Madras Agric. J., 99 (4-6): 311-314, June 2012
https://doi.org/10.29321/MAJ.10.100073

Short Note

Effect of Weed Competition and Management in Direct Seeded Aerobic Rice

K. Ramachandiran*, R. Balasubramanian and R. Babu
Department of Agronomy, Agricultural College and Research Institute, Madurai

Field experiment was conducted at Agricultural College and Research Institute, Madurai during Rabi 2010-2011 to study the effect of weed competition in direct seeded rice under aerobic condition. In this study, post-emergence mixture of fenoxaprop + (chlorimuron + metsulfuron) on 30 DAS (T_6) provided a broad spectrum of weed control by significantly reducing weed density and dry weight at 60 DAS and resulted in significantly higher weed control efficiency and lower nutrient depletion by weeds. Post-emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS (T_9) resulted in significantly higher nutrient uptake and grain yield of aerobic rice.

Key words: Direct seeded rice, weed competition, weed density, weed dry weight, Weed Control Efficiency.

In direct seeded rice both crop and weeds emerge simultaneously as a result crop suffers, starting from early period of growth. This in turn reduces the rice yield (Choubey *et al*., 2001). The greatest weed pressure and crop weed competition occur in upland and aerobic rice and least in transplanted irrigated and rainfed lowland rice. However, aerobic systems are subjected to much higher weed pressure than conventional puddled transplanting systems. The crop weed competition starts with nutrient depletion to suppression of plant height (Ramamoorthy *et al.,* 1974). Aerobic soil conditions and dry tillage practices, beside alternate wetting and drying conditions are conductive for germination and growth of highly competitive weeds, which cause grain yield loss of 50-91 per cent (Singh *et al.,* 2006). Therefore, weeds are the most severe constraints to aerobic rice production and timely weed management is crucial to increase the productivity of aerobic rice.

Materials and Methods

Field experiment was conducted at Agricultural College and Research Institute, Madurai during Rabi 2010-2011. An investigation was carried out on weed management in rice with twelve treatments in randomized block design (RBD) with three replications. The test variety was ADT 47. The weed management treatments imposed were T_1 – Pre–emergence application of Pyrazosulfuron (25 g ha^{-1}) on 3 - 7 DAS, T_2 – pre–emergence application of Pertilachlor – S (750 ml ha^{-1}) on 0 - 5 DAS, T_3 – post–emergence application of Cyhalofop butyl (90 ml ha^{-1}) on 25 DAS, T_4 – post–emergence application of Fenoxaprop (60 ml ha^{-1}) on 30 DAS, T_5 – post–emergence application of Cyhalofop butyl + (Chlorimuron + Metsulfuron) (90 ml + 20 g ha^{-1}) on 25 - 30 DAS, T_6 – post–emergence application of Fenoxaprop + (Chlorimuron + Metsulfuron) (60 ml + 20 g ha^{-1}) on 25 - 30 DAS, T_7 – post–emergence application of Azimsulfuron (35 g ha^{-1}) on 20 DAS, T_8 – post–emergence application of Bispyribac sodium (25 ml ha^{-1}) on 20 DAS, T_9 – post–emergence application of Fenoxaprop + Ethoxysulfuron (60 ml + 15 g ha^{-1}) on 0 - 5 DAS, T_{10} – application of Oxyfluorfen + 2, 4-D (300 ml + 500 g ha^{-1}) on PE + 30 DAS, T_{11} – two hand weeding at 15 and 35 DAS and T_{12} – unweeded control. The observations on weeds and crop yield were recorded and statistically analysed. The weed density and DMP were subjected to square root transformation. The nutrient depletion by weeds and nutrient uptake by rice were analysed using the samples collected from experimental plots.

Results and Discussion

Weed flora

The weed flora observed in the experimental field during the course of study consisted of grasses, sedges and broad leaved weeds. The predominant category of weed was broad leaved weeds followed by grasses and sedges. The weed flora mainly consisted of *Echinochloa colonum, Panicum javanicum, Chloris barbata, Dactyloctenium aegyptium* and *Panicum repens* under grasses, *Cyperus iria* under sedges and *Cleome viscosa, Corchorus olitorius, Euphorbia hirta, Merremia emarginata, Portulaca oleracea* and *Trianthema protulacastrum* under broad leaved weeds.

Effect on weed

Post-emergence mixture of fenoxaprop + (chlorimuron + metsulfuron) on 30 DAS (T_6)

*Corresponding author email: krchandiran@gmail.com

significantly lowered the total weed density and dry weight to 18.00 m^{-2} and 53 kg ha^{-1}, respectively. This was followed by sequence application of pre-emergence oxyfluorfen and post-emergence 2, 4-D on 30 DAS (T_{10}) and post-emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS (T_9). But post-emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS (T_9) was comparable with post-emergence bispyribac sodium alone on 20 DAS (T_8) (Table 1).

Post-emergence mixture of fenoxaprop + (chlorimuron + metsulfuron) on 30 DAS (T_6) registered higher WCE (93.50%). This treatment also significantly lowered the nutrient depletion by weeds at harvest than farmers' practice of hand weeding twice. It might be due to the use of mixture of herbicides which showed broad spectrum control of weeds. This is evident from earlier result that fenoxaprop ethyl at 50 g ha^{-1} could be used as post-emergence spray for the control of grassy weeds

Table 1. Effect of herbicides on total weed density, dry weight at 60 DAS, WCE, nutrient depletion by weed, nutrient uptake by rice and grain yield of aerobic rice

Treatment	*Total weed density (No. m^{-2})	*Total weed dry weight (kg ha^{-1})	Weed control efficiency (%)	Nutrient depletion by weeds (Kg ha^{-1})			Nutrient uptake of aerobic rice (Kg ha^{-1})			Grain yield (kg ha^{-1})
				NP_2O_5		K_2O	N	P_2O_5	K_2O	
T_1 - Pre-emergence pyrazosulfuron alone on 3 DAS	9.10 (82.35)	15.24 (232)	70.26	7.53	1.46	5.12	51.29	7.40	51.53	3795
T_2 - Pre-emergence pretilachlor - S alone on 3 DAS	9.72 (94.00)	16.49 (271)	66.05	8.96	1.97	6.34	50.65	7.80	51.93	3743
T_3 - Post-emergence cyhalofop butyl alone on 25 DAS	8.48 (71.44)	14.48 (209)	74.20	6.49	1.94	6.33	51.12	7.00	52.31	3860
T_4 - Post-emergence fenoxaprop alone on 30 DAS	7.92 (62.36)	11.81 (139)	77.48	4.42	1.56	4.25	51.41	7.18	52.60	4065
T_5 - Post-emergence mixture of cyhalofop butyl + (chlorimuron + metsulfuron) on 30 DAS	7.67 (58.33)	11.06 (122)	78.93	4.17	1.31	4.10	51.57	7.80	53.50	4118
T_6 - Post-emergence mixture of fenoxaprop + (chlorimuron + metsulfuron) on 30 DAS	4.30 (18.00)	7.30 (53)	93.50	3.43	0.89	3.03	55.80	8.10	58.15	4345
T_7 - Post-emergence azimsulfuron alone on 20 DAS	6.28 (39.00)	9.80 (96)	85.92	3.91	0.98	3.56	59.37	8.75	63.16	5153
T_8 - Post-emergence bispyribac sodium alone on 20 DAS	5.24 (27.00)	9.40 (88)	90.25	3.76	0.98	3.45	64.98	9.72	63.34	5805
T_9 - Post-emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS	5.24 (27.00)	9.33 (87)	90.25	3.68	0.95	3.14	68.23	9.74	64.63	6278
T_{10} - Pre-emergence oxyfluorfen and post emergence 2, 4-D on 30 DAS	4.56 (20.34)	8.93 (79)	92.66	3.62	0.91	3.08	55.86	7.84	58.14	4262
T_{11} - Two hand weeding at 15 and 35 DAS	7.01 (48.66)	10.25 (105)	82.43	3.67	1.15	3.18	55.99	8.55	62.16	4508
T_{12} - Unweeded control	16.66 (276.91)	32.20 (1036)	-	19.77	5.28	16.20	30.24	4.42	26.48	2105
SEd	0.12	0.20		0.18	0.042	0.15	2.02	0.29	2.00	172
CD=(0.05)	0.25	0.42		0.38	0.10	0.31	4.20	0.61	4.14	357

(Samar Singh *et al.,* 2008b). Another result with metsulfuron-methyl + chlorimuron-ethyl at 4 g ha^{-1} provided excellent control of broad-leaved weeds and sedges (Singh and Tewari, 2005). Tiwari *et al.* (2010) found that fenoxoprop at 0.06 kg ha^{-1} mixed with ethoxysulfuron at 0.015 kg ha^{-1} as post emergence showed the highest weed control efficiency.

Nutrient depletion by weeds in aerobic rice

Post-emergence mixture of fenoxaprop + (chlorimuron + metsulfuron) on 30 DAS (T_6) controlled the weed growth effectively and resulted in significantly lower nutrient depletion by weeds. This was followed by sequential application of pre-emergence oxyfluorfen and post-emergence 2, 4-D on 30 DAS (T_{10}) and Post-emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS (T_9) (Table 1). It might be due to the lowered weed density, dry weight and higher WCE achieved in the above treatments. These treatments had effective weed control at early stage of crop weed competition.

Mukherjee and Singh (2005) stated that this was due to less weed competition and low weed biomass production. The nutrient depletion in post-emergence mixture of fenoxaprop + (chlorimuron + metsulfuron) on 30 DAS (T_6) and sequential application of pre-emergence oxyfluorfen and post-emergence 2, 4-D on 30 DAS (T_{10}) were lower by 3.43, 0.89, 3.03 and 3.62, 0.91, 3.08 NPK kg ha^{-1} compared to unweeded check (T_{12}), respectively.

Effect of weed competition on nutrient removal by weeds

Generally, weed competition under aerobic rice is higher. The greatest weed pressure and crop–weed competition occur in upland and aerobic rice (Rao *et al.,* 2007). Nutrient depletion by weeds in unweeded condition of aerobic rice showed higher removal of 19.77, 5.28, 16.20 kg NPK ha^{-1}. This removal was greater by 3.67, 1.15, 3.18 and 3.43, 0.89, 3.03 kg NPK ha^{-1} over farmers practice of hand weeding twice (T_{11}) and best weed management practice of post-emergence mixture of fenoxaprop + (chlorimuron + metsulfuron) on 30 DAS (T_6), respectively. This clearly indicated the level of weed competition for nutrients, which inturn greatly reduced the uptake of NPK in rice. The nutrient uptake by rice in unweeded check was very much reduced by 25.75, 4.13, 35.68 and 25.56, 3.68, 31.67 kg NPK ha^{-1} compared to farmers practice of hand weeding twice (T_{11}) and best weed management practice of post-emergence mixture of fenoxaprop + (chlorimuron + metsulfuron) on 30 DAS (T_6) respectively. Nutrient depletion by weeds and nutrient uptake by crop are inversely related. Weeds in wet seeded rice removed significantly higher quantities of N, P and K nutrients due to higher weed density and weed dry matter (Thirumurugan *et al.,* 1998).

Nutrient uptake of direct seeded aerobic rice

Post-emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS (T_9) resulted in significantly higher nutrient uptake by rice. The nutrient uptake in this treatment (T_9) was 12.24, 1.19, 2.47 and 17.58, 1.94, 12.70 kg NPK ha^{-1} higher than farmers practice of hand weeding twice and pre-emergence pretilachlor alone, respectively. This was due to the lower weed density, dry weight and efficient weed control noticed at early stage of crop weed competition with broad spectrum herbicide mixture usage. This lowered the nutrient removal by weeds. The reduced weed growth and consequently decreased nutrient depletion enabled more nutrient uptake by the rice crop in the above promising weed management practices (Table 1). This is in conformity with the findings of Mohamed Ali and Sankaran (1986) who reported increased N, P and K uptake by rice through effective weed management practices. The weed free condition was created by the herbicide which increased the nutrient uptake of crop. These results are in accordance with the findings of Rajkhowa *et al.* (2001).

Post-emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS (T_9) recorded more nutrient uptake than post-emergence mixture of fenoxaprop + (chlorimuron + metsulfuron) on 30 DAS (T_6) which could be due to more DMP of rice and might also be due to long term weed control.

Yield of aerobic rice

Post-emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS (T_9) recorded significantly higher grain yield. The best treatment post-emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS (T_9) recorded additional grain yield of 1770, 1933 and 2535 kg ha^{-1} compared to farmers practice, post-emergence mixture of fenoxaprop + (chlorimuron + metsulfuron) on 30 DAS (T_6) and pre-emergence application of pretilachlor alone. This showed the superiority of the treatment T_9 over all other common weed management practices of direct seeded rice. It might be due to the broad spectrum weed control, reduced weed growth and higher weed control efficiency at early stage crop weed competition caused by the mixture of herbicides. This also increased NPK uptake by crop which inturn increased the growth and yield attributes and yield of crop (Table 1).

Effect of weed competition in yield of direct seeded aerobic rice

The grain yield in unweeded check was reduced by 2403 kg ha^{-1} (66.47 %) and 4173 (53.30 %) kg ha^{-1} compared to farmers practice of hand weeding twice (T_{11}) and best treatment of post-emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS (T_9), respectively. This is in line with the results of Samar Singh *et al.* (2008a) who reported loss of grain yield in aerobic rice due to weed competition ranging from 38 to 92 per cent. Because of greater weed competition for nutrients the uptake of nutrients in crop was reduced which inturn affected the growth parameters, DMP and yield attributes. This ultimately affected the grain yield production.

References

Choubey, N.K., Kolhe, S.S. and Tripathi, R.S. 2001. Relative performance of Cyhalofop- butyl for weed control in direct seeded rice. *Indian J. Weed Sci.,* **33**: 132-135.

Mohamed Ali, A. and Sankaran, S. 1986. Effect of Butachlor, Thiobencarb and Pendimethalin on *Echinochloa colona* in dry seeded bunded rice (var.) Bhavani. *Madras Agric. J.,* **73**: 287-293.

Mukherjee, D. and Singh, R.P. 2005. Effect of low doses of herbicides on weeds, nutrient uptake and yield of transplanted rice. Institute of Agricultural Science, Varanasi, UP. *Indian. J. Agron.,* **50:** 194-196.

Rajkhowa, D.J., Gogoi, A.K. and Kandali, R. 2001. Effect of weed control and nutrient management practices in rice. *Indian J. Weed Sci.,* **33**: 41-45.

Ramamoorthy, R., Kulandaisamy, S. and Sankaran, S. 1974. Effect of propanil on weed growth and yield of IR 20 rice under different seeding methods and rates. *Madras Agric. J.,* **61**: 307-312.

Rao, A.N., Johnson, D.E., Sivaprasad, B., Ladha, J.K. and Mortimer, A.M. 2007. Weed management in direct-seeded rice. *Adv. Agron.,* **93**: 153–257.

Samar Singh, Ladha, J.K., Gupta, R.K., Lav Bhushan and Rao, A.N. 2008a. Weed management in aerobic rice systems under varying establishment methods, Rice-Wheat Consortium for the Indo-Gangetic Plains, CIMMYT-India, *Crop Prot.,* **27**: 660-671.

Samar Singh, Chhokar, R.S. and Sharma, R.K. 2008b. Weed management in direct seeded rice. RRS, CCSHAU, Haryana. *Indian Fmg.,* p. 7-10.

Singh, D.K. and Tewari, A.N. 2005. Effect of herbicides in relation to varying water regimes in controlling weeds in direct seeded puddled rice. *Indian J. Weed Sci.,* **37**: 193-196.

Singh, S., Bhushan, L., Ladha, J.K., Gupta, R.K., Rao, A.N. and Sivaprasad, B. 2006. Weed management in dry-seeded rice (*Oryza sativa*) cultivated on furrow irrigated raised bed planting system. *Crop Prot.,* **25**: 487-495.

Thirumurugan, V., Balasubramanian, R. and Thanasekaran, T. 1998. Influence of field preparation, planting methods and weed management on rice. *Pestology,* **22**: 11-16.

Tiwari, R.B., Pandey, T.D. and Nandeha, K.L. 2010. Weed management studies in direct-seeded rice. In: Biennial conference of Indian society of weed science on Recent Advances in Weed Science Research-2010, February 25-26,Indira Gandhi Krishi Vishwa vidyalaya, Raipur. P-30.

Received: November 30, 2011; Accepted: March 6, 2012