14.8
T_6:T4 *fb* halosulfuron @ 35 g ha^{-1} as post emergence (25 DAS)	0.18	1.98	5.04	245	125	15.0
T_7 :T3 *fb* propanil @ 3.75 kg ha^{-1} as post emergence (25 DAS)	0.17	1.78	4.76	223	117	14.5
T_8 : T4 *fb* propanil @ 3.75 kg ha^{-1} as post emergence (25DAS)	0.17	1.81	4.81	231	120	14.7
T_9 : T3 *fb* manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} (35 DAS)	0.20	2.30	6.66	301	151	15.3
T_{10} :T4 *fb*manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1}(35 DAS)	0.21	2.35	6.79	308	154	15.5
T_{11} :T3 *fb* manual weeding at 20 DAS *fb* propanil @ 3.75 kg ha^{-1} (35 DAS)	0.19	2.19	6.35	275	141	15.0
T_{12} :T4 *fb*manual weeding at 20 DAS *fb* propanil @3.75 kg ha^{-1} (35 DAS)	0.19	2.21	6.41	281	144	15.1
SEm±	0.08	0.09	0.27	11.4	5	0.5
CD (P=0.05)	0.24	0.29	0.81	33	16	NS

Table 3: Yield and economics of direct seeded rice as influenced by integrated weed management practices

Treatments	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Weed Index (%)	Cost of cultivation (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
T_1 :Weedy check	2.16	3.79	61.2	26112	13671	0.52
T_2 :Manual weeding twice at 20 and 40 DAS	5.39	6.61	3.0	35200	58871	1.66
T_3 :Pretilachlor + pyrazosulfuron ethyl @ 615 g a.i ha^{-1}(1 to 2 DAS)	2.95	4.34	46.9	26634	26279	0.98
T_4 :Pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1}(1 to 2 DAS)	3.01	4.41	45.8	26772	27258	1.01
T_5 : T3 *fb* halosulfuron @ 35 g ha^{-1} as post emergence (25 DAS)	4.04	5.34	27.3	26786	44509	1.66
T_6:T4 *fb* halosulfuron @ 35 g ha^{-1} as post emergence (25 DAS)	4.19	5.40	24.7	26924	46666	1.73
T_7 :T3 *fb* propanil @ 3.75 kg ha^{-1} as post emergence (25 DAS)	3.79	5.11	32.0	28757	38176	1.32
T_8 : T4 *fb* propanil @ 3.75 kg ha^{-1} as post emergence (25DAS)	3.97	5.24	30.4	28895	39628	1.37
T_9 : T3 *fb* manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} (35 DAS)	5.42	6.77	2.4	30250	64665	2.13
T_{10} :T4 *fb*manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1}(35 DAS)	5.56	6.81	0.0	30335	66652	2.20
T_{11} :T3 *fb* manual weeding at 20 DAS *fb* propanil @ 3.75 kg ha^{-1} (35 DAS)	5.08	6.34	8.4	32237	56788	1.76
T_{12} :T4 *fb*manual weeding at 20 DAS *fb* propanil @3.75 kg ha^{-1} (35 DAS)	5.19	6.42	6.7	32376	58290	1.80
SEm±	252	301	-	-	-	-
CD (P=0.05)	739	882	-	-	-	-

5. References

1. Bhurer KP, Yadav DN, Ladha JK, Thapa RB, Pandey K. Effect of integrated weed management practices on performance of dry direct seeded rice (*Oryza sativa* L.). Agronomy Journal of Nepal. 2013; 3:53-63.
2. Joshi N, Singh VP, Dhyani VC, Singh SP. Effect of planting geometries and weed management practices on weeds, crop performance and economics of direct seeded aerobic rice (*Oryza sativa* L.). Indian Journal of Agronomy. 2015; 60(4):614-616.
3. Maity SK, Mukherjee PK. Integrated weed management in dry direct-seeded rainy season rice. Indian Journal of Agronomy. 2008; 53(2):116-120.
4. Mishra JS, Singh VP, Bhanu C, Subramanyam D. Crop establishment, tillage and weed management techniques on weed dynamics and productivity of rice (*Oryza sativa* L.) – chickpea (*Cicer arietinum*) cropping system. Indian Journal of Agricultural Sciences. 2012; 82(1):15-20.
5. Panse VG, Sukhatme PV. Statistical methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, 1978, 152.
6. Singh M, Bhullar MS, Chauhan BS. The critical period for weed control in dry-seeded rice. Crop Protection. 2014; 66:80-85.
7. Singh NK, Singh UP. Crop establishment methods and weed management on growth and yield of dry direct seeded rice. Indian Journal of Weed Science. 2014; 46 (4):308 -313.
8. Singh S, Singh G, Singh VP, Singh AP. Effect of establishment methods and weed management practices on weeds and rice in rice-wheat cropping system. Indian Journal of Weed Science. 2005; 37: 51-57.
9. Singh VP, Singh SP, Dhyani VC, Tripathi N, Kumar A, Singh MK. Bioefficacy of Azimsulfuron against sedges in direct seeded rice. Indian Journal of Weed Science. 2010; 42(1 & 2):98-101.