International Journal of Advanced Research in Biological Sciences
ISSN : 2348-8069
www.ijarbs.com

Research Article

Bio-efficacy of pretilachlor 50 EC on different cultivars of hybrid and high yielding rice (*Oryza sativa* L.) on growth and yield parameters

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Abstract

The field experiment was carried out in a typical gangetic alluvium (Entisol) with sandy loam soil under subtropical climate at *Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India* during summer and *kharif* seasons to study the effect of weed management treatments on different varieties of hybrid and high yielding rice *(Oryza sativa L.).* The experiment was laid out in a split plot design with three replications. Six varieties of hybrid and two varieties of high yielding rice used as a check were in main plot. Three weed management treatments were in subplot. Both the weed control treatments (i.e. hand weeding and chemical treatment by Pretilachlor 50 Emulsifiable Concentrate) used in this experiment significantly decreased weed density and bio-mass over the unweeded control. Hand weeding twice recorded 13% and 36% higher grain yield; 16% and 45% higher straw yield over the unweeded check in summer and during *kharif* season 20% and 42% higher grain yield; 16% and 46% more straw yield was found over the unweeded check respectively. Hand weeding treatment in hybrid rice variety also recorded better yield in comparison to that of high yielding varieties.

Keywords: Bio-efficacy, High Yield Variety, Hybrid rice, Pretilachlor, Split plot.

Introduction

Rice is the most important cereal food crop of the world providing major source of the food energy for more than half of the human population. Within 2025 AD production of rice need to be increased up to 140 million tonnes to fulfill the increasing demand (Anonymous, 2005). To increase rice production and productivity, hybrid rice is the most suitable technological solution till date. Management of weed is an acute problem in rice cultivation which causes reduction in yield to a great extent. Weeds remove a large amount of plant nutrients from the soil and it may deprive the crops as much as 50% K, 47% N, 42% P, 39% Ca and 24% Mg of their nutrient uptake as well as reduce the yield potential by harbouring number of crop pests (Balasubramanian and Palaniappan 2001). This problem of weed management is gradually increasing because of increasing the labour wages and that too unavailability of labours at the critical crop weed competition (for the traditional hand weeding), less awareness of the farmers about the dose and time of application of synthetic chemical or biological herbicides besides the problem of availability of these chemicals in rural areas (for chemical or biological weed management) and lastly unavailability of mechanical paddy weeders in rural areas. To study the effects of different crop establishment methods and weed management practices on the productivity and economics of rice several field experiments were conducted and results indicated that treatment combination of preemergence herbicide pretilachlor followed by hand weeding recorded significantly lower total weed count and total

weed dry weight resulting in superior grain yield straw yield and net income (Sanjay *et al.*, 2008). Hence for increasing rice production the use of hybrids with proper weed management is an important option.

Materials and Methods

An investigation was undertaken to study the effect of hand weeding (W_1), chemical treatment with pretilachlor 50 EC @ 500 g/ha (W_2) applied at 2 DAT and unweeded control on different varieties of hybrid and high yielding varieties of transplanted rice (*Oryza sativa* L.) during summer and *kharif* seasons of two successive years, respectively at 'C' Block (Incheck) Farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India. The experimental site was situated at $22^0 5^/$ N latitude and 89^oE longitude with an altitude of 9.75 m above the mean sea level and topographically the land was medium. The climate of the place where the experiment was conducted was sub-tropical humid type. It was observed that the experimental soil is a typical gangetic alluvium (Entisol) with sandy loam soil with a pH of 6.8, Organic carbon 0.61%, total N 0.067%, available P_2O_5 22.13 kg/ha, available K_2O 139.42 kg/ ha. The experiment was laidout in split plot design with three replications. Six (6) varieties of hybrid (V_1- 6129, V_2- 6444, V_3- 96110, V_4- 97304, V_5 – 94024, V_6 – 97158) and two (2) high yielding varieties (HYV) of rice (V_7- IET 4786, V_8- IET 4094) as a check were used in main plot. Three weed management treatments viz. hand weeding (W_1), application of pretilachlor 50 EC @ 500 g/ha as pre-emergence (W_2) at 2 DAT and unweeded control (W_3) were in subplot. The plot size and spacing were 6 m x 3 m and 20 cm x 15 cm respectively.

Results and Discussion

In case of dry matter accumulation (Table 1) the pooled data revealed that highest dry matter accumulation (DMA) was recorded from the hybrid 6444 (V_2) which gave 21%, 24% and 25% more DMA at 30, 60 and 90 DAT, respectively than that of the hybrid 94024 (V_5) which was the lowest recorder of DMA among the hybrids during summer season and corresponding figures during *kharif* season were 20%, 26% and 23% at 20, 40 and 60 DAT respectively. Again the hybrid 6444 gave 57%, 63% and 61% more DMA at 30, 60 and 90 DAT than the HYV of rice and the hybrid 94024 recorded 29%, 31% and 28%, respectively. The corresponding figures during *kharif* season were 56%, 61% and 53%, respectively for the hybrid 6444 and 29%, 27% and 24%, respectively for the hybrid 94024. The reason behind this in vegetative stage hybrid rice is more vigorous in growth and it has thicker leaves, larger leaf area, and higher seedling dry matter content and longer root system. Hybrid rice has higher activities of L-ascorbate peroxidise and glutathione reductase. At late stage the flag leaves of the hybrid shows lower degradation of chlorophyll and protein contents because of its strong antioxidant capacity. Islam et al. (2009) opined in the similar way. In case of dry matter accumulation the pooled data (Table 1) showed that twice hand weeding (W_1) gave 21% and 39%, 19% and 39%, 13% and 35% more DMA at 30, 60 and 90 DAT, respectively than that of chemical treatment (W_2) and unweeded check (W_3) during summer season. Corresponding figures during *kharif* season were 17% and 40%, 16% and 36%, 15% and 38% at 20, 40 and 60 DAT respectively. Hand weeding created a favourable condition for crop growth by reducing crop weed competition and chemical treatment reduced weed population initially but more flushes of weed emergence occur during later vegetative stage of crop growth. Better result in controlling weed is noticed both in case of hand weeding (W_1) and chemical treatment (W_2) than that of the unweeded check. Similar result was obtained by Bhowmick (2002). Among the interaction hand weeding combined with all varieties recorded higher DMA in comparison to other treatment combination because of the same reason. Furthermore hybrids of rice combining with hand weeding treatment performed better than that of hand wedding in high yielding varieties plot. Similarly chemical treatment practiced in hybrid varieties plot gave better result than that of chemical treatment in high yielding varieties. Same result was found in case of unweeded control treatment**.** Pooled data presented in table 2 revealed that among the varieties the hybrid varieties recorded 33% and 36% more filled grain/panicle during summer and *kharif* season than the high yielding varieties. The hybrid variety 6444 (V_2) showed 4%, 10% and 15% more filled grain per panicle than that of the hybrid 6129 (V_1), hybrid 97158 (V_6) and hybrid 96110 (V_3) respectively during summer season. The corresponding figure during *kharif* were 7%, 12% and 18% filled grain/panicle. Pooled data in table 2 showed that among the varieties local checks gave 13.3% and 13.66% more effective tiller/m^2 during summer and *kharif* season than the

Table 1: Effect of variety and weed management and their interaction on Dry Matter Accumulation (g/m^2) of plant during summer (pooled of 2 years) and *kharif* seasons (pooled of 2 years)

Treatments	Summer			*Kharif*		
	30 DAT	60 DAT	90 DAT	20 DAT	40 DAT	60 DAT
V_1	399.53	751.08	1238.28	240.50	456.03	758.76
V_2	401.65	754.39	1247.04	242.22	459.92	766.62
V_3	379.99	697.45	1145.40	231.36	415.46	703.23
V_4	339.55	622.22	1022.67	206.04	371.58	634.31
V_5	329.32	605.97	997.72	201.57	362.54	619.71
V_6	391.58	732.59	1193.69	238.21	427.34	718.44
V_7	256.44	464.88	780.88	157.60	289.83	505.03
V_8	252.81	458.01	768.01	153.51	282.38	492.94
SEm($\pm$)	13.882	12.230	32.843	9.888	19.044	13.495
CD (P= 0.05)	42.105	37.095	99.620	29.991	57.762	40.932
W_1	405.75	746.32	1201.69	245.95	442.00	753.09
W_2	334.45	624.77	1056.56	205.11	381.78	653.94
W_3	291.38	536.37	889.38	175.56	325.62	542.61
SEm($\pm$)	13.914	12.263	32.876	9.920	19.076	13.527
CD (P= 0.05)	40.082	35.325	94.705	28.577	54.952	38.968
Interaction						
V_1W_1	462.35	858.94	1396.99	272.61	507.61	844.91
V_2W_1	463.58	861.25	1402.45	274.25	509.85	849.75
V_3W_1	442.67	813.50	1303.40	266.51	469.91	803.61
V_4W_1	398.30	730.97	1167.62	252.79	440.99	752.19
V_5W_1	394.84	723.94	1152.94	247.07	432.37	739.07
V_6W_1	453.03	844.24	1356.94	271.70	477.50	813.60
V_7W_1	317.15	571.70	922.55	193.57	353.57	618.47
V_8W_1	314.07	566.08	910.63	189.15	344.25	603.15
V_1W_2	395.74	751.98	1241.43	238.97	457.57	755.27
V_2W_2	398.69	756.30	1255.50	241.50	463.90	766.20
V_3W_2	374.14	688.69	1148.44	227.75	410.95	699.15
V_4W_2	332.45	600.33	1023.63	198.70	363.90	642.70
V_5W_2	307.68	572.73	989.13	194.74	356.34	627.64
V_6W_2	385.21	727.22	1194.17	235.91	426.11	719.21
V_7W_2	243.35	454.98	807.03	153.21	289.51	514.11
V_8W_2	238.36	445.95	793.20	150.14	285.94	507.24
V_1W_3	340.51	642.32	1076.42	209.91	402.91	676.11
V_2W_3	342.67	645.64	1083.19	210.91	406.01	683.91
V_3W_3	323.18	590.16	984.36	199.82	365.52	606.92
V_4W_3	287.89	535.37	876.77	166.65	309.85	508.05
V_5W_3	285.44	521.24	851.09	162.92	298.92	492.42
V_6W_3	336.51	626.30	1029.95	207.01	378.41	622.51
V_7W_3	208.83	367.98	613.08	126.03	226.43	382.53
V_8W_3	206.01	362.00	600.20	121.24	216.94	368.44
SEm($\pm$)	13.934	12.282	32.895	9.940	18.396	13.547
V_1W_1 vs V_1W_2	13.939	12.287	32.900	9.945	18.401	13.552
(V_1W_1 vs V_2W_1) CD (P= 0.05)	40.138	35.380	94.760	28.663	52.991	39.024
	31.442	27.716	74.214	22.432	41.507	30.569

Table 2: Effect of variety and weed management and their interaction on filled grain/panicle and number of effective tiller/m^2 during summer (pooled of 2 years) and *kharif* (pooled of 2 years)

Treatment		Summer		*Kharif*	
		filled grain/panicle	effective tiller/m^2	filled grain/panicle	effective tiller/m^2
V_1		155.05	376.98	129.70	338.20
V_2		161.84	385.45	144.18	345.54
V_3		140.73	366.22	122.57	319.68
V_4		135.15	343.88	109.45	296.03
V_5		128.57	334.65	115.04	306.29
V_6		147.87	354.82	135.99	330.70
V_7		105.04	413.82	95.82	362.36
V_8		113.11	404.04	88.86	370.80
SEm($\pm$)		3.117	5.332	3.129	4.753
CD (P= 0.05)		9.454	16.174	9.492	14.418
W_1		165.15	395.80	149.32	362.23
W_2		134.19	377.55	115.26	335.76
W_3		108.41	344.10	88.52	303.11
SEm($\pm$)		3.229	5.365	3.469	4.786
CD (P= 0.05)		9.302	15.455	9.993	13.788
Interaction					
V_1W_1		186.14	400.79	160.98	365.75
V_2W_1		192.31	408.68	178.53	373.71
V_3W_1		171.36	390.69	153.36	347.56
V_4W_1		165.36	367.42	140.72	326.62
V_5W_1		157.37	355.88	145.69	334.63
V_6W_1		178.83	378.03	169.34	357.95
V_7W_1		131.31	437.57	126.31	391.77
V_8W_1		138.54	427.37	119.66	399.87
V_1W_2		153.71	381.86	128.52	339.44
V_2W_2		160.79	390.17	142.51	347.40
V_3W_2		138.25	370.64	119.98	323.54
V_4W_2		132.93	349.70	106.67	297.90
V_5W_2		126.85	340.18	112.99	310.39
V_6W_2		145.75	358.43	134.06	332.98
V_7W_2		102.75	419.00	92.81	363.06
V_8W_2		112.53	410.42	84.56	371.39
V_1W_3		125.32	348.30	99.62	309.41
V_2W_3		132.42	357.50	111.51	315.51
V_3W_3		112.57	337.34	94.36	287.95
V_4W_3		107.17	314.54	80.97	263.56
V_5W_3		101.49	307.91	86.46	273.87
V_6W_3		119.03	327.99	104.56	301.17
V_7W_3		81.05	384.88	68.34	332.25
V_8W_3		88.25	374.35	62.36	341.15
	SEm($\pm$)	3.997	5.384	4.034	4.806
V_1W_1 vs V_1W_2		4.207	5.389	4.249	4.811
(V_1W_1 vs V_2W_1)	CD (P= 0.05)	11.514	15.511	11.621	13.843
		9.490	12.157	9.585	10.851

hybrid varieties of rice. Among the hybrids 6444 (V_2) recorded maximum number of effective tiller/m^2 (385.45) which produce 15% more effective tiller/m^2 than that of hybrid 94024 (V_5) which was lowest recorder of effective tiller/m^2 among the hybrids in summer season. During *kharif* season hybrid 97304 (V_1) produced lower number of effective tiller/m^2 (129.03) which gave 14% less effective tiller/ m^2 than that of the hybrid 6444. It is predicted that the emergence of new tillers stopped earlier in hybrid

rice than the HYV, thereby enhancing the distribution of newly gained assimilate to the existing tillers, on the other hand part of the newly gained assimilate was used by HYV to the production of new tillers. In hybrid rice this more efficient control in tillering patterns increased fertility rate of tiller and reduced wastage of assimilates (Peng et al., 1994). Moreover this efficient mechanism in tillering in hybrid rice give higher filled grain per panicle at maturity and higher translocation of carbohydrates from vegetative parts to spikelets and larger LAI also found during the grain filling stage. More dry matter is accumulated by hybrid rice during vegetative stage which results in higher spikelet per panicle compared to HYV rice. Regarding weed management the hand weeding twice recorded 23% and 52% higher filled grain/panicle during summer season than that of chemical treatment and unweeded check, respectively. The corresponding figure in case of *kharif* season 29% and 68%. The chemical treatment also recorded 23% and 30% higher filled grain panicle^{-1} during summer and *kharif* season over the unweeded check. In case of effective tiller/m^2 chemical treatment (W_2) recorded 4% less but 10% more during summer season than that of twice hand weeding (W_1) and unweeded control (W_3). The corresponding figures in case of *kharif* season were 7% and 11%, respectively. Hand weeding (W_1) showed 15% and 19% more effective tiller/m^2 than that of unweeded control (W_3) during summer and *kharif* season, respectively. Twice hand weeding was able to reduce the weed competition and created a favourable growth environment of the paddy where as chemical treatment reduce weed population up to initial tillering stage but later due to resurgence of the weed flora during the active tillering stage the weed competition was again observed. Both these hand weeding (W_1) and chemical treatment (W_2) give better result in controlling weed than that of the unwedded check (Bhowmick, 2002). Among the interaction hand weeding combined with all varieties recorded higher filled grain/panicle and effective tiller/m^2 in comparison to other treatment combination because of the same reason. From the pooled data of grain and straw yield of summer and *kharif* season as presented in Table 3 showed that among the varieties the hybrid varieties recorded 36% and 22% more grain and straw yield, respectively in summer season than HYV. The corresponding figures in *kharif* season were 32% and 23%. The hybrid variety 6444 (V_2) showed 0.05, 0.12 and 0.23 t/ha more grain yield during summer than that of the hybrid V_1, V_6 and V_3, respectively. The corresponding higher straw yields were 0.21, 0.41 and 0.67 t/ha during summer season. Similarly in *kharif* season the hybrid variety 6444 (V_2) gave 0.10, 0.21 and 0.34 t/ha more grained yield than that of the hybrid V_1, V_6 and V_3, respectively. The corresponding higher straw yields were 0.25, 0.64 and 0.65 t/ha. The reason may be that the hybrids though recorded lesser number of tillers than that of the HYV but the number of filled grains/panicle and the panicle length were higher than that of the HYV. Similar results were observed by Ghosh (2001). Regarding weed management the hand weeding twice as expected recorded 13% and 36% higher grain yield than that of the chemical treatment and unweeded check, respectively. The corresponding figures in case of straw yield were 16% and 45%. The chemical treatment also recorded 20% and 25% higher grain and straw yield over the unweeded check during summer season. During *kharif* season 20% and 42% higher grain yield was recorded than that of the chemical treatment and unweeded check, respectively. The corresponding figures in case of straw yield were 16% and 46%. The chemical treatment also recorded 19% and 26% higher grain and straw yield over the unweeded check.

Twice hand weeding though costly but can able to increase growth environment of the paddy by managing all types of weed flora timely. Therefore, the paddy yield was higher in comparison to chemical treatment where the initial application of pretilachlor can manage the weed flora and reduced the weed competition at the initial tillering stage but later due to resurgence of the weed flora during the active tillering stage the weed competition was again increased. Both these hand weeding (W_1) and chemical treatment (W_2) because of managing the weeds in higher percentage than that of the unweeded check recorded higher yield. Among the interaction hand weeding combined with all varieties recorded higher yield in comparison to other treatment combinations because of the same reason. Moreover, twice hand weeding followed in hybrids plot recorded 38% and 19% more grain and straw yield than that of the hand weeding followed in high yielding varieties plot during summer season. The corresponding figures were 30% and 20% in *kharif* season. Similarly chemical treatment and unweeded control followed in hybrids plot showed better performance than that of the chemical treatment and unweeded control practiced in high yielding varieties (HYV) plot during both summer and *kharif*

Table 3: Effect of variety and weed management and their interaction on grain yield (t/ha) and Straw yield during summer (pooled of 2 years) and *kharif* (pooled of 2 years)

Treatment		Summer		*Kharif*	
		Grain yield	Straw yield	Grain yield	Straw yield
V_1		6.08	8.55	4.94	7.38
V_2		6.13	8.76	5.04	7.63
V_3		5.90	8.09	4.70	6.98
V_4		5.49	7.79	4.40	6.72
V_5		5.27	7.49	4.09	6.42
V_6		6.01	8.35	4.83	5.86
V_7		4.41	6.97	3.63	5.51
V_8		4.14	6.46	3.42	6.99
SEm($\pm$)		0.093	0.157	0.086	0.131
CD (P= 0.05)		0.281	0.476	0.261	0.397
W_1		6.22	9.18	5.17	7.88
W_2		5.51	7.91	4.33	6.78
W_3		4.56	6.33	3.64	5.39
SEm($\pm$)		0.086	0.190	0.097	0.151
CD (P= 0.05)		0.248	0.547	0.280	0.435
Interaction					
V_1W_1		6.96	10.11	5.79	8.56
V_2W_1		7.05	10.31	6.01	8.80
V_3W_1		6.80	9.42	5.53	8.25
V_4W_1		6.39	9.05	5.16	8.08
V_5W_1		6.04	8.79	4.82	7.66
V_6W_1		6.88	9.76	5.67	7.02
V_7W_1		4.88	8.26	4.27	6.68
V_8W_1		4.77	7.80	4.14	8.02
V_1W_2		6.21	8.48	4.96	7.41
V_2W_2		6.19	8.53	4.94	7.61
V_3W_2		5.99	8.24	4.63	6.89
V_4W_2		5.43	7.96	4.31	6.74
V_5W_2		5.28	7.61	4.13	6.60
V_6W_2		6.11	8.41	4.81	6.11
V_7W_2		4.60	7.33	3.61	5.77
V_8W_2		4.26	6.73	3.27	7.15
V_1W_3		5.08	7.06	4.07	6.18
V_2W_3		5.16	7.44	4.17	6.48
V_3W_3		4.93	6.63	3.93	5.79
V_4W_3		4.64	6.36	3.73	5.35
V_5W_3		4.49	6.08	3.33	5.01
V_6W_3		5.04	6.87	4.02	4.44
V_7W_3		3.76	5.34	3.00	4.09
V_8W_3		3.41	4.86	2.85	5.80
	SEm($\pm$)	0.096	0.209	0.086	0.151
V_1W_1 vs V_1W_2		0.088	0.214	0.085	0.159
(V_1W_1 vs V_2W_1)	CD (P= 0.05)	0.276	0.603	0.248	0.435
		0.197	0.483	0.192	0.359

season. From the above findings, it may be concluded that among the two types of varieties, the performance of hybrids are superior to that of the HYV in respect of yield and yield parameters. More yield of rice observed in summer season than that of the *kharif* of all the varieties irrespective of high yielding and hybrid. Among the hybrids 6444 give best result which is followed by hybrid 6129, 97158 and 96110. On the other hand among the HYV of rice IET- 4786 give best performance in comparison to IET 4094. Moreover hand weeding treatment in hybrid rice variety recorded better yield in comparison to that of high yielding varieties.

Acknowledgments

I am extremely thankful to *M/s. Bayer Bio Science Pvt. Ltd., Hyderabad, India* for providing me the seed of hybrid rice during my research. I am also indebted to Dr. Soumen Bera, *Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India* for his technical assistance.

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