

Weed Management in Semidry Rice

K Hemalatha, A V Ramana, K V Ramana Murthy and J Jagannadam

Department of Agronomy, Agricultural College, Naira 532 185, Andhra Pradesh

ABSTRACT

A field experiment was conducted during *kharif*, 2014 in sandy loam soils of Agricultural College Farm, Naira, to find out the effect of weed management practices on growth and yield of semidry rice. The experiment was laid out in randomized block design with ten treatments which were replicated thrice. It was found that superior performance of rice in terms of growth, yield attributes and yield was observed with pre-emergence application of pendimethalin @ 0.75 kg a.i ha⁻¹ at 3-5 DAS *fb* post-emergence application of metsulfuron methyl + chlorimuron ethyl @ 4 g a.i ha⁻¹ at 20-25 DAS (T₁₀) which was comparable with weed free check (T₂). Among the weed control treatments maximum grain yield (5396 kg ha⁻¹) was associated with pre-emergence application of pendimethalin @ 0.75 kg a.i ha⁻¹ at 3-5 DAS *fb* post-emergence application of metsulfuron methyl + chlorimuron ethyl @ 4 g a.i ha⁻¹ at 20-25 DAS (T₁₀).

Key words : Herbicides, Semidry rice, Weeds, Yield.

Declining profitability of transplanted rice due to increasing production costs and plateauing yield levels have encouraged rice farmers to shift from traditional transplanting to direct seeding. Adoption of direct-seeded rice has resulted in a change in the relative abundance of weed species in rice crop. The outcome of competition would depend not only on the competing species but also on their density, duration and level of fertility. Weeds pose a serious problem in semidry rice production system due to the prevalence of congenial atmosphere for its growth during monsoon season and uncontrolled weed growth reported to reduce yield up to 30.2% (Singh *et al.*, 2005). The shift from transplanted to direct-seeded rice results in more aggressive weed flora and increased reliance on herbicides, owing to increasing labour problem and in view of time consuming, cumbersome and less effective nature of cultural and mechanical methods of weed control.

Recently a number of low dose sulfonylurea herbicides like metsulfuron methyl (MSM), chlorimuron ethyl (CME) and MSM + CME (almix) etc. have been developed which control grassy and non-grassy weeds in cereals. These low doses herbicides are eco-friendly in nature. The present era of low dose herbicide use

has started with the discovery of sulfonylureas, which is characterized by crop selective weed control at use rates of 2-100 g ha⁻¹. It has been observed that individual herbicides like metsulfuron methyl, chlorimuron ethyl, butachlor, anilofos, 2, 4-DEE, which are effective on certain weed species fail to control other weed species. Hence, to have a broad-spectrum weed control in single application, herbicide mixtures (both concocted and tank) were tried and found to be effective. The simultaneous application of more than one herbicide in a mixture is increasingly becoming a standard practice in modern weed control strategies, particularly in the absence of effective broad spectrum herbicides to control highly diverse weed populations.

MATERIAL AND METHODS

A field experiment was conducted during *kharif*, 2014 at the Agricultural College, Naira, Andhra Pradesh. The soil was sandy loam in texture with a pH of 6.5 and EC of 0.15 dSm⁻¹, low in organic carbon (0.33%) and available nitrogen (174 kg ha⁻¹), medium in available phosphorus (38 kg ha⁻¹) and potassium (264 kg ha⁻¹). Rice variety »Vijetha¹/₄ was sown by using line markers at 20 cm row spacing with solid rows with a seed rate of 75 kg ha⁻¹ on 26th july, 2014. During the crop

growing period, 723.9 mm rainfall in 36 rainy days was received. The plot size was 6 m × 4 m. The experiment was laid out in randomized block design with three replications. The treatments consisted of ten different weed management practices viz., T₁: Weedy check, T₂: Hand weeding twice at 20 and 40 DAS (weed free check), T₃: Pendimethalin @ 0.75 kg a.i ha⁻¹ as pre-emergence application at 3-5 DAS, T₄: Orthosulfamuron @ 100 g a.i ha⁻¹ as pre-emergence application at 3-5 DAS, T₅: Orthosulfamuron @ 100 g a.i ha⁻¹ as post-emergence application at 20-25 DAS, T₆: Ethoxysulfuron @ 20 g a.i ha⁻¹ post-emergence application at 20-25 DAS, T₇: Metsulfuron methyl + Chlorimuron ethyl @ 4 g a.i ha⁻¹ as post-emergence application at 20-25 DAS, T₈: T₃ followed by T₅, T₉: T₃ followed by T₆, T₁₀: T₃ followed by T₇. The herbicides were applied with knapsack sprayer; using spray volume of 500 l ha⁻¹. The crop was harvested on 2nd December, 2014.

The density and dry weight of weeds were taken at 30, 60 DAS and at harvest in each plot using a quadrat of 0.25m². Weed species in each quadrat were separated and dried in shade initially and later oven dried till the constant weight was recorded. The data on density and dry weight of weeds were subjected to square-root transformation and statistically analysed following standard procedure. Weed Management Index (WMI) was calculated by using the formula suggested by Devasanapathy *et al.* (2008).

$$\text{WMI} = \frac{\% \text{ of crop yield over control}}{\% \text{ of control of weeds}}$$

RESULTS AND DISCUSSION

Weed flora

All together there were 11 species of weed flora that belong to seven different families were recorded in the experimental field. Among them, *Echinochloa colona*, *Echinochloa crusgalli* and *Cynodon dactylon* were grasses, *Cyperus rotundus*, *Cyperus difformis*, *Fimbristylis miliaceae* were sedges while, *Eclipta alba*, *Ludwigia parviflora*, *Ammania baccifera*, *Euphorbia hirta*, *Trianthema portulacastrum* were broad leaved weed. However, *Echinochloa colona* and *Echinochloa crusgalli* among

grasses, *Cyperus rotundus* among sedges and *Eclipta alba* and *Ludwigia parviflora* among broad leaved weed were dominant throughout the crop growth period.

Effect on weeds

Statistically detectable disparities were noticed with respect to total weed density (Table 1). The lowest total weed density among the herbicide treatments was registered with T₄ (pre-emergence application orthosulfamuron @ 100 g a.i ha⁻¹), T₈ (pre-emergence application of pendimethalin @ 0.75 kg a.i ha⁻¹ fb orthosulfamuron @ 100 g a.i ha⁻¹) and T₁₀ (pre-emergence application of pendimethalin @ 0.75 kg a.i ha⁻¹ fb post-emergence application metsulfuron methyl + chlorimuron ethyl @ 4 g a.i ha⁻¹) which were on par with each other as well as with weed free check (T₂) and significantly superior to rest of the herbicide treatments and weedy check (T₁). Better performance exhibited by T₄ and T₁₀ in reducing the total weed density might be due to the reason that it was able to control both grassy as well as broad leaved weeds effectively at 60DAS and at harvest. Better performance of orthosulfamuron, pendimethalin and metsulfuron methyl + chlorimuron ethyl in reducing total weed density has also been reported by Ramana *et al.* (2007).

Environment for a fairly long period for the weeds to emerge and grow as seen from significant Pre-emergence application of pendimethalin @ 0.75 kg a.i ha⁻¹ fb metsulfuron methyl + chlorimuron ethyl @ 4 g a.i ha⁻¹ as post-emergence (T₁₀) exhibited its superiority over rest of the treatments by registering the lowest total dry weight of weeds which was however, comparable with weed free check (T₂). Sequential application of pendimethalin fb metsulfuron methyl + chlorimuron ethyl (T₁₀) was found to be highly efficacious in reducing total weed dry weight as reflected from the perusal of the data at harvest (Table 1). Superior performance of herbicides in reducing the weed dry weight due to sequential application compared to alone application has been reported Narolia *et al.*, 2014.

Pre-emergence application of pendimethalin fb post-emergence application of metsulfuron methyl + chlorimuron ethyl (T₁₀) registered the highest weed control efficiency (89.7%) which was comparable with weed free

Table 1. Total weed density, total weed dry weight, weed control efficiency (WCE) and weed management index at harvest as influenced by different weed control treatments.

Treatments	Total weed density (No. m ⁻²)	Total dry weight of weeds (g m ⁻²)	Weed control efficiency (%)	Weed management index
T ₁ : Weedy check	16.1 (259.9)	16.9 (283.4)	-	0.71 (0)
T ₂ : Hand weeding twice at 20 and 40 DAS (weed free check)	6.0 (35.7)	5.2 (26.7)	72.1 (90.6)	1.12 (0.75)
T ₃ : Pendimethalin @ 0.75 kg a.i ha ⁻¹ as pre-emergence at 3-5 DAS	12.8 (163.2)	10.9 (119.0)	49.6 (58.0)	1.07 (0.64)
T ₄ : Orthosulfamuron @ 100 g a.i. ha ⁻¹ as pre-emergence at 3-5 DAS	7.0 (48.9)	6.9 (47.7)	65.7 (83.1)	1.11 (0.74)
T ₅ : Orthosulfamuron @ 100 g a.i. ha ⁻¹ as post-emergence at 20-25 DAS	12.7 (160.4)	9.4 (87.6)	56.2 (69.1)	1.07 (0.64)
T ₆ : Ethoxysulfuron @ 20 g a.i ha ⁻¹ post-emergence at 20-25 DAS	12.2 (149.6)	9.0 (80.9)	57.7 (71.4)	1.10 (0.71)
T ₇ : Metsulfuron methyl + chlorimuron ethyl@ 4 g a.i ha ⁻¹ as post-emergence at 20-25 DAS	11.7 (136.6)	8.0 (63.9)	61.7 (77.4)	1.10 (0.71)
T ₈ : T ₃ followed by T ₅	7.5 (55.2)	6.9 (48.2)	65.6 (82.9)	1.11 (0.74)
T ₉ : T ₃ followed by T ₆	8.1 (65.2)	7.7 (59.5)	62.7 (78.9)	1.11 (0.74)
T ₁₀ : T ₃ followed by T ₇	6.1 (37.5)	5.4 (29.1)	71.3 (89.7)	1.12 (0.75)
S.Em ±	0.7	0.3	1.5	0.08
CD (P=0.05)	2.2	0.9	4.5	0.02
CV (%)	12.9	6.2	4.6	1.3

Data were subjected to square root transformation $\sqrt{x + 0.5}$ except for WCE which was subjected to arc sine transformation. Figures in parentheses are original values.

check (90.6%). The highest weed control efficiency associated with T₁₀ might be due to the fact that the successive application of two herbicides at an interval of 20 days created an adverse reduction in total weed dry matter which was comparable with weed free check (T₂). The results of the present investigation was in conformity with those reported by Narolia *et al.* (2014) who also obtained significant increase in weed control efficiency with sequential application of herbicides.

Among the weed control treatments, except T₃ (pre-emergence application of pendimethalin) and T₅ (post-emergence application of orthosulfamuron), all other herbicide treatments recorded significantly higher values for weed management index which were comparable with

each other as well as with weed free check (T₂). Comparable performance of the herbicide applied treatments except T₃ and T₅ with that of the weed free check (T₂) could be attributed to enhanced weed control efficiency of the herbicides that reflected in inflated yield levels. Comparative values for weed management index due to application of herbicides with that of weed free check was also reported by Abdul Khaliq *et al.* (2012).

Effect on crop

Statistical detectable disparities were noticed among the herbicide treatments with regard to plant height (Table 2). Maximum plant height was recorded in plots where weed free

Table 2. Growth parameters of semidry rice as influenced by different weed control treatments.

Treatments	Plant height (cm)	Dry matter production (kg ha ⁻¹)	Productive Tillers (m ⁻²)
T ₁ : Weedy check	78.1	8776.2	122
T ₂ : Hand weeding twice at 20 and 40 DAS (weed free check)	102.0	12748.2	312
T ₃ : Pendimethalin @ 0.75 kg a.i ha ⁻¹ as pre-emergence at 3-5 DAS	86.8	10211.3	207
T ₄ : Orthosulfamuron @ 100 g a.i. ha ⁻¹ as pre-emergence at 3-5 DAS	100.3	11583.6	304
T ₅ : Orthosulfamuron @ 100 g a.i. ha ⁻¹ as post- emergence at 20-25 DAS	87.3	10302.6	224
T ₆ : Ethoxysulfuron @ 20 g a.i ha ⁻¹ post-emergence at 20-25 DAS	89.1	10684.8	238
T ₇ : Metsulfuron methyl + chlorimuron ethyl@ 4 g a.i ha ⁻¹ as post-emergence at 20-25 DAS	92.4	11174.6	250
T ₈ : T ₃ followed by T ₅	96	11369.4	295
T ₉ : T ₃ followed by T ₆	95.1	11184.6	284
T ₁₀ : T ₃ followed by T ₇	101.4	12756.3	311
S.Em ±	1.2	386.9	8.3
CD (P=0.05)	3.7	1149.7	24.8
CV (%)	2.3	6.1	5.7

Table 3. Yield attributes of semidry rice as influenced by different weed control treatments.

Treatments	Filled grains panicle ⁻¹	Panicle length (cm)	Test weight (g)
T ₁ : Weedy check	95	19.9	20.9
T ₂ : Hand weeding twice at 20 and 40 DAS (weed free check)	151	23.8	22.4
T ₃ : Pendimethalin @ 0.75 kg a.i ha ⁻¹ as pre-emergence at 3-5 DAS	110	20.8	20.4
T ₄ : Orthosulfamuron @ 100 g a.i. ha ⁻¹ as pre-emergence at 3-5 DAS	140	23.6	22.0
T ₅ : Orthosulfamuron @ 100 g a.i. ha ⁻¹ as post- emergence at 20-25 DAS	113	21.7	21.0
T ₆ : Ethoxysulfuron @ 20 g a.i ha ⁻¹ post-emergence at 20-25 DAS	116	21.9	21.2
T ₇ : Metsulfuron methyl + chlorimuron ethyl@ 4 g a.i ha ⁻¹ as post-emergence at 20-25 DAS	119	22.2	21.5
T ₈ : T ₃ followed by T ₅	133	23.0	21.9
T ₉ : T ₃ followed by T ₆	125	22.6	21.7
T ₁₀ : T ₃ followed by T ₇	149	23.7	22.2
S.Em ±	3.8	0.2	0.4
CD (P=0.05)	11.4	0.5	NS
CV (%)	5.3	1.4	3.6

Table 4. Grain yield, straw yield and harvest index of rice as influenced by different weed control treatments.

Treatments	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Harvet index (%)
T ₁ : Weedy check	1971	3049	39.7
T ₂ : Hand weeding twice at 20 and 40 DAS (weed free check)	5402	6967	43.6
T ₃ : Pendimethalin @ 0.75 kg a.i ha ⁻¹ as pre-emergence at 3-5 DAS	3018	4701	39.1
T ₄ : Orthosulfamuron @ 100 g a.i. ha ⁻¹ as pre-emergence at 3-5 DAS	4936	6458	43.4
T ₅ : Orthosulfamuron @ 100 g a.i. ha ⁻¹ as post- emergence at 20-25 DAS	3496	5024	41.0
T ₆ : Ethoxysulfuron @ 20 g a.i ha ⁻¹ post-emergence at 20-25 DAS	3996	5694	41.2
T ₇ : Metsulfuron methyl + chlorimuron ethyl@ 4 g a.i ha ⁻¹ as post-emergence at 20-25 DAS	4230	5707	42.6
T ₈ : T ₃ followed by T ₅	4711	6238	43.0
T ₉ : T ₃ followed by T ₆	4680	6283	42.7
T ₁₀ : T ₃ followed by T ₇	5396	6966	43.6
S.Em ±	116.0	186.9	1.3
CD (P=0.05)	344.8	555.5	NS
CV (%)	4.8	5.7	5.4

environment was maintained (T₂) which was however, found parity with pre-emergence application of orthosulfamuron (T₄) and pendimethalin *fb* metsulfuron methyl + chlorimuron ethyl (T₁₀). Statistically comparable values for plant height might be due to the fact that the sequential application of pre *fb* post-emergence herbicides has suppressed weeds effectively from the beginning of the crop growth compared to other treatments. Increase in plant height of rice with sequential application of herbicides was also reported by Chongtham *et al.* (2015) which was in agreement with the present findings.

Pre-emergence application of orthosulfamuron (T₄) recorded comparable values for dry matter production to that of post-emergence application of orthosulfamuron @ 100 g a.i ha⁻¹ (T₅), ethoxysulfuron @ 20 g a.i ha⁻¹ (T₆), metsulfuron methyl + chlorimuron ethyl @ 4 g a.i ha⁻¹ (T₇) and sequential application of pendimethalin @ 0.75 kg a.i ha⁻¹ *fb* orthosulfamuron @ 100 g a.i ha⁻¹ (T₈), pendimethalin @ 0.75 kg a.i ha⁻¹ *fb* ethoxysulfuron

@ 20 g a.i ha⁻¹ (T₉) and pendimethalin @ 0.75 kg a.i ha⁻¹ *fb* metsulfuron methyl + chlorimuron ethyl @ 4 g a.i ha⁻¹ (T₁₀) which in turn found parity with weed free check (T₂). Accumulation of higher dry matter is the outcome of better weed free environment manifested by timely and effective weed control which in turn responsible for creation of congenial conditions for availability of adequate amounts of nutrients, space, light as well as stress free environment in the early growth phase (before conversion to wet), all might have enabled greater accumulation of dry matter. Enhanced dry matter production due to efficient weed control has been an undisputed fact as could be visualized from widely documented research evidence (Chongtham *et al.*, 2015, Narolia *et al.*, 2014).

Weed free check (T₂) produced significantly higher number of productive tillers m⁻² which was however, on par with pendimethalin *fb* metsulfuron methyl + chlorimuron ethyl (T₁₀), pendimethalin *fb* orthosulfamuron (T₈) and pre-emergence application of orthosulfamuron (T₄).

The highest no. of productive tillers m^{-2} in T_{10} , T_8 and T_4 might be due to the efficacy of herbicides in successful control of a broad-spectrum of weeds which enabled the semidry rice to produce significantly large number of productive tillers m^{-2} . While, the intense competition prevailed due to high weed density throughout the crop growing period might have resulted in adverse environment for rice crop to convert total tillers to productive tillers due to insufficient growth factors leading to large gap between these two parameters. Higher number of productive tillers due to effective suppression of weeds was also evidenced by Zahoor Ahmad Ganie *et al.*, 2014 which was in conformity with the findings of the present investigation.

Weed management practices were found to influence the yield attributing characters markedly. Filled grains panicle⁻¹ and panicle length were noticed with pendimethalin *fb* metsulfuron methyl + chlorimuron ethyl (T_{10}), pendimethalin *fb* orthosulfamuron (T_8) and pre-emergence application of orthosulfamuron (T_4) which were comparable with weed free check (T_2). Thousand grain weight did not alter significantly due to weed management practices. Effective suppression of weed growth throughout the critical period of crop-weed competition might have enabled semidry rice to bear promising architecture for yield attributes, both in T_4 and T_{10} among herbicides as well as in weed free check (T_2). Test weight being largely governed by genetic constitution of the cultivar did not alter significantly due to weed control treatments. The results obtained in the present investigation also corroborating with the earlier findings of several fellow agronomists (Zahoor Ahmad Ganie *et al.*, 2014 and Ramana *et al.*, 2007).

Maximum grain and straw yield was obtained with the application of pendimethalin *fb* metsulfuron methyl + chlorimuron ethyl (T_{10}) was comparable with weed free check (T_2). Harvest index did not vary to a statistically perceptible magnitude. The increase in grain and straw yield might be due to the reason that the sequential application of two herbicides having distinct mode of actions created a rather weed free environment by effectively suppressing a broad-spectrum of weed population and consequently weed dry matter. Prevalence of weed free crop growing environment

might have enabled congenial conditions for production of higher growth stature and better yield structure which might have eventually resulted in higher yields in T_{10} (pre-emergence application of pendimethalin @ 0.75 kg a.i ha^{-1} *fb* metsulfuron methyl + chlorimuron ethyl @ 4 g a.i ha^{-1} as post-emergence), on par with weed free check (T_2). Similar views were also expressed by Narolia *et al.* (2014).

Thus, it may be concluded that, sequential application of pendimethalin @ 0.75 kg a.i ha^{-1} at 3-5 DAS *fb* metsulfuron methyl + chlorimuron ethyl @ 4 g a.i ha^{-1} at 20-25DAS (T_{10}) was found to be the most effective weed management practice to achieve broad spectrum weed control and to realize higher grain yield and yield attributes from *khari*f sown semidry rice in North Coastal Zone of Andhra Pradesh.

LITERATURE CITED

- Abdul Khaliq, Amar Matloob, Saqib Mahmood, Rana Nadeem Abbas and Muhammad Bismillah Khan 2012** Seeding density and herbicide tank mixtures furnish better weed control and improve growth, yield and quality of direct seeded fine rice. *International Journal of Agriculture & Biology*, 14 (4): 499-508.
- Chongtham S K, Singh R P and Singh R K 2015** Weeds, growth and yield of dry seeded rice as influenced by crop establishment methods and integrated weed management practices. *Environment & Ecology*, 33(1): 115-120.
- Narolia R S, Pratap Singh, Chandra Prakash and Harpool Meena 2014** Effect of irrigation schedule and weed-management practices on productivity and profitability of direct-seeded rice (*Oryza sativa*) in South-eastern Rajasthan. *Indian Journal of Agronomy*, 59 (3): 398-403.
- Ramana A V, Naidu G J and Ramana Murthy K V 2007** Integrated weed management in rainfed upland rice (*Oryza sativa*). *Indian Journal of Agronomy*, 52 (4): 311-314.
- Zahoor Ahmad Ganie, Samar Singh and Samunder Singh 2014** Integrated weed management in dry-seeded rice. *Indian Journal of Weed Science*, 46(2): 172-173.