The Andhra Agric. J 69 (4): 465-471, 2022

Studies on Nutrient Uptake by Weeds as influenced by Different Weed Management Practices in Direct Sown Rice

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ABSTRACT

The experiment was conducted under field conditions at Agricultural College farm, Bapatla, Guntur, Andhra Pradesh during *Kharif* 2015–2016 and 2016–2017 to assess the effect of sequential application of herbicides in direct sown rice. The experiment was laid out in complete randomized block design with three replications. The pre emergence application of bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor with safener at 500 g a.i. ha^{-1} *fb* post emergence application of azimsulfuron @ 20 g a.i. ha^{-1} at 25 DAS *fb* post emergence application of metsulfuron methyl and chlorimuron ethyl @ 4 g a.i. ha^{-1} applied at 45 DAS recorded lower uptake of Nitrogen, Phosphorous and Potassium by weeds and significantly the highest uptake was noticed in weed check plot.

Keywords: *Direct sown rice, Nitrogen, Phosphorus, Potassium, Uptake and Weed management.*

Weed is a significant element that influences several growth factors and eventually influences yield direct seeded Rice (Ujjwal Bishnoi and Sandeep Menon, 2022). In the tropics in general and India in particular, rice is the main crop grown for food. In terms of food and nutritional security for Asian nations, the phrase “Rice is Life” perfectly captures the significance of rice (Jyothi Basu *et al.,* 2021). It is grown in 2.21 million hectares in Andhra Pradesh, with a productivity of 3.73 t ha^{-1} and an annual production of 8.23 million tons (Reserve Bank of India, 2020). Weed losses rank among the most significant of the many reasons of reduced rice productivity. The greatest threat to crop output in India is weeds, which account for 33% of all pest-related losses (Verma *et al.,* 2015). Irrespective of the method of rice establishment, weeds are a major impediment to rice production due to their ability to compete for resources. In general, weeds problem in transplanted paddy is lower than that of direct-seeded rice (Rao *et al.,* 2007). In some parts of Asia, direct-seeding rice is gaining popularity as a labor- and money-saving technique that can replace transplanting. Weeds have been determined to be the major biological constraint during direct planting compared to transplanted rice because they emerge concurrently with rice seedlings (Rao and Nagamani, 2013). In this context, the present investigation was carried out to study the effect of weed management practices on nutrient uptake by weeds as influenced by different weed management practices in direct sown rice.

MATERIAL AND METHODS

A field experiments were conducted during two rainy seasons (2015-16 and 2016-17) at northern block of Agricultural College Farm, Bapatla, Guntur, Andhra Pradesh. The soil of the experimental site was sandy loam in texture, slightly alkaline in reaction (pH 8.0 and 7.5), low in organic carbon (0.45 and 0.48%), low in available nitrogen (212 and 230 kg ha^{-1}) and available phosphorus (17 and 18 kg ha^{-1}) and medium in available potassium (261 and 285 kg ha^{-1}). The experiment was laid out randomized complete block design with fourteen treatments, which are given in Table 1.

Hand operated knapsack sprayer fitted with a flat-fan type nozzle was used for spraying the herbicide adopting a spray volume of 500 l ha^{-1}. Application of fertilizers was done as per the recommendation *i.e.* 120 kg N, 60 kg P_2O_5 and 60 kg K_2O ha^{-1} in the form of urea, single superphosphate and muriate of potash respectively. Nitrogen was applied in 3 equal splits at sowing, active tillering and panicle initiation stage. Entire quantity of phosphorus

Table 1. Treatments used in the present expriments

Treatments	Dose (g ha-1)	Time (DAS)
T_1. Pyrazosulfuron ethyl *fb* Azimsulfuron	25 *fb* 20	Pre *fb* Post
T_2. Pyrazosulfuron ethyl *fb* Bispyribac-sodium	25 *fb* 25	Pre *fb* Post
T_3. Bensulfuron methyl + Pretilachlor with safener *fb* Azimsulfuron	60 + 500 *fb* 20	Pre *fb* Post
T_4. Bensulfuron methyl + Pretilachlor with safener *fb* Bispyribac-sodium	60 + 500 *fb* 25	Pre *fb* Post
T_5. Oxadiargyl *fb* Azimsulfuron	75 *fb* 20	Pre *fb* Post
T_6. Oxadiargyl *fb* Bispyribac-sodium	75 *fb* 25	Pre *fb* Post
T_7. Pyrazosulfuron ethyl *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	25 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post
T_8. Pyrazosulfuron ethyl *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	25 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post
T_9. Bensulfuron methyl + Pretilachlor with safener *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	60 + 500 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post
T_{10}. Bensulfuron methyl + Pretilachlor with safener *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	60 + 500 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post
T_{11}. Oxadiargyl *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	75 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post
T_{12}. Oxadiargyl *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	75 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post
T_{13}. Weed free	-	-
T_{14}. Weedy check	-	-

was applied as basal. Potassium was applied in 2 splits 2/3 as basal and 1/3 at panicle initiation stage along with urea. Other agronomic and plant protection measures were adopted as recommended during the crop growth. The weed samples collected for dry matter estimation from different treatments were dried, powdered and analyzed for the total nitrogen, phosphorus and potassium by following standard methods as listed in the following table. Uptake was calculated by multiplying the nutrient content with the respective dry matter weight of grain and straw, which were summed up to estimate total N uptake at harvest.

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient concentration (\%) x weight of dry matter (kg/ha)}}{100}$$

Nutrient	Method
Nitrogen	Microkjeldhal distillation (Bremner, 1965)
Phosphorus	Vando-molybdo-phosphoric yellow colour method (Koeing and Johnson, 1942)
Potassium	Flame photometer (Jackson, 1973)

After harvest and threshing of crop, grain yield was recorded in net plot wise and converted to grain yield per hectare. The data of each year was analyzed separately. The data on weeds were transformed by square root transformation by adding one before being subjected to ANOVA (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Nitrogen uptake by weeds (kg ha^{-1})

Total Nitrogen uptake by weeds at different crop growth stages during both the years of study as affected by weed management practices is presented in Table 2.

At 30 DAS, all herbicide treated plots recorded significantly lower Nitrogen uptake by weeds than weedy check (T_{14}). The treatment T_9 (pre emergence application of bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor with safener at 500 g a.i. ha^{-1} *fb* post emergence application of azimsulfuron @ 20 g a.i. ha^{-1} at 25 DAS *fb* post emergence application of metsulfuron methyl and chlorimuron ethyl @ 4 g a.i. ha^{-1} applied at 45 DAS) recorded the lowest Nitrogen uptake by weeds (1.9 and 1.8 kg ha^{-1} during 2015-16 and 2016-17, Respectively) similar trend was observed at 60 DAS and Harvest of the crop.

These findings are in agreement with Mishra and Singh (2008) and Duary *et al.* (2015).

Phosphorus uptake by weeds (kg ha^{-1})

Phosphorus uptake by weeds was significantly influenced by different weed management practices during both the years of study (Table 2). At 30 DAS, the lowest weed dry weight (2.1 and 2.2 kg ha^{-1}) was recorded with pre emergence application of bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor with safener at 500 g a.i. ha^{-1} *fb* post emergence application of azimsulfuron @ 20 g a.i. ha^{-1} at 25 DAS *fb* post emergence application of metsulfuron methyl and chlorimuron ethyl @ 4 g a.i. ha^{-1} applied at 45 DAS (T_9), which was significantly superior to over weedy check (T_{14}) (7.0 and 5.5 kg ha^{-1}), similar pattern was seen at 60 DAS and crop harvest. These findings are in agreement with Mishra and Singh (2008) and Duary *et al.* (2015).

Potassium uptake by weeds (kg ha^{-1})

At 30 DAS, the weed control treatment T_9 (pre emergence application of bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor with safener at 500 g a.i. ha^{-1} *fb* post emergence application of azimsulfuron @ 20 g a.i. ha^{-1} at 25 DAS *fb* post emergence application of metsulfuron methyl and chlorimuron ethyl @ 4 g a.i. ha^{-1} applied at 45 DAS) registered the lowest Potassium uptake by weeds (3.2 and 2.5 kg ha^{-1}) over rest of the treatments (Table 4). Obviously the highest Potassium uptake by weeds was associated with treatment weedy check (T_{14}) which was higher than any other weed management treatments. These findings are in agreement with Mishra and Singh (2008) and Duary *et al.* (2015).

Overall, the weed management practices were found to have a significant influence in controlling broad spectrum of weeds associated with rice crop. Consequently the nutrient uptake by weeds presented a distinctive trend of reduced nutrient uptake under effective weed management measures during both the years of study. N, P and K uptake by weeds in weed free treatment was comparable with pre-emergence application of bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor with safener at 500 g a.i. ha^{-1} *fb* post-emergence application of azimsulfuron @ 20 g a.i. ha^{-1} at 25 DAS *fb* post-emergence application of metsulfuron methyl and chlorimuron ethyl @ 4 g a.i. ha^{-1} applied at 45 DAS (T_9). Of all the weed management practices, weedy check distinctly proved to manifest higher nutrient uptake owing to its biomass production compared to rest of the treatments during both the years of study.

Among the herbicides, application of bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor with safener at 500 g a.i. ha^{-1} *fb* post-emergence application of azimsulfuron @ 20 g a.i. ha^{-1} at 25 DAS *fb* post-emergence application of metsulfuron methyl and chlorimuron ethyl @ 4 g a.i. ha^{-1} applied at 45 DAS was effective in was evidenced lower biomass and uptake of nutrients by weeds.

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Table2. Nitrogen uptake (kg ha^{-1}) by weeds at different growth stages of direct seeded rice as influenced by weed management practices during *kharif* 2015-16 and 2016-17

Treatments	Dose (g ha^{-1})	Time (DAS)	30DAS		60DAS		At harvest	
			2015	2016	2015	2016	2015	2016
T_1. Pyrazosulfuron ethyl *fb* Azimsulfuron	25 *fb* 20	Pre *fb* Post	3.4	3.2	10.9	9.3	15.7	14.5
T_2. Pyrazosulfuron ethyl *fb* Bispyribac-sodium	25 *fb* 25	Pre *fb* Post	3.8	3.6	11.1	10.2	19.2	17.8
T_3. Bensulfuron methyl + Pretilachlor with safener *fb* Azimsulfuron	60 + 500 *fb* 20	Pre *fb* Post	1.8	1.9	9.4	8.1	12.6	11.5
T_4. Bensulfuron methyl + Pretilachlor with safener *fb* Bispyribac-sodium	60 + 500 *fb* 25	Pre *fb* Post	2.4	2.2	10.0	9.1	14.8	15.6
T_5. Oxadiargyl *fb* Azimsulfuron	75 *fb* 20	Pre *fb* Post	4.9	4.2	11.6	10.8	19.9	19.4
T_6. Oxadiargyl *fb* Bispyribac-sodium	75 *fb* 25	Pre *fb* Post	5.3	4.8	11.9	11.2	23.5	22.0
T_7. Pyrazosulfuron ethyl *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	25 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post	3.3	3.6	6.6	4.9	11.1	10.7
T_8. Pyrazosulfuron ethyl *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	25 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post	3.5	3.9	7.2	5.7	12.8	11.6
T_9. Bensulfuron methyl + Pretilachlor with safener *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	60 + 500 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post	1.9	1.8	5.1	4.2	8.6	7.2
T_{10}. Bensulfuron methyl + Pretilachlor with safener *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	60 + 500 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post	2.1	1.9	5.8	4.7	10.5	8.4
T_{11}. Oxadiargyl *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	75 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post	4.4	4.1	7.9	6.3	13.7	12.7
T_{12}. Oxadiargyl *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	75 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post	5.1	4.9	7.9	6.3	14.4	13.4
T_{13}. Weed free	-	-	0.0	0.0	0.0	0.0	0.0	0.0
T_{14}. Weedy check	-	-	12.8	14.9	25.6	21.2	37.1	32.7
SEm ±	-	-	0.7	0.5	1.3	1.5	1.6	1.2
CD (P = 0.05)	-	-	2.0	1.5	3.7	4.2	4.6	3.5

Table 3. Phosphorus uptake (kg ha^{-1}) by weeds at different growth stages of direct seeded rice as influenced by weed management practices during *kharif* 2015-16 and 2016-17

Treatments	Dose (g ha^{-1})	Time (DAS)	30DAS		60DAS		At harvest	
			2015	2016	2015	2016	2015	2016
T_1. Pyrazosulfuron ethyl *fb* Azimsulfuron	25 *fb* 20	Pre *fb* Post	2.8	2.6	3.7	3.5	4.2	4.4
T_2. Pyrazosulfuron ethyl *fb* Bispyribac-sodium	25 *fb* 25	Pre *fb* Post	2.9	2.7	4.0	3.7	4.8	4.5
T_3. Bensulfuron methyl + Pretilachlor with safener *fb* Azimsulfuron	60 + 500 *fb* 20	Pre *fb* Post	2.3	2.2	3.3	3.1	3.6	3.6
T_4. Bensulfuron methyl + Pretilachlor with safener *fb* Bispyribac-sodium	60 + 500 *fb* 25	Pre *fb* Post	2.5	2.4	3.7	3.2	3.8	3.7
T_5. Oxadiargyl *fb* Azimsulfuron	75 *fb* 20	Pre *fb* Post	3.3	3.2	4.3	4.1	5.3	5.0
T_6. Oxadiargyl *fb* Bispyribac-sodium	75 *fb* 25	Pre *fb* Post	3.6	3.9	4.6	4.4	5.7	5.3
T_7. Pyrazosulfuron ethyl *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	25 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post	2.6	2.7	3.1	3.2	3.4	3.1
T_8. Pyrazosulfuron ethyl *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	25 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post	2.9	2.9	3.3	3.2	3.7	3.3
T_9. Bensulfuron methyl + Pretilachlor with safener *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	60 + 500 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post	2.1	2.2	2.5	2.5	2.9	2.6
T_{10}. Bensulfuron methyl + Pretilachlor with safener *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	60 + 500 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post	2.4	2.4	2.6	2.7	3.3	3.1
T_{11}. Oxadiargyl *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	75 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post	3.2	3.2	3.3	3.2	4.1	3.9
T_{12}. Oxadiargyl *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	75 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post	3.5	3.4	3.8	3.6	4.4	3.9
T_{13}. Weed free	-	-	0.0	0.0	0.0	0.0	0.0	0.0
T_{14}. Weedy check	-	-	7.0	5.5	8.4	6.7	11.0	9.3
SEm ±	-	-	0.4	0.4	0.4	0.4	0.4	0.5
CD (P = 0.05)	-	-	1.3	1.3	1.2	1.2	1.1	1.4

Table 4. Potassium uptake (kg ha^{-1}) by weeds at different growth stages of direct seeded rice as influenced by weed management practices during *kharif* 2015-16 and 2016-17

Treatments	Dose (g ha^{-1})	Time (DAS)	30DAS		60DAS		At harvest	
			2015	2016	2015	2016	2015	2016
T_1. Pyrazosulfuron ethyl *fb* Azimsulfuron	25 *fb* 20	Pre *fb* Post	4.5	4.7	6.6	6.5	8.7	7.5
T_2. Pyrazosulfuron ethyl *fb* Bispyribac-sodium	25 *fb* 25	Pre *fb* Post	4.8	4.9	6.7	6.8	9.1	7.7
T_3. Bensulfuron methyl + Pretilachlor with safener *fb* Azimsulfuron	60 + 500 *fb* 20	Pre *fb* Post	3.5	2.9	5.3	4.7	7.5	5.9
T_4. Bensulfuron methyl + Pretilachlor with safener *fb* Bispyribac-sodium	60 + 500 *fb* 25	Pre *fb* Post	4.0	3.6	5.7	4.9	7.7	6.0
T_5. Oxadiargyl *fb* Azimsulfuron	75 *fb* 20	Pre *fb* Post	5.4	5.3	7.8	7.4	9.4	8.5
T_6. Oxadiargyl *fb* Bispyribac-sodium	75 *fb* 25	Pre *fb* Post	6.9	5.4	8.7	7.8	9.7	8.7
T_7. Pyrazosulfuron ethyl *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	25 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post	4.8	4.9	5.6	5.6	6.6	6.5
T_8. Pyrazosulfuron ethyl *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	25 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post	5.4	5.1	6.3	6.4	7.1	7.3
T_9. Bensulfuron methyl + Pretilachlor with safener *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	60 + 500 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post	3.2	2.5	4.3	3.5	5.3	4.6
T_{10}. Bensulfuron methyl + Pretilachlor with safener *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	60 + 500 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post	3.8	2.9	4.5	4.3	5.7	4.9
T_{11}. Oxadiargyl *fb* Azimsulfuron *fb* Metsulfuron methyl + Chlorimuron ethyl	75 *fb* 20 *fb* 4	Pre *fb* Post *fb* Post	5.1	5.0	5.7	6.2	6.7	7.4
T_{12}. Oxadiargyl *fb* Bispyribac-sodium *fb* Metsulfuron methyl + Chlorimuron ethyl	75 *fb* 25 *fb* 4	Pre *fb* Post *fb* Post	5.7	5.5	6.1	6.7	7.4	7.6
T_{13}. Weed free	-	-	0.0	0.0	0.0	0.0	0.0	0.0
T_{14}. Weedy check	-	-	14.9	12.2	17.6	16.5	20.6	19.7
SEm ±	-	-	0.6	0.5	0.9	0.7	0.8	0.8
CD (P = 0.05)	-	-	1.7	1.4	2.5	2.1	2.3	2.4

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Received on 01.06.2022 and Accepted on 26.12.2022