Effect of herbicides and cultural treatments on uptake of major nutrients by crop and weeds under aerobic rice cultivation

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Aerobic rice production system is gaining importance for increased productivity and reduced water usage and is expected to occupy 10-15 per cent of the total area in India. The major constrain to get higher yield in aerobic rice is weed infestation which cause around 80-90 per cent reduction in grain yield. Weeds that grow with the crop deplete considerable amount of costly and native plant nutrients, which results in lower crop yields. Effective control of weeds is therefore important to increase the aerobic rice productivity. Keeping the above information in view, the present investigation was under taken to study the effect of weed control treatments on losses of nutrients caused by weeds in aerobic rice.

The experiment was conducted during *kharif* season of 2005, at Agriculture College, V.C. Farm, Mandya. The soil was sandy loam in texture and slightly acidic in reaction (6.76) with low available nitrogen, medium available phosphorus and available potassium. The organic carbon content was medium (0.39 %). Rasi (IET-1444) a popular medium duration variety was sown in mid August with a spacing of 25 cm X 25 cm. Experiment included twelve treatments consisted of three doses, each of butachlor (0.75, 1.00 and 1.25 Kg a. i. ha^{-1}), pyrazosulfuron ethyl (20, 25 and 30 g a.i. ha^{-1}) and clomozone + 2,4-DEE (0.75, 1.00 and 1.25 litre ha^{-1}), two hand weeding at 20 and 45 DAS, two inter cultivation at 20 and 45 DAS and weedy check were laid out in Randomized Complete Block Design (RCBD) with three replications. Pre-emergence application of herbicides was done at one day after sowing. Irrespective of the treatments one intercultural operation was given at 45 DAS. Since the data on weed count and weed dry weight showed high variation the data was subjected to square root transformation using the formula $\sqrt{x+0.5}$ and the statistical analysis was done. The composite plant and weed dry matter samples at harvest were oven dried and ground into fine powder using Wiley mill and used for estimating nitrogen, phosphorus and potassium uptake by the plant and weed samples.

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The various observations made both on weeds and crop namely, weed density and dry weight of weeds and besides, growth, yield and yield parameters of rice as influenced by various treatments are presented and discussed here under.

Effect on weeds

The major weed flora observed in experimental plots were; Digitaria *sanguinalis, Cynodon dactylon, Panicum repens* and *Dactyloctenium aegyptium* among narrow leaved weeds, *Ageratum conyzoides, Commelina benghalensis, Euphorbia hirta, Tridax procumbens, Phyllanthus niruri and Celosia argentea* among broad leaved weeds and *Cyperus rotundus* and *Cyperus iria* among sedges.

Hand weeding at 20 and 45 DAS excelled with a lowest weed population of weeds (43.67 m^{-2}) and dry weight of weeds (3.42 g 0.25 m^{-2}) among the various treatments. Among the various herbicides lowest weed population (48 m^{-2}) and dry weight of weeds (3.94 g 0.25 m^{-2}) were observed with pyrazosulfuron ethyl @ 30 g a.i. ha^{-1} followed by clomozone + 2,4-DEE @ 1.25 litre ha^{-1}. The highest weed population (366.33 m^{-2}) and dry weight of weeds (43.11 g 0.25 m^{-2}) were observed with unweeded check. However, the rest of the herbicides were in between with weed population and dry weight of weeds ranging from 68 to 142 m^{-2} and 9.93 to 22.16, g 0.25 m^{-2}, respectively. In general, higher doses of various herbicides expressed lower weed population and dry weight of weeds. Intercultivation at 20 and 45 DAS had no significant influence on control of weeds due to heavy rainfall during imposition of treatments. The weed control efficiency was higher with hand weeding (92.07 %) and pyrazosulfuron ethyl @ 30 g a.i. ha^{-1} (90.86 %).

Effect on nutrient uptake by weeds

Nutrient uptake by weeds was higher in unweeded check (26.33, 13.53 and 27.08 kg N, P and K ha^{-1}, respectively) followed by butachlor @ 0.75 kg

a.i. ha^{-1} (Table 1). This was due to no or poor control of weeds that facilitates the weeds to utilize available nutrients to the maximum extent. Similar increase in nutrient uptake by increase in weed competition also reported by Biswas and Sattar (1991). The weed control treatments brought down uptake of these nutrients by weeds. The nutrient losses by weeds was reduced to (1.67, 1.16 and 1.01 Kg N, P and K ha^{-1}, respectively) in hand weeding at 20 and 45 DAS among various treatments. Among herbicides treatments, pyrazosulfuron ethyl @ 30 g a.i. ha^{-1} recorded lower uptake of nutrients by weeds (2.80, 1.54 and 2.57 Kg N, P and K ha^{-1}, respectively) followed by clomozone + 2,4-DEE @ 1.00 litre ha^{-1} because these treatments recorded lower dry weight of weeds due to effective control of weeds during active crop growth period which helps in minimizing the crop weed competitions and helps the crop to utilize available nutrients to the maximum extent. . Rana *et al*., 2002, also reported reduction in nutrient uptake by weeds due to weed control treatments in direct seeded rice.

Effect on nutrient uptake by rice

Among all the treatments the nutrient uptake by crop was higher in hand weeding at 20 and 45 DAS (97.16, 51.99 and 78.57 kg N, P and K ha^{-1}, respectively) (Table 2). It was on par with herbicide treatment pyrazosulfuron ethyl @ 30 g a.i. ha^{-1}. Among herbicides treatments, pyrazosulfuron ethyl @ 30 g a.i. ha^{-1} recorded significantly higher nutrient uptake by rice (95.27, 50.39 and 77.83 kg N, P and K ha^{-1}, respectively) followed by clomozone + 2,4-DEE @ 1.00 liter ha^{-1} (Table 1). This increased nutrient uptake by these treatments was mainly due to better control of weeds during active growth stage leads to reduced weed dry weight, which helps in minimizing the crop weed competition and help the crop to utilize the entire available nutrients to the maximum extent and leads to better crop growth. These results are in line with, Moorthy and Mitra (1991), Bhagawan Sahai and Bhan (1992), Chandrakar and Chandrakar (1992), Rana and Angiras (1999) and Rana *et al*. (2002). While unweeded check recorded significantly lower nutrient uptake by rice (16.65, 9.01 and 10.36 Kg N, P and K ha^{-1}, respectively) due to greater competitions offered by weeds for available nutrients throughout crop growth period suppressed the crop and severely affecting the plant growth.

Effect on crop growth and yield parameters

In general all the weed control treatments registered significantly higher plant height and dry matter production than the weedy check. Hand weeding at 20 and 45 DAS recorded significantly taller plant height and higher dry matter production (72.53 cm and 66.25 g $hill^{-1}$, respectively) among the various treatments. It was statistically on par with pyrazosulfuron ethyl @ 30 g a.i. ha^{-1} (71.53 cm and 65.37 g $hill^{-1}$, respectively). This increase in growth parameters in these treatments owing to effective weed control during active crop growth period and reduced the nutrients uptake by weeds and gave better environment for development growth attributing parameters. Earlier workers like Sharma *et al*. 2004 and Moorthy 2002 also reported similar results in direct seeded rice. Unwedded check registered significantly least plant height and dry matter production (52.33cm and 16.58 g $hill^{-1}$, respectively) as a consequence of severe competition of rice plant with weeds for available nutrients.

The yield attributing parameters *viz*, number of effective tillers per hill, panicle length, filled grains per panicle and 1000 grain weight was found significantly higher with two hand weeding at 20 and 45 DAS (20, 23.67 cm, 132.73 and 24.93 g, respectively) and was remaining statistically on par with pyrazosulfuron ethyl @ 30 g a.i. ha^{-1}. Among the various herbicides, pyrazosulfuron ethyl @ 30 g a.i. ha^{-1} was recorded significantly higher effective tillers per hill (19.3), panicle length (23.30 cm), filled grains per panicle (132.27) and 1000 grain weight (24.83 g) followed by clomozone + 2,4-DEE @ 1.25 litre ha^{-1}. The increase in yield attributing parameters in above mentioned treatments was mainly due to better crop growth. In general higher doses of various herbicides expressed higher growth and yield attributing characters as compared to their lower doses due to their higher weed control efficiency except clomozone + 2,4-DEE where, higher dose recorded lower growth and yield parameters as compared to its middle dose because of its phytotoxicity. The significantly lowest growth and yield attributing parameters among the treatments were observed with unweeded check owing to sever crop weed competitions throughout crop growth period.

Effect on yield

All the weed control treatments registered significantly higher yield than weedy check (Table 2). The highest grain and straw yield among the treatments was recorded under hand weeding at 20 and 45 DAS (5.07 t ha^{-1} and 5.53 t ha^{-1}). It was on par with pyrazosulfuron ethyl @ 30 g a.i. ha^{-1}. Pyrazosulfuron ethyl @ 30 g a.i. ha^{-1} recorded significantly highest grain and straw yield (5.0 and 5.47 t ha^{-1}, respectively) followed by clomozone + 2,4-DEE @ 1.25 litre ha^{-1}. This increase in yield was mainly attributed to higher weed control efficiency during early growth stage of crop. Due to its higher weed control efficiency competition between crop and weeds for nutrients was minimized and made the crop plants to utilize available nutrients more efficiently

throughout crop growth period which in turn positively influenced the grain and straw yield by improving yield components *viz*, number of effective tillers per hill, panicle length, filled grains per panicle and 1000 grain weight and better yield components in these treatments is a consequence of better crop growth *viz*, plant height and dry matter production. The results are similar to earlier workers like, Budhar *et al*. (1991), Moorthy (1997b) and Moorthy (2002). Unwedded check recorded 82.84 and 82.60 per cent reduction in grain yield and 75.91 and 75.69 per cent reduction in straw yield as compared to hand weeding at 20 and 45 DAS and pyrazosulfuron ethyl @ 30 g a.i. ha-1. This was due to less number of effective tillers per hill, panicle length, filled grains per panicle and 1000 grain weight. Greater competitions offered by weeds for available nutrients throughout crop growth period suppressed the crop, severely affecting plant height and dry matter production per hill led to the poor yield components and thus lower grain yield. Howere, the rest of the herbicides in between with grain and straw yield 2.76 to 4.16 ha^{-1} and 3.71 to 4.90 ha^{-1}, respectively. In general, lower doses of various herbicides and intercultivation at 20 and 45 DAS expressed lower grain and straw yield due to poor control of weeds.

The above study concludes that hand weeding at 20 and 45 DAS found effective in control of weeds and recorded lower weed population and dry weight among various treatments. It was on par with herbicide treatment pyrazosulfuron ethyl @ 30 g a.i. ha^{-1}. The growth and yield attributing characters were recorded higher with hand weeding at 20 and 45 DAS howere, on par with pyrazosulfuron ethyl @ 30 g a.i. ha^{-1}. The nutrient uptake by weeds was higher in unweeded check followed by butachlor 0.75 Kg a.i. ha^{-1}. While lowest in hand weeding at 20 and 45 DAS and pyrazosulfuron ethyl @ 30 g a.i. ha^{-1}. The nutrients uptake by rice was highest in hand weeding at 20 and 45 DAS and was on par with pyrazosulfuron ethyl @ 30 g a.i. ha^{-1}. Hand weeding at 20 and 45 DAS recorded significantly higher grain yield and was on par with herbicide treatment pyrazosulfuron ethyl @ 30 g a.i. ha^{-1}.

REFERENCES

Bhagawan S., and Bhan, V. M. 1992. Competition for nitrogen between weeds and drilled rice. Effect of time of weed control. *Ind. J. Weed Sci*., **24** : 47-51.

Biswas, S. B. and Sattar, S. A. 1991. Effect of nitrogen uptake by weeds on rice yield. *Int. Rice Res. News Letter*, **16** : 16.

Budhar, M. N., Munoli, K. S. S. and Ramaswami, C. 1991. Weed control in direct sown rice under puddled condition. *Ind. J. Weed Sci*., **23** ; 76-82.

Chandrakar, B. L. and Chandrakar, G. 1992. Rice weed competition for nutrient as influenced by seedling methods and weed control treatments. *Ind. J. Weed Sci*., **24** : 30-33.

Moorthy, B.T.S. 1997b. Chemical weed control in puddle seeded rice, *Oryza*, **29**: 54-58.

Moorthy, B.T.S. and Mitra, B. N. 1991. Influence of seeding densities and weed management practices on the performance of upland rice. *Thai J. Agric. Sci*., 24:19.

Moorthy, B.T.S. 2002. Evaluation of pyrazosulfuron ethyl alone and in combination with molinate for controlling weeds in rainfed direct seeded low land rice. I*nd. J. Weed Sci*., **34**: 79-80.

Rana, S.S. and Angiras, N. N. 1999. Influence of integrated weed management practices on weed competition for nutrient in puddle-sown rice. *Ind. J. Weed Sci*., **31**: 161-63.

Rana, S.S., Angiras, N.N. and SHARMA, S.W. 2002. Effect of herbicides and inter culture on nutrient uptake by puddle seeded rice and associated weeds. *Ind. J. Weed Sci*., **33** : 70-73.

Table-1: Effect of weed control treatments on weed growth parameters and nutrient uptake by weeds (at harvest)

Treatments	Weed population (No. m^{-2})	Weed dry weight (g 0.25 m^{-2})	Nutrient uptake by weeds (Kg ha^{-1})		
			N	P	K
T_1: Butachlor @ 0.75 Kg a.i. ha^{-1}	11.93 (142.00)	4.82 (22.16)	13.37	10.49	11.03
T_2: Butachlor @ 1.00 Kg a.i. ha^{-1}	9.30 (88.33)	4.00 (14.59)	9.20	6.59	6.19
T_3: Butachlor @ 1.25 Kg a.i. ha^{-1}	8.39 (70.67)	3.54 (11.58)	8.63	5.53	5.01
T_4: Pyrazosulfuron ethyl @ 20 g a.i. ha^{-1}	9.66 (93.33)	3.96 (14.79)	13.27	6.84	7.23
T_5: Pyrazosulfuron ethyl @ 25 g a.i.ha^{-1}	8.27 (68.00)	3.23 (9.93)	8.17	4.33	3.99
T_6: Pyrazosulfuron ethyl @ 30 g a.i.ha^{-1}	6.96 (48.00)	2.10 (3.94)	2.80	1.54	2.57
T_7: Clomozone + 2,4 - DEE (RM) @ 0.75 lit. ha^{-1}	9.96 (99.67)	4.30 (17.50)	12.72	8.50	11.68
T_8: Clomozone + 2,4 - DEE (RM) @ 1.00 lit. ha^{-1}	8.39 (70.66)	3.57 (11.58)	7.90	5.29	6.15
T_9: Clomozone + 2,4 - DEE (RM) @ 1.25 lit. ha^{-1}	8.08 (65.33)	3.25 (9.40)	7.50	4.24	4.29
T_{10}: Two IC at 20 & 45 DAS	9.40 (88.34)	4.18 (16.73)	9.53	7.43	9.05
T_{11}: Two HW at 20 & 45 DAS	6.66 (43.67)	1.86 (3.42)	1.67	1.16	1.01
T_{12}: Weedy check	19.19 (366.33)	6.67 (43.11)	26.33	13.53	27.08
S.Em. (±)	**0.507**	**0.177**	**0.428**	**0.473**	**0.551**
LSD (P=0.05)	**1.484**	**0.519**	**0.605**	**0.668**	**0.778**

Values in the parenthesis are original values

Table-2: Effect of weed control treatments on yield and nutrient uptake of aerobic rice (at harvest)

Treatments	No. of effective tillers $hill^{-1}$	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Nutrient uptake by rice (Kg ha^{-1})		
				N	P	K
T_1: Butachlor @ 0.75 Kg a.i. ha^{-1}	10.33	2.76	3.71	54.82	24.96	34.73
T_2: Butachlor @ 1.00 Kg a.i. ha^{-1}	15.60	3.37	4.16	67.32	30.67	42.27
T_3: Butachlor @ 1.25 Kg a.i. ha^{-1}	16.80	3.75	4.49	72.64	34.81	49.05
T_4: Pyrazosulfuron ethyl @ 20 g a.i. ha^{-1}	13.33	2.95	3.86	59.15	26.12	42.51
T_5: Pyrazosulfuron ethyl @ 25 g a.i.ha^{-1}	15.47	3.81	4.61	71.44	37.42	54.43
T_6: Pyrazosulfuron ethyl @ 30 g a.i.ha^{-1}	19.30	5.00	5.47	95.27	50.39	77.83
T_7: Clomozone + 2,4 - DEE (RM) @ 0.75 lit. ha^{-1}	13.13	2.96	3.79	56.23	26.44	38.25
T_8: Clomozone + 2,4 - DEE (RM) @ 1.00 lit. ha^{-1}	17.40	4.16	4.90	80.64	40.93	56.69
T_9: Clomozone + 2,4 - DEE (RM) @ 1.25 lit. ha^{-1}	16.57	3.81	4.56	75.66	37.48	52.00
T_{10}: Two IC at 20 & 45 DAS	15.13	3.23	4.07	64.02	30.72	39.78
T_{11}: Two HW at 20 & 45 DAS	20.00	5.07	5.53	97.16	51.99	78.57
T_{12}: Weedy check	4.67	0.87	1.33	16.65	9.01	10.36
S.Em. (±)	**0.573**	**0.167**	**0.163**	**0.785**	**0.792**	**1.012**
LSD (P=0.05)	**1.680**	**0.489**	**0.478**	**2.300**	**2.320**	**2.960**

RM: Ready Mix I.C.: Inter Cultivation H.W.: Hand Weeding a.i.: active ingredient