

## Weed infestation in rice (*Oryza sativa* L.) as influenced by seeding techniques and weed management practices

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### Abstract

In order to study the effect of seeding techniques and weed management practices on weed flora present in rice field an experiment was conducted during *kharif* season of 2013 at Crop Research Farm, Department of Agronomy, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, U.P. in sandy loam soil. The experiment was laid out in split plot design in which four seeding techniques and five weed management practices along with weedy check with three replications were adopted. The different treatments were allocated randomly in each replication. In the experimental field maximum weed appeared% was recorded by *Sorghum halapense* (9.56 %) followed by *Echinochloa colona* (7.74). The top five ranking of weeds which generally affected the growth and yield of rice was *Sorghum halapense* > *Echinochloa colona* > *Digitaria sanguinalis* > *Echinochloa crusgalli* > *Dactyloctenium aegyptium*. Among the seeding techniques minimum density of *Echinochloa colona*, *Echinochloa crusgalli*, *Eleusine indica*, *Brachiaria reptans*, *Cynodon dactylon*, *Sorghum halapense*, *Dactyloctenium aegyptium* and *Digitaria sanguinalis* were recorded in P<sub>1</sub> (Transplanted rice in puddled soil) followed by P<sub>3</sub> (DSR in puddled soil). W<sub>3</sub> (Pyrazosulfuron at 20 g/ha as pre emergence + one hand weeding at 40 DAT/DAS) was most effective and significantly superior to all tank mix application of herbicides in reducing density of all the grasses followed by W<sub>6</sub> (Tank mix application of Fenoxaprop at 90 g/ha + Ethoxysulfuron at 18 g/ha at 18 DAT/DAS).

**Keywords:** Rice, weed density, grasses, herbicides, seeding techniques, *Oryza sativa* L

### Introduction

Rice is an important and major food of India, producing 43% of calories requirement for more than 70% of Indian population. Rice occupies largest area among the entire crops grown in India. Sixty years since independence there has been a remarkable achievement in production of rice. The area under rice increased 1.5 times while the production increased 4 times and the productivity increased 3 times from 0.7 t ha<sup>-1</sup> to 2 t ha<sup>-1</sup>. This spectral progress helped India to achieve self sufficiency in rice production during early 80s (Anonymous, 2010) [1].

The two commonly used methods for controlling the weeds in India are manual or hand weeding; and use of herbicides. Due to scarcity of labour hand weeding is becoming less common and herbicides are taking its place. Some studies by different Scientists revealed that cultural practices viz. seeding methods, tillage, water and fertilizer management affected weed flora in DSR (Moody, 1993; Bhagat *et al.*, 1999; Tuong *et al.*, 2000; Phuong *et al.*, 2005) [2-5]. Research are being continuously carried out to find some alternative rice establishment techniques specially in relation to addressing a systemic compression of weed infestation, weed control efficiency and yield of rice in both puddled, Unpuddled and also in DSR. Weed infestation is the main problem which hampers sustainability of DSR system of rice establishment (Chauhan, 2012; Mahajan *et al.*, 2013) [6, 7]. Controlling weeds in DSR system is a tedious task because of the severity and

diversity of weeds as both rice and weed seedling emerge at same time secondly, due to absence of standing water layer to suppress the weed growth. Land preparation operations of DSR system distributes weed seed in the soil leading to abundance of weed species as the weed seeds buried in the soil come upwards (Chauhan and Opena, 2012) [8]. The shifts in weed flora composition in agricultural cropping systems have been widely taken notice off and resulted in these changes modifications and innovations in agricultural technologies, which have altered weed habitats to some extent (Haas and Streibig, 1982; Hall *et al.*, 2000) [20, 21]. Keeping the mention points in view, there was a need of an experiment to find out suitable seeding techniques and proper weed management practices to control weed flora.

### Method and Material

With a view to obtain higher precision in the results of the present experiment, the experiment was conducted at Crop Research Farm, Department of Agronomy, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, U.P., during *kharif* season of 2013. The field was well levelled and bounded from all sides. More or less the weather conditions throughout the crop season were quite favorable for growth and development of rice crops. The total rainfall received during the crop season was 1061.90 mm distributed in 37 rainy days. The soil of the experimental field was sandy loam having 59.6% sand, 25.27% silt and 15.13% clay. The

soil contained 0.42% organic carbon, 238.12 kg/ha available N, 20.05 kg/ha available P and 256.44 kg/ha available K, electrical conductivity 0.29 ds/m<sup>2</sup> with pH 7.78 in the year of experiment. The field experiment was carried out in split plot design. The treatment consisted of four seeding techniques *viz.* Transplanted rice in puddled soil, Transplanted rice in non puddled soil, Direct seeded rice in puddled soil and Direct seeded rice in non puddled soil were in main plot and five weed management practices (Weed free, Pyrazosulfuron at 0.20 kg ha<sup>-1</sup> as pre emergence + One hand weeding at 40 DAT/DAS, Tank mix application of Bispyribac sodium at 0.25 litre ha<sup>-1</sup> + Fenoxaprop at 1.00 litre ha<sup>-1</sup> at 18 DAT/DAS, Tank mix application of Bispyribac sodium at 0.25 litre ha<sup>-1</sup> + Ethoxysulfuron at 0.12 kg ha<sup>-1</sup> at 18 DAT/DAS, Tank mix application of Fenoxaprop at 1.00 litre ha<sup>-1</sup> + Ethoxysulfuron at 0.12 kg ha<sup>-1</sup> at 18 DAT/DAS) along with weedy check in sub plot were replicated thrice. For the treatment with transplanted puddled rice and transplanted not puddled rice, the transplanting of 22 days old rice seedlings was done in the experimental field. For direct seeded rice (DSR), line sowing of dry and sprouted seeds of rice was done in non puddled soil and in puddled soil respectively. Manual puddler was used for puddling. Seeds were soaked in water and sprouted before sowing. The sprouted seeds with radicle length one to two millimeters are uniformly sown manually in the puddled field. Sowing of DSR and nursery seeding of transplanted rice was done at same day *i.e.* 17 June 2013. 21 days old seedling was transplant in main field. A uniform dose 80 kg P<sub>2</sub>O<sub>5</sub>/ha through SSP and 60 kgK<sub>2</sub>O/ha through MOP along with 75 kg N were applied in all the experimental plots. Total nitrogen was applied through urea, 50% as basal dose + 25% at tillering stage + 25% at panicle initiation. Pre-emergence herbicide such as Pyrazosulfuron-ethyl was applied at 2 DAS/DAT and post-emergence herbicides such as Bispyribac-sodium, Ethoxysulfuron and Fenoxaprop-ethyl were applied at 18 DAS/DAT. The herbicides solution was sprayed uniformly with the help of knapsack sprayer fitted with flat fan nozzle. Appeared% of weeds was calculated by maximum weedy plot of weedy check at tillering stage. Densities of grassy weeds were recorded as species wise from three places of each plot randomly, using quadrat of 50 × 50 cm (0.25 m<sup>2</sup>) from the area marked for observations and was converted as number per meter square.

## Result and Discussion

Weeds such as grasses, sedges and broad leaf weeds were generally found in rice field. The total combined appearance of sedges and broad leaf weeds were 61.5% (data not presented) while the grasses was 38.5% (table 1). It is further clear from the table that maximum appeared% was recorded by *Sorghum halapense* (9.56 %) followed by *Echinochloa colona* (7.74) (table 1). The top five weeds which generally affected the growth and yield of rice was *Sorghum halapense* > *Echinochloa colona* > *Digitaria sanguinalis* > *Echinochloa crusgalli* > *Dactyloctenium aegyptium*. Several studies (Singh *et al.*, 2012; Mandal *et al.*, 2013; Kumar and Rane, 2013; Prakash *et al.*, 2013) [19, 17, 16, 18] reported that the maximum percent of *Echinochloa colona* in rice field but in the present study *Sorghum halapense* was the most dominant weed in the rice field. The favorable reason might be due to vigorous growth of this weed in water logged field as well as in dry field. However, alternate wetting and drying condition in un

puddled fields was also helpful for this weed. Secondly, the root of this weed when cut due to ploughing, emerged again in more vigorous manner in both water logged and dry field. A close scrutiny of mean data showed significant variation in density of total grasses among different seeding techniques and weed management practices at tillering stage. However, the effect of planting techniques and weed management practices showed significant variation in individual weed species except *Echinochloa colona* in seeding techniques at 30 DAS. Among the seeding techniques minimum density of *Echinochloa colona*, *Eleusine indica*, *Brachiaria reptans*, *Cynodon dactylon*, *Sorghum halapense* and *Dactyloctenium aegyptium* were recorded in P<sub>1</sub> (Transplanted rice in puddled soil) followed by P<sub>3</sub> (DSR in puddled soil) and significantly superior to other seeding techniques (table 2). However, minimum density of *Echinochloa crusgalli* and *Digitaria sanguinalis* were observed in P<sub>3</sub> (DSR in puddled soil). In puddled rice, there was several control factors which reduced the weed density. These factors are (i) standing water which suppress the growth of weeds (Chauhan and Johnson, 2010) [9] early and continuous flooding at a shallow depth (*e.g.* 2-5 cm) can also help to suppress the emergence of problematic weeds (Chauhan and Johnson, 2011) [10], (ii) seeds going to deeper layer or not near the soil surface after planting, seed bank of weeds were fully disturbed resulting several degree of reduction in weed germination (Chauhan *et al.*, 2012) [11]; (iii) control of perennial weed species which cannot be controlled by unpuddled condition so, this type of weed species not become dominant, (iv) seedling size advantage of puddled transplanted rice (Chauhan *et al.*, 2015) [12], (v) higher bulk density which badly affects the non rice plants (Gangwar *et al.*, 2006, 2008) [14, 13] and puddling also create the reduced oxygen zone (Joshi *et al.*, 2013) [15] ultimately check the weeds root growth and gives lower biomass of weeds, (vi) it provides better availability of nutrients (Singh *et al.*, 1997; Singh, 2012; Shan *et al.*, 2012) [25, 26, 23] and as the growth advance the crop develop a good canopy to suppress the weed growth. These factors provide a good control of weeds. Amongst herbicides, W<sub>3</sub> (Pyrazosulfuron at 0.20 kg ha<sup>-1</sup> as pre emergence + one hand weeding at 40 DAT/DAS) was most effective and significantly superior to all tank mix application of herbicides in reducing density of grasses *viz.* *Echinochloa colona*, *Echinochloa crusgalli*, *Eleusine indica*, *Brachiaria reptans*, *Cynodon dactylon*, *Sorghum halapense*, *Dactyloctenium aegyptium* and *Digitaria sanguinalis* followed by W<sub>6</sub> (Tank mix application of Fenoxaprop at 1.00 litre ha<sup>-1</sup> + Ethoxysulfuron at 0.12 kg ha<sup>-1</sup> at 18 DAT/DAS) (table 2). Similar finding was also reported by Chopra and Chopra (2003). All the herbicidal treatments had significantly minimum density of grasses then weedy check at tillering stage. This might be also due to the fact that pyrazosulfuron is basically related to Sulfonylureas group and inhibit the plant enzyme acetolactate synthase, which is involved in biosynthesis of protein in plants (Singh and Singh (2013) [24]. The ALS compounds inhibit the production of amino acid, valine, leucine and isoleucine in the weeds by binding to ALS enzyme (Tranel and Wright, 2002) [27], without these amino acids, protein synthesis and growth is inhibited ultimately causing weed death (WSSA 2007). In addition of one handweeding at 40-50 DAS/DAT with pyrazosulfuron also provided good control of weeds after 40 DAS/DAT (Singh *et*

al., 2012) [23] and controlled the weed population in aforesaid treatment.

**Table 1:** Appeared% of grasses as influenced by seeding techniques and weed management practices at tillering stage

S.No.	Name of the weed	Common name/ Hindi name	English name	Family	Habitat	Appeared %
1.	<i>Echinochloa colona</i>	Jungle rice	Shama millet	Poaceae	Annual	7.74
2.	<i>Echinochloa crusgalli</i>	Sawank	Common barnyardgrass	Poaceae	Annual	3.83
3.	<i>Eleusine indica</i>	Mandua	Goose grass	Poaceae	Annual	1.58
4.	<i>Brachiaria reptans</i>	Lemon grass	Running grass	Poaceae	Annual	2.90
5.	<i>Cynodon dactylon</i>	Doob ghass	Barmuda grass	Poaceae	Perennial	3.43
6.	<i>Sorghum halapense</i>	Johnson grass	Johnson grass	Poaceae	Perennial	9.56
7.	<i>Dactyloctenium aegyptium</i>	Four-finger grass	Crow foot grass	Poaceae	Annual	3.56
8.	<i>Digitaria sanguinalis</i>	Makada ghass	Hairy crabgrass	Poaceae	Annual	5.90
<b>Total grasses</b>						38.5

**Table 2:** Density of total grasses as influenced by seeding techniques and weed management practices at tillering stage

Treatments	Weed density (No. /m <sup>2</sup> )								
	<i>Echinochloa colona</i>	<i>Echinochloa crusgalli</i>	<i>Eleusine indica</i>	<i>Brachiaria reptans</i>	<i>Cynodon dactylon</i>	<i>Sorghum halapense</i>	<i>Dactyloctenium aegyptium</i>	<i>Digitaria sanguinalis</i>	Total grasses
<b>Seeding techniques (S)</b>									
S <sub>1</sub>	5.37	4.02	3.63	2.96	2.94	7.98	3.69	5.71	36.30
S <sub>2</sub>	9.67	6.24	7.16	5.79	5.65	14.97	6.72	13.37	69.57
S <sub>3</sub>	6.76	3.92	4.75	3.82	3.73	9.75	4.48	4.06	41.28
S <sub>4</sub>	7.13	3.98	5.37	4.40	4.24	10.97	5.05	6.27	47.41
F-test	NS	S	S	S	S	S	S	S	S
S.Ed. (±)	1.28	0.44	0.73	0.60	0.57	1.59	0.64	1.29	6.71
C.D. at 5%	3.14	1.07	1.78	1.48	1.40	3.90	1.58	3.16	16.42
<b>Weed management practices (W)</b>									
W <sub>1</sub>	19.05	11.69	14.09	11.41	11.13	30.41	13.25	20.73	131.76
W <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W <sub>3</sub>	3.43	2.73	2.68	2.18	2.05	5.55	2.72	3.33	24.68
W <sub>4</sub>	6.02	5.03	5.70	4.66	4.55	12.42	5.43	7.07	50.89
W <sub>5</sub>	7.05	3.53	4.70	3.79	3.69	7.60	4.49	5.50	40.36
W <sub>6</sub>	7.83	4.25	4.19	3.43	3.43	9.53	4.02	7.49	44.16
F-test	S	S	S	S	S	S	S	S	S
S.Ed. (±)	1.52	0.85	0.83	0.68	0.65	2.10	0.77	1.33	7.61
C.D. at 5%	3.08	1.71	1.67	1.38	1.31	4.24	1.57	2.70	15.38

S<sub>1</sub> = Transplanted rice in puddled soil; S<sub>2</sub> = Transplanted rice in non puddled soil; S<sub>3</sub> = DSR in puddled soil; S<sub>4</sub> = DSR in non puddled soil; W<sub>1</sub> = Weedy check (control); W<sub>2</sub> = Weed free; W<sub>3</sub> = Pyrazosulfuron at 0.20 kg ha<sup>-1</sup> as pre emergence + one hand weeding at 40 DAT/DAS; W<sub>4</sub> = Tank mix application of Bispyribac sodium at 0.25 litre ha<sup>-1</sup> + Fenoxaprop at 1.00 litre ha<sup>-1</sup> at 18 DAT/DAS; W<sub>5</sub> = Tank mix application of Bispyribac sodium at 0.25 litre ha<sup>-1</sup> + Ethoxysulfuron at 0.12 kg ha<sup>-1</sup> at 18 DAT/DAS; W<sub>6</sub> = Tank mix application of Fenoxaprop at 1.00 litre ha<sup>-1</sup> + Ethoxysulfuron at 0.12 kg ha<sup>-1</sup> at 18 DAT/DAS

**Conclusion**

From the present investigation we conclude that *Sorghum halapense* and *Echinochloa colona* were commonly found in rice field. P<sub>1</sub> (Transplanted rice in puddled soil) was the most suitable method for rice sowing. Among the herbicides W<sub>3</sub> (Pyrazosulfuron at 0.20 kg ha<sup>-1</sup> as pre emergence + one hand weeding at 40 DAT/DAS) was most effective and superior to all tank mix application of herbicides in reducing density of grasses.

**References**

1. Anonymous. Ministry of Agriculture & Cooperation, GOI, Agriculture statistics at a glance, 2010.
2. Moody K. Weed control in wet-seeded rice. *Exp. Agr.* 1993; 29:393-403.
3. Bhagat RM, Bhuiyan SI, Moody K, Estorninos LE. Effect of water, tillage and herbicide on ecology of weed

communities in intensive wet-seeded rice system. *Crop Prot.* 1999; 18:293-303.

4. Tuong TP, Pablico PP, Yamauchi M, Confesor R, Moody K. Increasing water productivity and weed suppression of wet-seeded rice: Effect of water management and rice genotypes. *Exp. Agr.* 2000; 36:71-89.
5. Phuong LT, Denich M, Vlek PLG, Balasubramanian V. Suppressing weeds in direct-seeded lowland rice: effects of methods and rates of seeding. *J Agron Crop Sci.* 2005; 191:185-194.
6. Chauhan BS. Weed ecology and weed management strategies for dry-seeded rice in Asia. *Weed Technol.* 2012; 26:1-13.
7. Mahajan G, Chauhan BS, Gill MS. Dry-seeded rice culture in Punjab state of India: lessons learned from farmers. *Field Crop. Res.* 2013; 144:89-99.

8. Chauhan BS, Opena J. Effect of tillage systems and herbicides on weed emergence, weed growth, and grain yield in dry-seeded rice systems. *Field Crops Res.* 2012; 137:56-69.
9. Chauhan BS, Johnson DE. The role of seed ecology in improving weed management strategies in the tropics. *Adv. Agron.* 2010; 105:221-262.
10. Chauhan BS, Johnson DE. Row spacing and weed control timing affect yield of aerobic rice. *Field Crops Res.* 2011; 121:226-231.
11. Chauhan BS, Mahajan G, Sardana V, Timsina J, Jat ML. Productivity and sustainability of the rice-wheat cropping system in the Indo-Gangetic Plains of the Indian subcontinent: problems, opportunities, and strategies. *Adv. Agron.* 2012; 117:315-369.
12. Chauhan BS, Awan TH, Abugho SB, Evengelista G, Yadav S. Effect of crop establishment methods and weed control treatments on weed management, and rice yield. *Field Crops Research.* 2015; 172:72-84.
13. Gangwar KS, Gill MS, Tomar OK, Pandey DK. Effect of crop establishment methods on growth, productivity and soil fertility of rice (*Oryza sativa*)-based cropping systems. *Indian Journal of Agronomy.* 2008; 53(2):102-106.
14. Gangwar KS, Singh KK, Sharma SK, Tomar OK. Alternative tillage and crop residue management in wheat after rice in sandy loam soils of Indo-Gangetic plains. *Soil & Tillage Research.* 2006; 88:242-252.
15. Joshi E, Kumar D, Lal B, Nepalia V, Gautam P, Vyas AK. Management of direct seeded rice for enhanced resource - use efficiency. *Plant Knowledge Journal.* 2013; 2(3):119-134.
16. Kumar S, Rane SS. Bioefficacy of Bispyricbac-sodium for Weed Control in Direct Seeded Rice. *Pesticide Research Journal.* 2013; 25(2):123-127.
17. Mandal MK, Duary B, De GC. Effect of crop establishment and weed management practices on weed growth and productivity of Basmati rice. *Indian Journal of Weed Science.* 2013; 45(3):166-170.
18. Prakash C, Shivran RK, Koli NR. Bioefficacy of new herbicides in transplanted rice. *Indian Journal of Weed Science.* 2013; 45(4):282-284.
19. Singh M, Sairam CV, Hanji MB, Prabhukumar S, Kishor Nand. Crop-weed competition and weed management studies in direct seeded rice (*Oryza sativa*). *Indian Journal of Agronomy.* 2012; 57(1):38-42.
20. Haas H, Streibig JC. Changing patterns of weed distribution as a result of herbicide use and other agronomic factors. In: Le Baron, H.M., Gressel, J. (Eds.), *Herbicide Resistance in Plants.* John Wiley & Sons, New York, 1982, 57-79.
21. Hall JC, Van Eerd LL, Miller SD, Owen MDK, Prather TS, Shaner DL *et al.* Future research directions for weed science. *Weed Technol.* 2000; 14:647-658.
22. Chopra NK, Chopra N. Effect of doses and stages of application of pyrazosulfuron ethyl on weeds in transplanted rice. *Indian Journal of Weed Science.* 2003; 35(1&2):27-28.
23. Shan FA, Bhat MA, Ganai MA, Hussain A, Bhat TA. Effect of crop establishment and weed control practices on the performance of rice (*Oryza sativa* L.). *Applied Biological Research.* 2012; 14(1):79-85.
24. Singh SB, Singh Neera. Degradation behaviour of Pyrazosulfuron-ethyl in water as affected by pH. *Journal of Environmental Science and Health. Part B* 2013; 48:266-271.
25. Singh A, Awasthi RP, Singh RD. Performance of rice under different methods of cultivation in hilly soils of Sikkim. *Indian J Agron.* 1997; 42(4):611-613.
26. Singh SK. Improving productivity and profitability of rice-wheat cropping system through different methods of crop establishment. *Oryza* 2012; 49(4):280-283.
27. Tranel PJ, Wright TR. Resistance of weeds to ALS-inhibiting herbicides: what have we learned? *Weed Sci.*, 2002; 50:700-712.
28. WSSA (Weed Science Society of America). *Herbicide Handbook*, 9th (ed. W. K. Vencill) Lawrence, KS. 2007, 493.