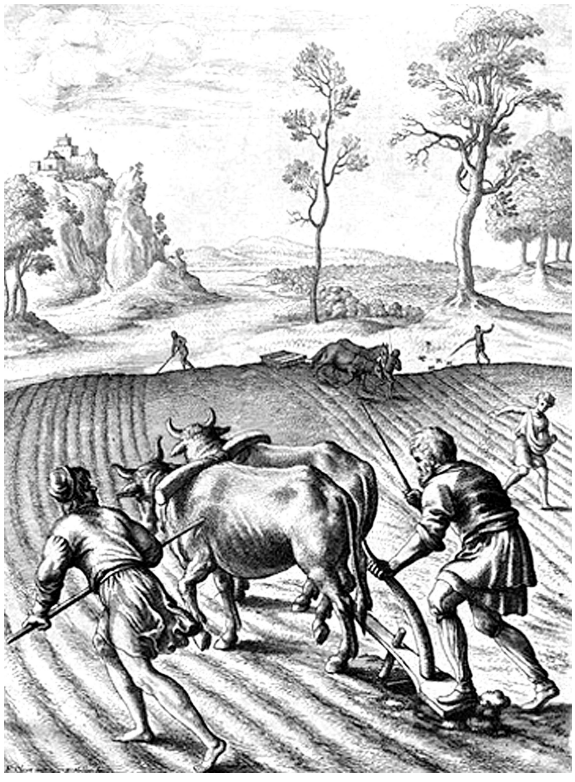
ISSN : 1812-5379 (Print)
ISSN : 1812-5417 (Online)
http://ansijournals.com/ja

JOURNAL OF AGRONOMY



ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Journal of Agronomy 12 (2): 99-103, 2013
ISSN 1812-5379 / DOI: 10.3923/ja.2013.99.103

Integrated Weed Management on Growth and Yield of Transplanted Rice and its Residual Effect on Succeeding Black gram

T. Parthipan, V. Ravi, E. Subramanian and T. Ramesh
Department of Agronomy, Tamil Nadu Rice Research Institute,
Tamil Nadu Agricultural University, Aduthurai-612 101, Tamil Nadu, India

Abstract: Rice is the most important cereal crop which plays major role in Indian food economy as well as dietary needs of the world. A major hindrance in the successful cultivation of rice is heavy infestation of weeds. Hence, the field investigations were carried out at Tamil Nadu Rice Research Institute, Aduthurai during wet seasons of 2011-12 and 2012-13 to study the effect of integrated weed control on growth and yield of transplanted rice and its residual effect on succeeding black gram. Experiments were tested in randomized block design replicated thrice. Treatments consisted of application of herbicides viz., clomazone 500 g ha^{-1}, clomazone + 2, 4-DEE 500 g ha^{-1}, butachlor 1250 g ha^{-1}, pretilachlor 500 g ha^{-1} and bispyribac sodium 25 g ha^{-1} followed by (fb) Hand Weeding (HW) on 45 Days After Transplanting (DAT). Pre plant incorporation of glyphosate 2.5 L ha^{-1} fb pre emergence application of bensulfuron methyl plus pretilachlor 660 g ha^{-1} was also tested with two hand weedings and unweeded control. The highest grain yield (5831 and 8783 kg ha^{-1}) were recorded under two hand weedings during both years as a result of reduced weed dry weight and increased growth attributes. This was on par with application of bispyribac sodium 25 g ha^{-1} fb one HW (5613 and 8653 kg ha^{-1}). The results indicated that herbicides applied in rice did not showed their residual effects on succeeding black gram. Even though the results of two hand weedings were better, it can not be recommended at larger scale as it is time consuming and laborious. Hence, post emergence application of bispyribac sodium 25 g ha^{-1} fb one HW on 45 DAT can be recommended for better weed control and productivity in transplanted rice.

Key words: Rice, herbicides, hand weeding, weed dry weight, weed control efficiency, succeeding black gram

INTRODUCTION

Weeds are often called plants out of place. They are unwanted, prolific, competitive, often harmful to the environment and they occur in the every rice field of the world. Weeds reduced the potential production of rice by interfering with agricultural operations. In India, rice is cultivated in an area of 44 million hectares annually with a production of 103 million tonnes, with an average productivity of 2.3 t ha^{-1}. The average yield of rice in India is very low due to several constrains. Among them, weeds pose a major threat for increasing rice productivity. Uncontrolled weed growth caused 33-45% reduction in grain yield of rice (Singh *et al*., 2007; Manhas *et al*., 2012). Any delay in weeding will lead to increased weed biomass as a result drastic reduction in yield.

Weed control is one of the most important and suggestive practices for potential rice production. Butachlor, anilofos, oxadiargyl and pretilachlor are being the herbicides presently used for weed control in transplanted rice. These herbicides provide effective control of annual grasses, but not annual sedges and broad leaved weeds. It has been observed that whenever there is effective control of grasses due to these herbicides, annual sedges and broad leaved weeds emerge in high density competing with crop and resulting into heavy yield losses (Singh *et al*., 2004). At present, no single practice i.e., either uses of herbicides or manual/mechanical weeding is convenient and effective in eliminating the weed menace. So, there is a necessity that these herbicides are supplemented with Hand Weeding (HW) for broad spectrum weed control with respect to all kind of weeds in rice. Hence, the present study was aimed to find out the effect of integrated weed management packages on weed control efficiency and productivity of transplanted rice.

Corresponding Author: T. Parthipan, Department of Agronomy, Tamil Nadu Rice Research Institute,
Tamil Nadu Agricultural University, Aduthurai-612 101, Tamil Nadu, India

MATERIALS AND METHODS

Experimental site and soil status: Field investigations were carried out at Tamil Nadu Rice Research Institute (Tamil Nadu Agricultural University), Aduthurai during wet seasons of 2011-12 and 2012-13 to study the effect of integrated weed management practices on growth and yield of transplanted rice and residual effect of herbicides on succeeding black gram in Cauvery Delta Zone of Tamil Nadu. The soil of the experimental field was clay with slightly alkaline pH (8.2), medium in organic carbon (0.52%), low in available nitrogen (161 kg ha^{-1}), high in available phosphorus (54.5 kg ha^{-1}) and medium in available potassium (206 kg ha^{-1}).

Experimental design with treatment details: The experiments were laid out in Randomized Block Design (RBD) with three replications. Treatments consisted of application of Pre Emergence (PE) herbicides viz., clomazone 500 g ha^{-1}, clomazone+2, 4-DEE (ready mix) 500 g ha^{-1} alone and their integration with HW on 45 Days After Transplanting (DAT); butachlor 1250 g ha^{-1} +HW on 45 DAT; pretilachlor 500 g ha^{-1}+HW on 45 DAT; Post emergence (POE) herbicide bispribac sodium 25 g ha^{-1} on 15 DAT + HW on 45 DAT and pre plant incorporation of glyphosate 2.5 L ha^{-1} at 15 Days Before Transplanting (DBT) fb PE application of bensulfuron methyl plus pretilachlor 660 g ha^{-1} on 3 DAT were tested with two hand weedings on 25 and 45 DAT and unweeded control for weed control efficiency and productivity of transplanted rice. PE herbicides were mixed with sand and applied uniformly to the field on 3 DAT. The POE herbicide was sprayed on 15 DAT by using knapsack sprayer fitted with flat fan nozzle. A thin film of water was maintained at the time of herbicide application. Hand weedings were carried out as per the treatment schedule. All other agronomic and plant protection measures were adopted as per the recommended packages.

Cultivar selection, biometric observations and calculations: Long duration (155 days) and high yielding paddy variety CR 1009 was transplanted on 07.09.2011 and 17.09.2012 for two years, respectively with two seedlings per hill with a spacing of 20×15 cm. The data on plant height, weed dry weight and yield were recorded at harvest and leaf area index was calculated based on leaf length-breadth method during 90 DAT. Weed control efficiency and weed index were worked out as per standard procedures.

Succeeding crop of black gram: The succeeding crop of black gram (ADT 3) was raised without disturbing the layout of rice experiment. After the harvest of rice crop, the seeds of follow up black gram were dibbled in rice stubbles using the residual soil moisture. A seed rate of 20 kg ha^{-1} was adopted with a spacing of 30×10 cm. In residual crop of black gram, germination per cent on 10 Days After Sowing (DAS) and plant height on 30 DAS were measured.

Statistical analysis: The data recorded were analysed statistically in RBD as per the method suggested by Gomez and Gomez (1984). The data on weed dry weight were subjected to square root transformation (vx+0.5) prior to statistical analysis to normalize their distribution. Wherever the treatment means were significant, critical differences were calculated at 5% probability level for comparisons of mean values. Non significant differences among treatment means were denoted as NS.

RESULTS AND DISCUSSION

Weed flora: The dominant weed flora of experimental fields consisted of *Echinochloa crusgalli, Echinochloa colonum and Leptochloa chinensis* among grasses, *Cyperus difformis*, *Cyperus iria* and *Fimbristylis miliacea* among sedges and *Marselia quadrifolia*, *Eclipta alba*, *Ammania baccifera*, *Bergia capensis*, *Commelina diffusa* and *Ludwigia parviflora* among broad leaved weeds.

Weed dry weight and weed control efficiency: Weed control treatments significantly reduced dry weight of weeds during both years of study (Table 1). The lowest weed dry weight was recorded under two hand weedings (6.00 g m^{-2}) fb POE application of bispyribac sodium 25 g ha^{-1} supplemented with HW on 45 DAT (6.53 g m^{-2}) during 2011-12, whereas this was reverse during 2012-13. The weed dry weight recorded by two hand weedings were found on par with POE application of bispyribac sodium 25 g ha^{-1} supplemented with HW on 45 DAT during both years. The reduced dry weight of weeds may be attributed to broad spectrum weed control by the application of post-emergence herbicides fb HW as observed in the plots in which two hand weedings were given. These results are in conformity with findings of Singh *et al.* (2012) who reported that dry weight of weeds were greatly reduced under two hand weedings in transplanted rice.

Two hand weedings recorded the highest weed control efficiency (92.95 and 92.81%) fb POE application

Table 1: Effect of integrated weed management practices on weed dry weight and weed control efficiency (WCE) at harvest in transplanted rice

	2011-12			2012-13		
Treatments	Weed dry weight (g m^{-2})	WCE (%)	Weed Index (%)	Weed dry weight (g m^{-2})	WCE (%)	Weed Index (%)
Clomazone 500 g ha^{-1}	6.89 (47.17)	44.62	28.98	6.41 (40.62)	50.28	29.84
Clomazone + 2, 4 DEE 500 g ha^{-1}	5.92 (34.61)	59.36	25.73	5.50 (29.79)	63.53	24.36
Clomazone 500 g ha^{-1}+ HW 45 DAT	3.53 (12.00)	85.91	19.38	3.50 (11.75)	85.62	10.89
Clomazone + 2, 4 DEE 500 g ha^{-1} + HW 45 DAT	3.05 (8.80)	89.67	15.37	2.95 (8.21)	89.94	8.76
Butachlor 1250 g ha^{-1}+ HW 45 DAT	2.75 (7.07)	91.70	11.16	2.79 (7.26)	91.11	5.76
Pretilachlor 500 g ha^{-1}+ HW 45 DAT	2.84 (7.60)	91.08	13.19	2.78 (7.25)	91.12	8.15
Bispyribac sodium 25 g ha-1 + HW 45 DAT	2.65 (6.53)	92.33	3.73	2.48 (5.64)	93.10	1.48
PPI Glyphosate 2.5 L ha^{-1} 15 DBT+Bensulfuron methyl+Pretilachlor 660 g ha^{-1}	3.11 (9.20)	89.20	15.48	2.85 (7.60)	90.70	9.22
Hand weedings twice 25 and 45 DAT	2.54 (6.00)	92.95	0.00	2.52 (5.88)	92.81	0.00
Unweeded control	9.24 (85.17)	0.00	47.02	9.06 (81.68)	0.00	53.79
SEd	0.25	-	-	0.13	-	-
CD (P = 0.05)	0.53	NA	NA	0.27	NA	NA

Values in parentheses are original values, which were subjected to square root transformation (vx+0.5) before statistical analysis. NA: Not Analysed, DBT: Days Before Transplanting, DAT: Days After Transplanting, HW: Hand Weeding, PPI: Pre Plant Incorporation

Table 2: Effect of integrated weed management practices on growth and yield of transplanted rice

	2011-12			2012-13		
Treatments	Plant height (cm) at harvest	LAI at 90 DAT	Grain yield (kg ha^{-1})	Plant height (cm) at harvest	LAI at 90 DAT	Grain yield (kg ha^{-1})
Clomazone 500 g ha^{-1}	113.9	4.45	4141	115.9	5.46	6162
Clomazone+2, 4 DEE 500 g ha^{-1}	114.3	4.68	4330	118.8	5.71	6643
Clomazone 500 g ha^{-1}+HW 45 DAT	120.3	5.42	4701	121.8	6.14	7826
Clomazone+2, 4 DEE 500 g ha^{-1}+HW 45 DAT	122.7	5.82	4934	124.0	6.27	8013
Butachlor 1250 g ha^{-1}+HW 45 DAT	121.2	5.99	5180	122.4	6.20	8277
Pretilachlor 500 g ha^{-1}+HW 45 DAT	117.8	5.76	5062	124.8	6.14	8067
Bispyribac sodium 25 g ha^{-1}+HW 45 DAT	121.7	6.06	5613	125.1	6.38	8653
PPI Glyphosate 2.5 L ha^{-1}+Bensulfuron methyl+Pretilachlor 660 g ha^{-1}	121.5	5.51	4928	122.6	6.18	7973
Hand weedings twice 25 and 45 DAT	123.8	6.55	5831	125.1	6.50	8783
Unweeded control	109.9	3.94	3089	112.9	3.60	4059
SEd	3.3	0.24	230	3.5	0.32	297
CD (P = 0.05)	7.0	0.49	483	7.3	0.66	624

DBT: Days Before Transplanting, DAT: Days After Transplanting, HW: Hand Weeding, PPI: Pre Plant Incorporation

of bispyribac sodium 25 g ha^{-1} with one HW on 45 DAT (92.33 and 93.10%) during both years. Similar findings of higher weed control efficiency with two hand weedings were also reported by Yadav *et al.* (2009). No significant differences were observed among PE application of pretilachlor, butachlor and clomazone+2,4-DEE ready mix fb one HW on 45 DAT and pre plant application of glyphosate 2.5 L ha^{-1} at 15 DBT fb PE application of bensulfuron methyl+pretilachlor 660 g ha^{-1} at 3 DAT. The highest dry matter of weeds was recorded with unweeded control during both years. It indicates that if weeds were not controlled, their dry weight continuously increased and crop growth adversely affected.

Growth and yield of rice: Growth attributes and yield of transplanted rice were significantly influenced by weed control treatments during both the years (Table 2). Taller plants (123.8 and 125.1 cm) with higher leaf area index (6.55 and 6.50) were recorded by two hand weedings fb POE application of bispyribac sodium 25 g ha^{-1} supplemented with one HW during both years. Increase in plant height and leaf area index might be due to better environment with increased uptake of both macro and micro nutrients by rice due to reduced crop weed competition. The highest grain yield (5831 and 8783 kg ha^{-1}) was recorded by two hand weedings during both the years of study. Similar results have been reported by Prasad *et al.* (2001) and Deepthi Kiran and Subramanyam (2010). Superiority of two hand weedings might be ascribed to absence of weed competition due to complete removal of weeds from field and hence better crop growth. No hesitation, the results of two hand weedings are appreciably better in terms of weed control and rice grain yield, but as it is time consuming and laborious, it can not be recommended at large scale.

Grain yield (5613 and 8653 kg ha^{-1}) recorded under post emergence application of bispyribac sodium 25 g ha^{-1} on 15 DAT fb HW on 45 DAT was found on par with two hand weedings. Higher grain yield under these treatments might be due to increased panicles/m^2 and grains/panicle. Similar findings were also obtained by Veeraputhiran and Balasubramanian (2010) and

Table 3: Residual effect of herbicides applied to rice on succeeding black gram

	2011-12		2012-13	
Treatments	Germination (%)	Plant height (cm)	Germination (%)	Plant height (cm)
Clomazone 500 g ha^{-1}	56.1 (82.8)	25.19	48.4 (74.8)	25.77
Clomazone + 2, 4 DEE 500 g ha^{-1}	50.2 (76.8)	25.77	55.0 (81.8)	25.70
Clomazone 500 g ha^{-1} + HW 45 DAT	51.1 (77.8)	23.18	45.0 (70.7)	21.84
Clomazone + 2, 4 DEE 500 g ha^{-1}+ HW 45 DAT	52.0 (78.8)	25.20	50.3 (76.8)	23.79
Butachlor 1250 g ha^{-1} + HW 45 DAT	55.0 (81.8)	25.50	55.0 (81.8)	24.17
Pretilachlor 500 g ha^{-1} + HW 45 DAT	58.1 (84.8)	24.10	54.2 (80.8)	22.68
Bispyribac Sodium 25 g ha^{-1} + HW 45 DAT	55.0 (81.8)	22.93	51.1 (77.8)	22.26
PPI glyphosate 2.5 L ha^{-1}+ Bensulfuron methyl + Pretilachlor 660 g ha^{-1}	60.6 (86.9)	24.40	52.1 (78.8)	21.23
Hand weedings twice 25 and 45 DAT	58.1 (84.8)	24.53	57.2 (83.8)	21.86
Unweeded control	63.0 (87.9)	26.01	55.2 (81.8)	23.85
SEd	4.4	1.39	3.8	1.48
CD (P=0.05)	NS	NS	NS	NS

Figures in parentheses are original values which were subjected to arcsine transformation before statistical analysis. NS: Not Significant, DBT: Days Before Transplanting, DAT: Days After Transplanting, HW: Hand Weeding, PPI: Pre Plant Incorporation

Nalini *et al.* (2012). Grain yield registered by pre plant incorporation of glyphosate at 15 DBT fb POE application of bensulfuron methyl+pretilachlor at 3 DAT were found on par with pre-emergence application of butachlor, pretilachlor, clomazone+2,4-DEE fb one HW at 45 DAT. Superior results of pre plant application of glyphosate at 15 DBT fb post plant application of bensulfuron methyl+pretilachlor at 3 DAT have also been reported by AICRIP (2011) and Kishor Jalindar *et al.* (2012). This might be accredited to better growth of plants on account of reduced crop-weed competition. Weeds in unweeded control caused 47.02 and 53.79% reduction in grain yield during both years.

Succeeding black gram: Growth and establishment of black gram was not significantly affected due to herbicides applied in rice. No significant variation among the treatments was found with respect to germination per cent of black gram on 10 DAS and plant height on 30 DAS (Table 3). However, higher germination percentage was recorded under unweeded check (87.9%) during 2011-12 and under two hand weedingss (83.8%) during 2012-13. These results are in harmony with findings of Upendra Rao *et al.* (2009) for succeeding black gram and Ezhilarasi *et al.* (2012) for succeeding green gram.

CONCLUSION

From this study, it can be concluded that application of POE herbicide bispyribac sodium 25 g ha^{-1} on 15 DAT fb HW on 45 DAT produced higher grain yield and this was on par with two hand weedings. Sequential application of herbicides viz., glyphosate 2.5 L ha^{-1} at 15 DBT fb bensulfuron methyl+pretilachlor 660 g ha^{-1} at 3 DAT was also found promising and it can also be recommended for weed control in transplanted rice wherever the problem of paucity of labour for hand weeding prevails. Hence, application of POE herbicide bispyribac sodium 25 g ha^{-1} on 15 DAT fb one HW on 45 DAT can be recommended for better weed control, growth and yield of transplanted rice.

REFERENCES

AICRIP, 2011. All India Co-ordinated Rice Improvement Programme, Annual Progress Report. Vol. 3, DRR, Hyderabad, Pages: 144.

Deepthi Kiran, Y. and D. Subramanyam, 2010. Performance of pre and post emergence herbicides on weed flora and yield of transplanted rice (*Oryza sativa*). Indian J. Weed Sci., 42: 229-231.

Ezhilarasi, V., S. Manoharan, P. Murali Arthanari and C. Chinnusamy, 2012. Residual effect of pre emergence mixed herbicides in transplanted rice on succeeding crops. Proceedings of the Biennial Conference of Indian Society of Weed Science on Weed Threat to Agriculture, Biodiversity and Environment, April 19-20, 2012, Thrissur, Kerala, India, pp: 58.

Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedure for Agricultural Research. 2nd Edn., John Wiley and Sons Inc., New York, pp: 680.

Kishor Jalindar, M., A.C. Lourduraj, P.M. Arthanari and C. Chinnusamy, 2012. Herbicidal weed management in transplanted rice. Proceedings of the Biennial Conference of Indian Society of Weed Science on Weed Threat to Agriculture, Biodiversity and Environment, April 19-20, 2012, Thrissur, Kerala, India, pp: 92.

Manhas, S.S., G. Singh, D. Singh and V. Khajuria, 2012. Effect of tank-mixed herbicides on weeds and transplanted rice (*Oryza sativa* L.). Ann. Agric. Res. New Ser., 33: 25-31.

Nalini, K., P.M. Arthanari and C. Chinnusamy, 2012. Early post emergence herbicidal weed management in transplanted rice. Proceedings of the Biennial Conference of Indian Society of Weed Science on Weed Threat to Agriculture, Biodiversity and Environment, April 19-20, 2012, Thrissur, Kerala, India, pp: 74.

Prasad, S.M., S.S. Mishra and S.J. Singh, 2001. Effect of establishment methods, fertility levels and weed management practices on rice (*Oryza sativa*). Indian J. Agron., 46: 216-221.

Singh, A.P., A.K. Singh, S. Chaturvedi, S. Singh and O.P. Mishra, 2012. Bio-efficacy of sulfonylurea herbicides on mixed weed flora in transplanted rice. Indian J. Agric. Res., 46: 9-15.

Singh, G., V.P. Singh and M. Singh, 2004. Effect of almix and butachlor alone and in combinations on transplanted rice and associated weeds. Indian J. Weed Sci., 36: 64-67.

Singh, P., P. Singh, R. Singh and K.N. Singh, 2007. Efficacy of new herbicides in transplanted rice (*Oryza sativa*) under temperate conditions of Kashmir. Indian J. Weed Sci., 39: 167-171.

Upendra Rao, R., K.M. Dakshina Murthy and C. Venkata Reddy, 2009. Efficacy of bispyribac sodium 10% SC on early post emergence herbicide on rice. Proceedings of the National symposium on Weed Threat to Environment, Biodiversity and Agriculture Productivity, August 2-3, 2009, Coimbatore, India, pp: 117.

Veeraputhiran, R. and R. Balasubramanian, 2010. Evaluation of new post emergence herbicide in transplanted rice. Proceedings of the National Conference on Challenges in Weed Management in Agro-Ecosystems-Present Status and Future Strategies, November 30-December-1, 2010, TNAU, Coimbatore, pp: 175.

Yadav, D.B., A. Yadev and S.S. Punia, 2009. Evaluation of bispyribac sodium for weed control in transplanted rice. Indian J. Weed Sci., 41: 23-27.