INTERNATIONAL JOURNAL OF ADVANCED BIOLOGICAL RESEARCH

www.scienceandnature.org

EFFICACY OF PRE AND POST EMERGENT HERBICIDES ON GROWTH AND YIELD OF KHARIF AEROBIC RICE

Madhukumar, V., Kalyana Murthy, K.N., Sanjay, M.T., Prashanth, R., & Basavaraj Kumbar
Dept. of Agronomy, College of Agriculture, UAS, GKVK, Bangalore-560 065

ABSTRACT
A field trial was conducted during *kharif* 2010-11 at Main Research Station, Hebbal, University of Agricultural Sciences, Bangalore to study the efficacy of pre and post emergent herbicides on growth and yield of *kharif* aerobic rice. The results revealed that pre emergent application of bensulfuron methyl @ 60 g + pretilachlor @ 600 g a.i ha^{-1} recorded significantly higher plant height, dry matter production per hill, productive tillers per hill, No. of filled spikelets per panicle, grain and straw yield and lower total weed density and their dry weight followed by two hand weedings at 20 and 40 DAS and oxyfluorfen @ 90 g a.i. ha^{-1} as pre-emergent spray + 2, 4-DEE as post emergent spray @ 500 g a.i ha^{-1} at 25 DAS which were statistically on par with each other. Whereas, unweeded check registered significantly lower plant height, dry matter production per hill, productive tillers per hill, No. of filled spikelet's per panicle, grain and straw yield and higher total weed density and its dry weight.

KEY WORDS: Aerobic rice, pre emergent, post emergent.

INTRODUCTION

Aerobic rice refers to growing of rice in non-puddled and non-flooded condition. Aerobic rice is a new method of cultivating rice that requires less water than low land rice. It entails the growing of rice in aerobic soil with the use of external inputs such as supplementary irrigation, fertilizers besides aiming at high yields. In this method, land is brought to fine tilth under dry condition, the seeds are dibbled in definite row proportion with wider spacing and soil moisture regime is maintained almost around field capacity. With this method about 60 to 70 per cent of irrigation water is observed to be saved (Shanmuganathan, 2006). Weed infestation and competition is more severe in direct seeded aerobic rice as compared to transplanted rice, because of the reasons *viz.*, land is exposed during initial crop growth stages, aerobic soil conditions, dry tillage practices and alternate wetting and drying make the conditions more conducive for germination and growth of weeds. Direct seeded aerobic rice is highly infested with grasses, broad leaved weeds and sedges. Unlike transplanted rice early and timely weed control is essential in aerobic rice; otherwise the yield loss is to an extent of 82.00 per cent due to crop weed competition (Thimme Gowda, 2006). Among the agronomic requirements to improve the yield levels of aerobic rice timely weed control plays an important role. Traditional method of weed management practices are widely adopted for control of weeds in aerobic rice however, these practices are tedious, time consuming, labour intensive, costly and not possible to practice over an extensive area. Further, due to labour scarcity and high labour wages as a result of rapid industrialization and urbanization, traditional weed management practices are being impracticable. Herbicide usage for control of weeds in crop lands has been proved successful in many advanced countries and is now gaining importance in Indian agriculture. Chemical weed control is more economical, less time consuming, less expensive and provide early weed control and crop establishes in a weed free environment as a results it reduces the competition for light, space and nutrients. Several herbicides are available in the market and some new herbicides are continuously being introduced. But information on their usage under field conditions, suitability for aerobic rice and their concentrations for effective weed control of weeds is scarce. In view of the above facts, a field experiment was conducted.

MATERIALS AND METHODS

The field investigation was undertaken at Main Research Station, Hebbal, University of Agricultural Sciences, Bangalore during *Kharif* 2010. The soil of the experimental site was sandy loamy in texture and pH was normal (6.5). The soil was medium in available nitrogen (490 kg ha^{-1}), available phosphorus (24 kg ha^{-1}), available potassium (146 kg ha^{-1}) and organic carbon content was medium (0.75 %). A popular medium duration variety MAS-946-1 was sown in June with a spacing of 30 cm X 30 cm. The experiment consisted of 12 treatments laid out in randomized complete block design with three replications consisting five pre-emergent herbicides, two post emergent herbicides, two combination of pre and post-emergent herbicides, passing of cycle hoe at 15, 30 and 45 DAS and compared with two hand weedings at 20 and 40 DAS and unweeded check. The experimental data collected on

growth and yield components of crop and weed growth parameters was subjected to Fisher's method of "Analysis of Variance" (ANOVA) as outlined by Panse and Sukhatme (1967). Wherever, F- test was significant an appropriate value of critical difference (C.D.) was worked out for comparison among the treatment means, otherwise against C.D. values NS (Non significant) was indicated. The results were presented and discussed at a probability level of five per cent. Since the data on weed count and weed dry weight were not normally distributed, the data were subjected to square root and logarithmic transformation using the formulae $\sqrt{x+1}$ and Log X+2 and the statistical analysis was done.

$$\text{Weed control efficiency} = \frac{\text{Dry matter production of weeds in unweeded plot} - \text{Dry matter production of weeds in treated plot}}{\text{Dry matter production of weeds in unweeded plot}} \times 100$$

$$\text{Weed index} = \frac{\text{Yield from hand weeded plot} - \text{yield from treatment plot}}{\text{Yield from hand weeded plot}} \times 100$$

RESULTS & DISCUSSION

The various observations made on weeds and crop namely weed density, dry weight of weeds, weed control efficiency, growth, yield components and yield of aerobic rice as influenced by various treatments are presented in Table 1, 2 & 3.

Effect on weeds

The predominant weed flora observed in the experimental field in association with the aerobic rice includes grasses like, *Echinochloa colonum, Digitaria marginata, Elusine indica, Chloris barbata, Cynadon dactylon and Dactyloctenium aegyptium*. Among broad leaved weeds *Ageratum conyzoides, Commelina benghalensis, Spilanthus acmella, Acanthospermum hispidum, Mollugo disticha, Phyllanthus niruri, Protulaca oleraceae*, *Cynotis axillaries, Stachytarpheta indica, Celosia argentia, Parthenium hysterophorus* and *Aeschynomene indica* and among sedges *Cyperus rotundus*. Similar weed species under direct seeded upland rice, aerobic rice were also reported by Mishra and Singh (2007), Moorthy and Sanjoy Saha (2002), Fayaz Ahmed Bahar and Govindra Singh (2004), Singh *et al.* (2005), Sunil (2010) and Sanjoy Saha *et al*. (2005).

Weed control efficiency is a measure of the efficiency of weed control methods in restricting the weed growth. Among weed control treatments bensulfuron methyl @ 60 g + pretilachlor @ 600 g a.i. ha^{-1} as pre-emergent spray recorded higher weed control efficiency at harvest (91.37 %) which was followed by oxyfluorfen @ 90 g a.i. ha^{-1} as pre-emergent spray fb 2, 4-DEE as post emergent spray @ 500 g a.i. ha^{-1} at 25 DAS (90.14 %) and two hand weedings at 20 and 40 DAS (90.09%) compared to unweeded check. This was due to better control of weeds during crop growth period which results in lower total weed population and its dry weight. However, lower weed control efficiency among herbicide treatments was noticed with pre emergence application of butachlor at 750 g a.i. ha^{-1} (68.41 %) followed by chlorimuron ethyl + metsulfuron methyl @ 4 g a.i. ha^{-1} as post emergent spray at 20 DAS (72.34 %). The lower weed control efficiency was due to poor control of weeds as a result recorded higher weed population and their dry weight. The results are in conformity with findings of Sanjoy Saha (2009) and Singh *et al.* (2005).

The weed population and total dry weight of weeds differed significantly due to different weed control treatments. Bensulfuron methyl @ 60 g + pretilachlor @ 600 g a.i. ha^{-1} as pre-emergent spray recorded significantly lower grasses, broad leaved weeds, sedge population and their total dry weight (24.00, 31.33, 16.33 No. m^{-2} and 3.65 g 0.25 m^{-2}, at harvest, respectively) which was on par with two hand weedings at 20 and 40 DAS (32.70, 33.00,18.33 No. m^{-2} and 4.19g 0.25 m^{-2} at harvest, respectively) and oxyfluorfen @ 90 g a.i. ha^{-1} as pre-emergent spray fb 2, 4-DEE as post emergent spray @ 500 g a.i. ha^{-1} at 25 DAS (26.70, 38.00, 19.90 No. m^{-2} and 4.17 g 0.25 m^{-2}, at harvest, respectively). The reduced grasses, broad leaved weeds, sedges and their total dry weight in these treatments was due to effective control of the weeds at all stages of crop growth period resulted in lower weed population and their total dry weight. Whereas, significantly higher population of grasses, broad leaved weeds, sedges and their total dry weight was registered with unweeded check (84.00, 90.33, 76.00 No. m^{-2} and 42.30 g 0.25 m^{-2}, at harvest, respectively) is due to no control of weeds. The results are in conformity with findings of Dubey *et al*. (2005), Sanjoy Saha (2005 & 2009) and Singh *et al*. (2005).

TABLE 1: Effect of weed control treatments on weed density, weed dry weight and weed control efficiency

Treatments	Weed density (No. m^{-2}) #				Weed dry weight (g 0.25 m^{-2}) *				WCE
	Grasses	BLW	Sedges	Total	Grasses	BLW	Sedges	Total	
T_1: Pyrazosulfuron ethyl @ 25 g a.i. ha^{-1} as pre-emergent spray.	1.77 (57)	1.76 (56)	1.52 (31)	2.16 (144)	1.91 (2.70)	2.17 (4.70)	1.24 (0.53)	2.99 (7.93)	81.25
T_2: Pretilachlor + safener @ 300 g a.i. ha^{-1} as pre- emergent spray.	1.78 (58)	1.79 (60)	1.53 (32)	2.18 (150)	2.06 (3.30)	2.20 (4.75)	1.26 (0.60)	3.11 (8.65)	79.55
T_3: Oxadiargyl @ 80 g a.i. ha^{-1} as pre-emergent spray.	1.72 (50)	1.75 (54)	1.46 (27)	2.12 (131)	1.76 (2.10)	2.13 (6.30)	1.21 (0.46)	3.14 (8.86)	79.05
T_4 : Bensulfuron methyl 60g + Pretilachlor @ 600 g a.i. ha^{-1} as pre-emergent spray	1.41 (24)	1.53 (32)	1.26 (16)	1.87 (72)	1.48 (1.20)	1.65 (2.20)	1.11 (0.25)	2.16 (3.65)	91.37
T_5: Butachlor 750 g a.i. ha^{-1} as pre-emergent spray.	1.90 (78)	1.94 (85)	1.79 (60)	2.35 (223)	2.47 (5.20)	2.62 (7.10)	1.46 (1.16)	3.79(13.36)	68.41
T_6: Cyhalofop butyl @ 100 g a.i. ha^{-1} + Ethoxysulfuron @ 30 g a.i. ha^{-1} as post emergent spray at 20 DAS.	1.83 (65)	1.89 (75)	1.64 (42)	2.26 (182)	2.14 (3.60)	2.29 (4.85)	1.33 (0.77)	3.20 (9.22)	78.20
T_7: Chlorimuron ethyl + Metsulfuron methyl @ 4 g a.i. ha^{-1} as post emergent spray at 20 DAS.	1.85 (68)	1.91 (79)	1.79 (60)	2.32 (207)	2.29 (4.28)	2.50 (6.40)	1.42 (1.03)	3.56(11.70)	72.34
T_8: Oxyfluorfen @ 90 g a.i. ha^{-1} as pre-emergent spray fb 2,4-DEE as post emergent spray @ 500 g a.i. ha^{-1} at 25 DAS.	1.46 (27)	1.60 (38)	1.32 (19)	1.93 (84)	1.53 (1.35)	1.70 (2.50)	1.15 (0.32)	2.27 (4.17)	90.14
T_9: Pyrazosulfuron ethyl @ 25 g a.i. ha^{-1} as pre-emergent spray fb Chlorimuron ethyl + Metsulfuron methyl @ 4 g a.i. ha^{-1} as post emergent spray at 30 DAS.	1.68 (46)	1.73 (52)	1.45 (26)	2.10 (124)	1.61 (1.60)	1.73 (2.66)	1.19 (0.43)	2.39 (4.69)	88.91
T_{10}: Passing of cycle hoe at 15, 30 & 45 DAS.	1.88 (73)	1.88 (74)	1.74 (53)	2.31 (200)	2.02 (3.30)	2.41 (5.50)	1.39 (0.93)	3.28 (9.73)	76.99
T_{11}: Two hand weedings at 20 and 40 DAS.	1.53 (32)	1.54 (33)	1.30 (18)	1.93 (83)	1.51 (1.30)	1.69 (2.63)	1.12 (0.26)	2.28 (4.19)	90.09
T_{12}: Unweeded check.	1.95 (87)	1.96 (90)	1.89 (76)	2.41 (253)	4.70 (21.30)	3.61 (16.90)	2.23 (4.10)	6.58(42.30)	0.00
S. Em $\pm$	0.07	0.07	0.07	0.07	0.042	0.03	0.028	0.06	NA
CD @ 5 %	0.21	0.20	0.18	0.22	0.122	0.069	0.082	0.17	NA

Values in the parenthesis are original values, BLW: broad leaved weeds, # Sq root transformation, * Log transformation; NA**:** Not Analysed

TABLE 2: Effect of weed control treatments on growth, yield parameters and yield of aerobic rice

Treatments	Plant height (cm)	Dry matter production (g hill^{-1})	Productive tillers per hill	Total No. of spikelet's per panicle	No. of Filled spikelet's per panicle
T_1: Pyrazosulfuron ethyl @ 25 g a.i. ha^{-1} as pre- emergent spray.	82.26	53.30	20.10	96.87	83.42
T_2: Pretilachlor + safener @ 300 g a.i. ha^{-1} as pre-emergent spray.	82.00	48.70	20.14	95.22	81.24
T_3: Oxadiargyl @ 80 g a.i. ha^{-1} as pre-emergent spray.	82.60	54.80	20.85	96.10	83.12
T_4 : Bensulfuron methyl 60g + Pretilachlor @ 600 g a.i. ha^{-1} as pre- emergent spray	85.80	64.00	21.32	98.22	88.23
T_5: Butachlor 750 g a.i. ha^{-1} as pre-emergent spray.	73.80	42.80	18.95	86.60	68.97
T_6: Cyhalofop butyl @ 100 g a.i. ha^{-1} + Ethoxysulfuron @ 30 g a.i. ha^{-1} as post emergent spray at 20 DAS.	78.90	46.00	19.04	96.44	80.04
T_7: Chlorimuron ethyl + Metsulfuron methyl @ 4 g a.i. ha^{-1} as post emergent spray at 20 DAS.	74.60	43.00	18.01	87.35	70.10
T_8: Oxyfluorfen @ 90 g a.i. ha^{-1} as pre-emergent spray fb 2,4-DEE as post emergent spray @ 500 g a.i. ha^{-1} at 25 DAS.	83.33	61.00	21.16	98.08	87.90
T_9: Pyrazosulfuron ethyl @ 25 g a.i. ha^{-1} as pre-emergent spray fb Chlorimuron ethyl + Metsulfuron methyl @ 4 g a.i. ha^{-1} as post emergent spray at 30 DAS.	82.90	56.30	21.00	96.97	84.67
T_{10}: Passing of cycle hoe at 15, 30 & 45 DAS.	77.60	45.80	18.86	90.19	73.24
T_{11}: Two hand weedings at 20 and 40 DAS.	84.30	62.90	21.30	98.12	88.16
T_{12}: Unweeded check.	62.30	29.50	6.13	55.80	40.50
S. Em $\pm$	0.95	1.56	0.08	0.38	1.06
CD @ 5 %	2.77	4.56	0.25	1.18	3.00

TABLE 3: Effect of weed control treatments on grain and straw yield of aerobic rice

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1: Pyrazosulfuron ethyl @ 25 g a.i. ha^{-1} as pre- emergent spray.	3436	4290
T_2: Pretilachlor + safener @ 300 g a.i. ha^{-1} as pre- emergent spray.	3279	4015
T_3: Oxadiargyl @ 80 g a.i. ha^{-1} as pre-emergent spray.	3529	4376
T_4 : Bensulfuron methyl 60g + Pretilachlor @ 600 g a.i. ha^{-1} as pre- emergent spray	4100	4961
T_5: Butachlor 750 g a.i. ha^{-1} as pre-emergent spray.	2421	3190
T_6: Cyhalofop butyl @ 100 g a.i. ha^{-1} + Ethoxysulfuron @ 30 g a.i. ha^{-1} as post emergent spray at 20 DAS.	2907	3575
T_7: Chlorimuron ethyl + Metsulfuron methyl @ 4 g a.i. ha^{-1} as post emergent spray at 20 DAS.	2506	3190
T_8: Oxyfluorfen @ 90 g a.i. ha^{-1} as pre-emergent spray fb 2,4-DEE as post emergent spray @ 500 g a.i. ha^{-1} at 25 DAS.	3876	4730
T_9: Pyrazosulfuron ethyl @ 25 g a.i. ha^{-1} as pre- emergent spray fb Chlorimuron ethyl + Metsulfuron methyl @ 4 g a.i. ha^{-1} as post emergent spray at 30 DAS.	3696	4565
T_{10}: Passing of cycle hoe at 15, 30 & 45 DAS.	2660	3410
T_{11}: Two hand weedings at 20 and 40 DAS.	4074	4928
T_{12}: Unweeded check.	339	462
S. Em $\pm$	109	119
CD @ 5 %	320	350

Effect on crop

Grain and straw yield differed significantly due to different weed control treatments (Table 2 & 3). In the present investigation yield loss recorded due to crop weed competition is to an extent of 91.70 per cent as indicated by weed index value. Weed control treatments registered significantly higher grain and straw yield than unweeded check. The higher grain and straw yield was recorded with application of bensulfuron methyl @ 60g + pretilachlor @ 600 g a.i. ha^{-1} as pre-emergence spray at 3 DAS (4100 and 4961 kg ha^{-1}, respectively) which was on par with two hand weedings at 20 and 40 DAS (4074 and 4928 kg ha^{-1}, respectively) and oxyfluorfen @ 90 g a.i. ha^{-1} as pre-emergence spray at 3 DAS + 2, 4-DEE as post emergent spray at @ 500 g a.i. ha^{-1} at 25 DAS (3876 and 4730 kg ha^{-1}, respectively). The higher grain and straw yield in these treatments is mainly due to better control of weeds and higher weed control efficiency during early stage of crop growth which resulted in effective utilization of resources such as nutrients, moisture, space and light resulted in better expression of growth and yield component viz., plant height (85.80, 84.30, and 83.33 cm respectively), dry matter production per hill (64.00, 62.90 and 61.00 g $hill^{-1}$ respectively), number of productive tillers per hill (21.32, 21.30 and 21.16 respectively), number of spikelets per panicle (98.22, 98.12 and 98.02 respectively) and filled spikelets per panicle (88.23, 88.16 and 87.90, respectively). Whereas, lower grain and straw yield was recorded with unweeded check (339 and 462 kg ha^{-1}) owing to severe crop weed competition which resulted in reduction in the expression of growth and yield components such as plant height (62.30 cm), dry matter production per hill (29.50 g $hill^{-1}$), productive tillers per hill (6.13), number of productive tillers per hill (55.80) and filled spikelets per panicle (40.50). These results are in conformity with the findings of Dubey *et al.* (2005), Sanjoy Saha (2005 & 2009), Singh *et al.* (2005) and Sunil. (2011).

CONCLUSION

The above study indicates pre-emergence application of bensulfuron methyl @ 60g + pretilachlor @ 600 g a.i. ha^{-1} as or application of oxyfluorfen @ 90 g a.i. ha^{-1} as pre-emergent spray + 2, 4-DEE as post emergent spray @ 500 g a.i. ha^{-1} at 25 DAS resulted in similar grain and straw yield as that of hand weeding and significantly superior over unweeded control there by reducing the dependence of human labour for hand weeding, especially in the era of urbanization and industrialization.

REFERENCES

Fayaz Ahmed Bahar and Govindra Singh (2004) Effect of herbicides on dry seeded rice (*Oryza sativa* L.) and associated weeds. *Indian J. Weed Sci*., **36** (3&4): 269-270.

Bhanu Rekha K, Mahavishnan, K. and Srinivasa raju, M. (2003) Effect of weed management on crop – weed competition, grain yield and nutrient uptake in rice. *The Andhra Agriculture Journal* **50** (3&4):211-215.

Dubey, R.P., Moorthy, B.T.S. and Gogoi, A.K. (2005) Bio-efficacy of acetachlor + bensulfuron methyl against weeds in transplanted rice. *Indian J. Weed Sci*., **37** (3&4): 265-266.

Rana, S.S., Angira. N.N. and Sharma, S.W. (2002) Effect of herbicides and inter culture on nutrient uptake by puddle seeded rice and associated weeds. *Indian Journal of Weed Science,* **33** (1&2): 70-73.

Moorthy, B.T.S. and Sanjoy Saha (2002) Evaluation of pre and post emergence herbicides for their effects on weeds and upland direct seeded rice. *Indian J. Weed Sci.,* **34** (3&4): 197-200.

Mishra, J.S. and Singh, V.P. (2007) Integrated weed management in zero till direct seeded rice (*Oryza sativa* L.) – wheat (*Triticum aestivum*) cropping system. *Indian J. Agron*., **52** (3):198-203.

Panse, V.G. and Sukhatme, P.V. (1967) Statistical methods for agricultural workers. ICAR, Publications., New Delhi, P.359.

Sanjoy Saha (2005) Evaluation of some new herbicide formulations alone or in combination with hand weeding in direct sown rainfed low land rice. *Indian J. Weed Sci.*, **37** (1&2): 103-104.

Sanjoy Saha (2009) Efficacy of Bensulfuron-methyl for controlling sedges and non-grassy weeds in transplanted rice (*Oryza sativa* L.). *Indian J. Agric. Sci.*, 7**5** (1): 46-48.

Shanmuganathan, M.(2006)"Aerobic rice". *Agric. Update*, **1**(2): 15-17.

Singh, V.P., Govindra singh and Mahendra singh (2005) Effect of Bensulfuron-methyl (Londox 60 DF) on sedges and weeds in transplanted rice. *Indian J. Weed Sci.*, **37** (1 &2): 40-44.

Thimmegowda, P. (2006) Chemical weed control in aerobic rice. *M.Sc. (Agri.) thesis*, *Univ. Agric. Sci*., Bangalore.

Sunil, C.M. (2010) Integrated weed management in aerobic rice. *M.Sc. (Agri.) thesis*, *Univ. Agric. Sci*., Bangalore.