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Paper

## Economics and uptake of nutrients by crops and weeds as influenced by weed control practices in aerobic rice

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### ABSTRACT

A field experiment was conducted during *Kharif* 2009 at ZARS, V.C. Farm, Mandya to evaluate the different weed management practices in aerobic rice, with 4 herbicide formulations and combinations along with one intercultivation at 40 DAS, two hand weeding at 20 and 40 DAS, three intercultivation at 20, 40 and 60 DAS, weed free check and unweeded check. The results revealed that, application of bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> + one intercultivation at 40 DAS recorded significantly lower weed population and weed dry weight and higher grain yield (4804 kg ha<sup>-1</sup>) which was at par with bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> + one intercultivation at 40 DAS (4425 kg ha<sup>-1</sup>). The uptake of major nutrients by rice was higher in bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> + one intercultivation at 40 DAS which was at par with bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup>. While nutrient uptake by weeds was higher in unweeded check.

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**Key words :** Soil fertility, Productivity, Levels of NPK

## INTRODUCTION

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 constraint to get higher yield in aerobic rice is weed infestation which cause around 80-100% (Mishra and Singh, 2007) reduction in grain yield. Weeds that grow with the crop deplete considerable amount of plant nutrients, which results in lower crop yields. Nutrient depletion by weeds, besides other factors, depends on soil type and composition of weeds. Management of aerobic rice is, therefore, a very difficult task and would simultaneous approach on all these problems. 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.

## MATERIALS AND METHODS

A field experiment was conducted during *Kharif*

season of 2009, at Zonal Agricultural Research Station, V.C. Farm, Mandya district. The soil of the experimental site was red sandy loamy in texture and pH was normal (6.9). The soil was medium in available nitrogen (297.5 kg ha<sup>-1</sup>), available phosphorus (27.2 kg ha<sup>-1</sup>) and available potassium (174.3 kg ha<sup>-1</sup>). The organic carbon content was medium (0.59 %) in range. MAS-946-1 a popular medium duration variety was sown in July with a spacing of 25 cm x 25 cm. Experiment included twelve treatments consisted of T<sub>1</sub>= Butachlor (50 EC) @ 1.0 kg a.i ha<sup>-1</sup> as pre emergent herbicide, T<sub>2</sub>= Pyrazosulfuron ethyl (5 WP) @ 0.025 kg a.i ha<sup>-1</sup> as pre emergent herbicide, T<sub>3</sub>= Oxyfluorfen (23.5 EC) at 0.10 kg a.i ha<sup>-1</sup> as pre emergent herbicide, T<sub>4</sub>= Bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> as pre-emergent herbicide (pre mix formulation), T<sub>5</sub>= Butachlor (50 EC) @ 1.0 kg a.i ha<sup>-1</sup> as pre emergent + one intercultivation at 40 DAS, T<sub>6</sub>= Pyrazosulfuron ethyl (5 WP) @ 0.025 kg a.i ha<sup>-1</sup> as pre emergent + one intercultivation at 40 DAS, T<sub>7</sub>= Oxyfluorfen (23.5 EC) @ 0.10 kg a.i ha<sup>-1</sup> as pre emergent + one intercultivation at 40 DAS, T<sub>8</sub> = Bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> as pre -

emergent herbicide (pre mix formulation) + one intercultivation at 40 DAS, T<sub>9</sub>= Intercultivation at 20, 40, and 60 DAS, T<sub>10</sub>= Two hand weeding at 20 and 40 DAS, T<sub>11</sub>= Weed free check and T<sub>12</sub>= Unweeded check were laid out in Randomized Complete Block Design (RCBD) with three replications. Pre-emergence application of herbicides was done at three day after sowing. Since the data on weed count and weed dry weight showed high variation, the data were 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 rice and weed samples as per the standard methods.

## RESULTS AND DISCUSSION

The results obtained from the present investigation have been discussed in the following sub heads :

### Effect on weeds:

The predominant weed flora observed in the experimental field in association with the aerobic rice includes monocot weeds viz., *Echinochloa colonum*, *Digitaria marginata*, *Commelina benghalensis* and *Dactyloctenium aegyptium*. Among dicot weeds *Ageratum conyzoides*, *Cyanotis axillaris*, *Croton bonplandianum*, *Spilanths acmella*, *Acanthospermum*

*hispidum*, *Mollugo disticha*, *Protulaca oleracea*, *Phyllanthus niruri*, *Celosia argentia*, *Protulacae oleraceae* and *Aeschynomene indicia* and among sedges *Cyperus rotundus* and *Cyperus esculentus*.

Among different weed control treatments, bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> + one intercultivation at 40 DAS excelled with a lowest dry weight of weeds (2.32 g/ 0.25 m<sup>2</sup>) which was at par with bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> (3.54 g/ 0.25 m<sup>2</sup>). Whereas, unweeded check recorded significantly higher weed dry weight (46.4 g/ 0.25 m<sup>2</sup>). The reduced weed dry weight in these treatments was mainly due to effective control of all monocots, dicots and sedges at early stages and as a consequence recorded lower total weed population at all growth stages. The results are in conformity with findings of Saha (2005).

### Effect on nutrient uptake by rice:

Among different weed control treatments bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> (pre mix formulation) applied at 3 DAS + one intercultivation at 40 days after sowing recorded higher NPK uptake (107.70 N, 19.28 P and 77.71 K, kg ha<sup>-1</sup>, respectively) which was at par with bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> (pre mix formulation) applied at 3 DAS (99.30 N, 17.94 P and 71.76 K kg ha<sup>-1</sup>, respectively). Higher nutrient uptake of crop in these treatments was mainly due to lower weed

**Table 1: Effect of weed control treatments on weed growth parameters and nutrient uptake by weeds**

Treatments	Weed dry weight (g/0.25 m <sup>2</sup> )	Nutrient Uptake (kg ha <sup>-1</sup> )		
		N	P	K
T <sub>1</sub> : Butachlor (50EC) at 1.0 kg a.i ha <sup>-1</sup>	3.68 (13.1)	35.83	12.63	32.33
T <sub>2</sub> : Pyrazosulfuron ethyl (5WP) at 0.025kg a.i ha <sup>-1</sup>	2.54 (6.00)	26.95	7.62	14.40
T <sub>3</sub> : Oxyfluorfen (23.5EC) at 0.10kg a.i ha <sup>-1</sup>	3.34 (10.7)	31.58	11.33	29.75
T <sub>4</sub> : Bensulfuron methyl + Pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha <sup>-1</sup> as pre – emergence herbicide (pre mix formulation).	2.01 (3.54)	11.57	4.63	8.38
T <sub>5</sub> : Butachlor (50EC) at 1.0 kg a.i ha <sup>-1</sup> + One IC at 40DAS.	2.62 (6.39)	22.27	7.77	14.22
T <sub>6</sub> : Pyrazosulfuron ethyl (5WP) at 0.025kg a.i ha <sup>-1</sup> + one I.C. at 40DAS	2.12 (4.00)	14.91	5.39	9.48
T <sub>7</sub> : Oxyfluorfen (23.5EC) at 0.10 kg a.i ha <sup>-1</sup> + one I.C. at 40 DAS.	2.49 (5.70)	18.05	6.73	12.45
T <sub>8</sub> : Bensulfuron methyl + Pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha <sup>-1</sup> as pre – emergence herbicide (pre mix formulation) + one IC at 40DAS.	1.68 (2.32)	6.20	3.07	5.07
T <sub>9</sub> : Intercultivation (IC) at 20, 40, and 60 DAS.	2.37 (5.11)	30.69	7.68	27.73
T <sub>10</sub> : Two Hand weeding at 20 and 40 DAS.	2.71 (6.89)	30.36	8.12	21.77
T <sub>11</sub> : Weed free check	0.93 (0.36)	2.54	1.65	2.05
T <sub>12</sub> : Unweeded check.	6.82 (46.4)	58.63	18.98	49.40
S. E. ±	0.153	2.31	0.55	1.50
C.D. (P = 0.05)	0.449	6.78	1.62	4.40

Values in the parenthesis are original values

population and weed dry weight which helped the crop to grow well and absorb more nutrients from the soil. These results are in line with Sahai and Bhan (1992), Rana *et al.* (2002), Bhanu Rekha *et al.* (2002) and Singh *et al.* (2005). (Table 2).

**Effect on nutrient uptake by weeds:**

Unweeded check had recorded maximum uptake of nutrients by weeds (58.63 N, 18.98 P and 49.40 K, kg ha<sup>-1</sup>, respectively). This is due to no control of weeds which facilitates the weeds to utilize nutrient to the maximum extent. The nutrient uptake by crops was inversely proportional to nutrient uptake by weeds. Similarly increase in nutrient uptake by increase in weed competition also reported by Rana and Angiras (1999), Rana *et al.* (2002), Bhanu rekha *et al.* (2003), and Singh *et al.* (2005) (Table 1).

**Effect on yield:**

Among different weed control treatments bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> (pre mix formulation) applied at 3 DAS + one intercultivation at 40 days after sowing recorded higher grain yield and straw yield (4804 and 5470 kg ha<sup>-1</sup>, respectively) which was at par with bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> (pre mix formulation) applied at 3 DAS (4425 and 5020 kg ha<sup>-1</sup>, respectively). The increase in yield was mainly attributed to better control of weeds throughout the crop growth resulted in better availability of nutrients, moisture and light to the crop growth reflected through increased leaf area, number of productive tillers per hill, number of filled spikelets per panicle, panicle weight and test weight. These results are in conformity with the findings of Saha (2005 and 2009), Singh *et al.* (2005). Lower grain and straw yield was recorded in unweeded check (1074 and 1330 kg ha<sup>-1</sup>) owing to severe weed species which resulted in reduction in the magnitude of growth and yield components (Table 2).

**Economics of weed control treatments:**

The net returns and benefit cost ratio was maximum with bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> + one intercultivation at 40 DAS (Rs. 26815 ha<sup>-1</sup> and 2.29, respectively) followed by Bensulfuron methyl + Pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> (Rs. 23328 ha<sup>-1</sup> and 2.14, respectively).

The above study concludes that bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> + one intercultivation at 40 DAS was found effective in control of weeds and recorded lower weed population and dry

Treatments	Grain yield (kg/ha)		Straw yield (kg/ha)		N		P		K		Weed population (No./m <sup>2</sup> )		3C Ratio
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	
C <sub>1</sub>	1074	1330	11.81	14.96	1.10	0.33	1.00	0.33	1.00	0.33	1.00	0.33	1.00
C <sub>2</sub>	1074	1330	11.81	14.96	1.10	0.33	1.00	0.33	1.00	0.33	1.00	0.33	1.00
C <sub>3</sub>	1074	1330	11.81	14.96	1.10	0.33	1.00	0.33	1.00	0.33	1.00	0.33	1.00
C <sub>4</sub>	1074	1330	11.81	14.96	1.10	0.33	1.00	0.33	1.00	0.33	1.00	0.33	1.00
C <sub>5</sub>	4425	5020	44.25	50.20	4.425	5.020	4.425	5.020	4.425	5.020	4.425	5.020	4.425
C <sub>6</sub>	4425	5020	44.25	50.20	4.425	5.020	4.425	5.020	4.425	5.020	4.425	5.020	4.425
C <sub>7</sub>	4804	5470	48.04	54.70	4.804	5.470	4.804	5.470	4.804	5.470	4.804	5.470	4.804
C <sub>8</sub>	4804	5470	48.04	54.70	4.804	5.470	4.804	5.470	4.804	5.470	4.804	5.470	4.804
C <sub>9</sub>	4804	5470	48.04	54.70	4.804	5.470	4.804	5.470	4.804	5.470	4.804	5.470	4.804
C <sub>10</sub>	4804	5470	48.04	54.70	4.804	5.470	4.804	5.470	4.804	5.470	4.804	5.470	4.804
C <sub>11</sub>	4804	5470	48.04	54.70	4.804	5.470	4.804	5.470	4.804	5.470	4.804	5.470	4.804
C <sub>12</sub>	4804	5470	48.04	54.70	4.804	5.470	4.804	5.470	4.804	5.470	4.804	5.470	4.804
S.E.D.													
C.V. (%)													
C.D. (P 0.05)													

weight among various treatments. It was at par with herbicide treatment bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup>. The yield and yield attributing characters were recorded higher with bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> as + one intercultivation at 40 DAS however, which was at par with bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup>. The nutrient uptake by weeds was higher in unweeded check. The nutrients uptake by rice was higher in bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> + one intercultivation at 40 DAS and was at par with bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup>. bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup> + one intercultivation at 40 DAS recorded significantly higher grain yield and was at par with herbicide treatment bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg a.i ha<sup>-1</sup>.

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