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Effect of weed management practices on weed density and yield of transplanted rice

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Abstract

Field experiment was conducted at Agricultural College Farm, Agricultural College, Mahanandi on sandy loam soils to know the efficacy of different herbicides in transplanted rice. Most of the improved crop management practices in rice cultivation failed in controlling weeds due to poor and improper management. At present the use of herbicides or manual weeding alone is not effective in timely controlling the weed population. Hence, the present investigation was aimed to study the influence of herbicide in combination with hand weeding on the productivity of transplanted rice. The experiment comprised of 8 treatments *i.e.*, such as application of herbicides alone and their integration with one or two hand weedings and unweeded check were tested in randomized block design with three replications. Among these treatments, lower weed density and higher grain and straw yield were recorded under two hand weeding, which was at par with post emergence application of bispyribac sodium 20 g *a.i.* ha⁻¹ in combination with hand weeding at 40 DAT.

Keywords: Transplanted rice, herbicides, hand weeding, weed density and yield

Introduction

Rice [*Oryza sativa* (L.)] is the most important and extensively grown food crop in India with an area of 42.94 million hectares, production of 112.90 million tonnes and productivity of 2585 kg ha⁻¹. In Andhra Pradesh, it is grown in an area of 21.52 lakh hectares with a production of 80.51 lakh tonnes and productivity of 3741 kg ha⁻¹ (Indiastat, 2017-18). The major weed flora observed in the experimental plot are *Echinochloa colonum*, *Echinochloa crus-galli* among grasses, *Cyperus rotundus*, *Cyperus difformis*, *Cyperus iria* among sedges and *Eclipta alba* and *Ammania baccifera* among broad leaved weeds. However due to increased labour wages and non-availability of labour during peak periods of agricultural operations, timely weeding is not possible besides it is time taking and tedious. Therefore, farmers resorted to increased use of herbicides as it reduced human drudgery and weed management became more efficient in addition to saving of time and being less expensive (Rao *et al.*, 2007) [10]. Transplanted rice is particularly infested by heterogeneous types of weed flora under lowland ecosystem, which reduces yield up to 48 per cent with an annual loss of 15 million tonnes due to weed competition. Prevention of weed competition and provision of weed free environment at critical period of rice growth is necessary for successful rice production (Murali and Gowthami, 2017) [7]. Weed competition is one of the prime yield limiting constraints in rice resulting in yield reduction of 28-45 per cent (Maheshwari *et al.*, 2015). Hence, the present investigation was to study the influence of chemicals in combination with hand weeding on weed density and yield of transplanted rice.

Material and Methods

A field experiment was conducted to study "Efficacy of different herbicides in transplanted rice [*Oryza sativa* (L.)] in Scarce Rainfall Zone of Andhra Pradesh" under irrigated conditions during *kharif*, 2017-18 on sandy loam soils of College Farm, Agricultural College, Mahanandi, Andhra Pradesh which fall under semi-arid tropics (Table 1). The soil of the experimental site was neutral pH (7.91), medium in organic carbon (0.55%), low in N (227 kg ha⁻¹), high in P₂O₅ (82 kg ha⁻¹) and high in K₂O (1024 kg ha⁻¹). The experiment was laid out in a randomized block design having eight treatments and replicated thrice. The treatments consisting of T₁: Control (Unweeded), T₂: Two hand weedings at 20 and 40 DAT, T₃: Triafamone 20% + Ethoxysulfuron 10% WP @ 225 g ha⁻¹ at 15-20 DAT, T₄: Triafamone 20% + Ethoxysulfuron 10% WP @ 225 g ha⁻¹ at 15-20 DAT + hand weeding at 40 DAT, T₅: Chloromuron-ethyl 10% + metsulfuron-methyl 10% WP @ 20 g ha⁻¹ at 15-20 DAT, T₆: Chloromuron-ethyl 10% + metsulfuron-methyl 10% WP @ 20 g ha⁻¹ at 15-20 DAT + hand weeding at 40 DAT, T₇: Bispyribac Sodium 10% SC @ 200 ml ha⁻¹ at 15-20 DAT, T₈: Bispyribac Sodium 10% SC

@ 200 ml ha⁻¹ at 15-20 DAT + hand weeding at 40 DAT. The fertilizers such as urea, single super phosphate and muriate of potash were used for the supply of NPK and the entire quantity phosphorous applied as basal dose at the time of

transplanting and nitrogen and potassium were applied in 3 equal splits @ tillering, panicle initiation and grain filling stage of the crop. The seed rate used for study was 75 kg ha⁻¹ with a spacing of 25 x 15 cm.

Table 1: Location and weather parameters of experiment plot

Season	Latitude and longitude	Soil	Temperature (°C)		Rainfall (mm)	Relative humidity (%)
			Maximum	Minimum		
Kharif 2017	15° 51' N, 78° 61' E	Sandy loam	31.2	23.4	791.2	78.2

Results and Discussion

Weed Flora

During crop growth period, weed flora belonging to eight taxonomic families was observed, of which seven species were grasses, four species were sedges and seven species were broad leaved weeds. The predominant weed species observed were *Echinochloa colonum*, *Echinochloa crus-galli* among grasses, *Cyperus rotundus*, *Cyperus difformis*, *Cyperus saria* among sedges and *Eclipta alba* and *Ammania baccifera* among broad leaved weeds.

Effect on weed density and yields of crop

Weed management practices greatly influenced the density of weed species. The total weed density showed increasing trend from 30 DAT to 90 DAT and declined thereafter, the treatments are two hand weeding at 20 and 40 DAT (T₂), post-emergence application of triafamone + ethoxysulfuron at 20 DAT (T₃), post-emergence application of chloromuron ethyl + metsulfuron methyl applied at 20 DAT (T₅), post-emergence application of bispyribac sodium at 20 DAT (T₇) and unweeded check (T₁). With regard to post emergence application of herbicide in combination with hand weeding at 40 DAT the total weed density were higher at 30 DAT compared with 60 DAT, 90 DAT and at harvest, the total weed density shows increasing trend from 60 DAT to 90 DAT and declined thereafter. Among the sole application of herbicides combination with hand weeding the post-emergence application of bispyribac-sodium at 20 g a.i. ha⁻¹fb one hand weeding at 40 DAT was found to be very effective in controlling all weeds, which in turn, resulted in lower weed density. This is in line with the findings of Yadav *et al.* (2009) [18]. Hand weeding twice at 20 and 40 DAT was comparable with application of bispyribac sodium at 20 g a.i. ha⁻¹ as POE fb one hand weeding at 40 DAT in recorded lower weed density at all growth stages of crop. The reduced density of weeds might be attributed to broad spectrum and season long weed control by the application of post - emergence herbicides followed by hand weeding as that was observed in the treatment in which two hand weeding were given. This is in agreement with the findings of Pal *et al.* (2009) [9], Singh *et al.* (2012) [12] and Tathagata Das *et al.* (2017) [14] who reported that the weed density of weeds were greatly reduced under two hand weeding in transplanted rice.

The lower weed density of weeds was recorded with application of bispyribac sodium at 20 g a.i. ha⁻¹ as POE. This might be due to inherent ability of chemical to affect the cell

division, cell growth and hampering the germination of weeds, it inhibited the plant enzyme acetolactate synthase (ALS), which was involved in biosynthesis of the branched chain amino acids. Without these amino acids, protein synthesis and growth are inhibited, ultimately causing plant death. Similar findings were also reported by Chandra Prakash *et al.* (2013) [11], Hossain and Mondal (2014) [3], Uma *et al.* (2014) [15], Mathiyalayan and Muraliathanari (2015). The results obtained at all the growth stages of crop revealed that the treatments having sulfonyl urea herbicides as one of the components has shown their potential on sedges and worked effectively in reducing the density of sedges which is the major weed flora of the experimental site. These results are in accordance with Saha (2006) [11].

Almix (Metsulfuron methyl + Chlorimuron ethyl) act as amino acid synthesis inhibitor that inhibits specific plant enzyme involved in the synthesis of amino acids, which are building blocks of the all proteins and gave an excellent control of *Cyperus rotundus* and *Cyperus difformis* and good control of dicot weeds, but failed to bring about noticeable change in density of *Echinochloa* species. Similar results were also reported by Mukherjee and Singh (2005) [6], Sreelakshmi *et al.* (2016) and Negalur *et al.* (2017) [8].

The higher grain yield and straw yield were observed with two hand weeding over application of herbicides alone, herbicides followed by one-hand weeding and unweeded check. This might be attributed to reduced competition by weeds due to frequent elimination of weeds from the field that leads to reduce weed density, weed dry weight and results in good yields. However, the grain yield and straw yield recorded with post emergence application of bispyribac sodium 20 g a.i. ha⁻¹ followed by hand weeding at 40 DAT was comparable with that of two hand weeding. Higher yields under these treatments might be due to increased productive tillers, panicles m⁻² and grains panicle⁻¹. Similar findings were also confirmatory with the findings of Deepthi Kiran and Subramanyam (2010) [2] and Veeraputhiran and Balasubramanian (2013) [16].

The higher harvest index of rice was registered with post-emergence application of bispyribac sodium fb hand weeding at 40 DAT (T₈). This might be due to greater translocation of photosynthates from source to sink resulted in higher harvest index under weed control treatments as compared to unweeded check. Similar results were confirmatory with the findings of Uma *et al.* (2014) [15].

Table 2: Weed flora of the experimental field

S. No	Botanical Name	Common Name	Family
I	Grasses		
1	<i>Chloris barbata</i> Sw.	Finger grass	Poaceae
2	<i>Cynodon dactylon</i> (L) Pers.	Bermuda grass	Poaceae
3	<i>Dactyloctenium aegyptium</i> (L) Willd.	Crow foot grass	Poaceae
4	<i>Digitaria sanguinalis</i> (L.) Scop.	Large crab grass	Poaceae
5	<i>Echinochloa colonum</i> (L) Link.	Jungle grass	Poaceae

6	<i>Echinochloa crus-galli</i> (L.) Beauv.	Barnyard grass	Poaceae
7	<i>Dinebra retroflexa</i> (Vahl.) Panzer.	Viper grass	Poaceae
II	Sedges		
1	<i>Cyperus difformis</i> L.	Umbrella sedge	Cyperaceae
2	<i>Cyperus esculentus</i>	yellow nut sedge	Cyperaceae
3	<i>Cyperus iria</i> L.	Flat sedge	Cyperaceae
4	<i>Cyperus rotundus</i> L.	Purple nut sedge	Cyperaceae
III	Broad Leaved Weeds		
1	<i>Ageratum conyzoides</i>	Goat weed	Asteraceae
2	<i>Ammania baccifera</i> L.	Monarch red stem	Lythraceae
3	<i>Commelina benghalensis</i> L.	Day flower	Commelinaceae
4	<i>Eclipta alba</i> (L.) Hassk.	False daisy	Compositae
5	<i>Parthenium hysterophorus</i> L.	Congress grass	Asteraceae
6	<i>Phyllanthus niruri</i> L.	stonebreaker	Euphorbiaceae
7	<i>Phyla nodiflora</i>	Jalpagli	Verbenaceae

Table 3: Weed density (No. m⁻²) at 30 DAT of rice as influenced by different weed management practices

Treatments	Weed density (no m ⁻²)			
	Grasses	Sedges	BLWs	Total
T ₁ : Control (Unweeded)	17.00(4.18)	90.67(9.55)	46.00(6.82)	153.67(12.42)
T ₂ : Two hand weedings at 20 and 40 DAT	1.22(1.31)	11.00(3.39)	0.33(0.91)	12.56(3.61)
T ₃ : Triafamone 20% + Ethoxysulfuron 10% WP @ 225 g ha ⁻¹ at 15-20 DAT	10.00(3.24)	19.00(4.42)	19.67(4.49)	48.67(7.01)
T ₄ : Triafamone 20% + Ethoxysulfuron 10% WP @ 225 g ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	11.22(3.42)	18.00(4.30)	18.00(4.30)	47.22(6.91)
T ₅ : Chloromuron-ethyl 10% + metsulfuron-methyl 10% WP @ 20 g ha ⁻¹ at 15-20 DAT	16.00(4.06)	17.00(4.18)	13.00(3.67)	46.00(6.82)
T ₆ : Chloromuron-ethyl 10% + metsulfuron-methyl 10% WP @ 20 g ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	17.00(4.18)	18.00(4.30)	12.67(3.63)	47.67(6.94)
T ₇ : Bispyribac Sodium 10% SC @ 200 ml ha ⁻¹ at 15-20 DAT	8.00(2.92)	18.00(4.30)	13.67(3.76)	39.67(6.34)
T ₈ : Bispyribac Sodium 10% SC @ 200 ml ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	9.00(3.08)	16.00(4.06)	12.00(3.54)	37.00(6.12)
S.Em ±	0.63	1.90	1.39	2.57
CD (P = 0.05)	1.93	5.78	4.23	7.80

Figures in parenthesis indicates squares root transformed ($\sqrt{X} + 0.5$) values.

Table 4: Weed density (No. m⁻²) at 60 DAT of rice as influenced by different weed management practices

Treatments	Weed density (no m ⁻²)			
	Grasses	Sedges	BLWs	Total
T ₁ : Control (Unweeded)	68.33(8.30)	131.67(11.50)	53.00(7.31)	253.00(15.92)
T ₂ : Two hand weedings at 20 and 40 DAT	2.67(1.78)	12.67(3.63)	0.67(1.08)	16.00(4.06)
T ₃ : Triafamone 20% + Ethoxysulfuron 10% WP @ 225 g ha ⁻¹ at 15-20 DAT	20.67(4.60)	21.67(4.71)	25.67(5.12)	68.00(8.28)
T ₄ : Triafamone 20% + Ethoxysulfuron 10% WP @ 225 g ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	6.33(2.61)	15.67(4.02)	3.33(1.96)	25.33(5.08)
T ₅ : Chloromuron-ethyl 10% + metsulfuron-methyl 10% WP @ 20 g ha ⁻¹ at 15-20 DAT	41.33(6.47)	23.67(4.92)	20.00(4.53)	85.00(9.25)
T ₆ : Chloromuron-ethyl 10% + metsulfuron-methyl 10% WP @ 20 g ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	6.67(2.68)	17.33(4.22)	3.00(1.87)	27.00(5.24)
T ₇ : Bispyribac Sodium 10% SC @ 200 ml ha ⁻¹ at 15-20 DAT	20.00(4.53)	20.00(4.53)	16.67(4.14)	56.67(7.56)
T ₈ : Bispyribac Sodium 10% SC @ 200 ml ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	4.67(2.27)	15.33(3.98)	1.67(1.47)	21.67(4.71)
S.Em ±	1.36	1.95	1.18	3.89
CD (P = 0.05)	4.13	5.92	3.59	11.80

Figures in parenthesis indicates squares root transformed ($\sqrt{X} + 0.5$) values.

Table 5: Weed density (No. m⁻²) at 90 DAT of rice as influenced by different weed management practices

Treatments	Weed density (no m ⁻²)			
	Grasses	Sedges	BLWs	Total
T ₁ : Control (Unweeded)	83.00(9.14)	140.00(11.85)	58.33(7.67)	281.33(16.79)
T ₂ : Two hand weedings at 20 and 40 DAT	2.67(1.78)	14.00(3.81)	5.00(2.35)	21.67(4.71)
T ₃ : Triafamone 20% + Ethoxysulfuron 10% WP @ 225 g ha ⁻¹ at 15-20 DAT	26.67(5.21)	25.33(5.08)	31.67(5.67)	83.67 (9.17)
T ₄ : Triafamone 20% + Ethoxysulfuron 10% WP @ 225 g ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	7.67(2.86)	18.67(4.38)	6.33(2.61)	32.67 (5.76)
T ₅ : Chloromuron-ethyl 10% + metsulfuron-methyl 10% WP @ 20 g ha ⁻¹ at 15-20 DAT	55.67(7.49)	26.67(5.21)	23.67(4.92)	106.00(10.32)
T ₆ : Chloromuron-ethyl 10% + metsulfuron-methyl 10% WP @ 20 g ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	9.00(3.08)	18.67(4.38)	6.67(2.68)	34.33(5.90)
T ₇ : Bispyribac Sodium 10% SC @ 200 ml ha ⁻¹ at 15-20 DAT	24.67(5.02)	22.67(4.81)	21.33(4.67)	68.67(8.32)
T ₈ : Bispyribac Sodium 10% SC @ 200 ml ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	6.33(2.61)	18.00 (4.30)	5.00(2.35)	29.33(5.46)
S.Em ±	1.32	1.12	1.61	3.48
CD (P = 0.05)	4.02	3.42	4.89	10.55

Figures in parenthesis indicates squares root transformed ($\sqrt{X} + 0.5$) values.

Table 6: Weed density (No. m⁻²) at harvest of rice as influenced by different weed management practices

Treatments	Weed density (no m ⁻²)			
	Grasses	Sedges	BLWs	Total
T ₁ : Control (Unweeded)	34.33(5.90)	118.67(10.92)	67.33(8.24)	220.33(14.86)
T ₂ : Two hand weedings at 20 and 40 DAT	4.67(2.27)	10.00(3.24)	4.67(2.27)	19.33(4.45)
T ₃ : Triafamone 20% + Ethoxysulfuron 10% WP @ 225 g ha ⁻¹ at 15-20 DAT	14.33(3.85)	19.33(4.45)	24.33(4.98)	58.00(7.65)
T ₄ : Triafamone 20% + Ethoxysulfuron 10% WP @ 225 g ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	6.00(2.55)	16.00(4.06)	6.67(2.68)	28.67(5.40)
T ₅ : Chloromuron-ethyl 10% + metsulfuron-methyl 10% WP @ 20 g ha ⁻¹ at 15-20 DAT	29.00(5.43)	17.00(4.18)	21.00(4.64)	67.00(8.22)
T ₆ : Chloromuron-ethyl 10% + metsulfuron-methyl 10% WP @ 20 g ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	7.00(2.74)	16.33(4.10)	6.33(2.61)	29.67(5.49)
T ₇ : Bispyribac Sodium 10% SC @ 200 ml ha ⁻¹ at 15-20 DAT	12.00(3.54)	20.00(4.53)	17.67(4.26)	49.67(7.08)
T ₈ : Bispyribac Sodium 10% SC @ 200 ml ha ⁻¹ at 15-20 DAT + hand weeding at 40 DAT	4.67(2.27)	12.33(3.58)	5.33(2.42)	22.33(4.78)
S.Em ±	1.14	1.36	0.86	2.95
CD (P = 0.05)	3.48	4.14	2.60	8.96

Figures in parenthesis indicates squares root transformed ($\sqrt{X+0.5}$) values.

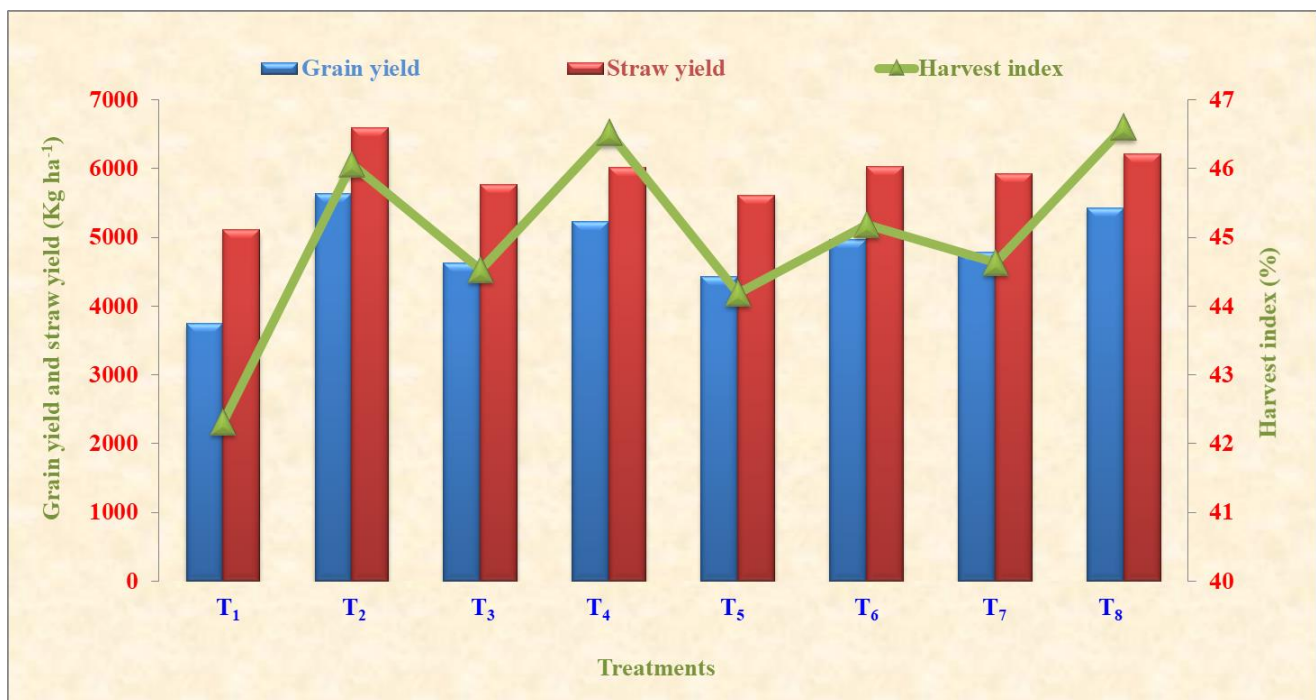


Fig. 1: Grain yield, straw yield (kg ha⁻¹) and harvest index (%) of transplanted rice as influenced by different weed management practices

Conclusion

From the above results, it can be concluded that lower weed density, higher grain yield and straw yield was obtained with two hand weeding at 20 and 40 DAT, however it was on par with the application of bispyribac sodium 20 g a.i. at 20 DAT as post emergence in combination with hand weeding at 40 DAT and the higher harvest index. Over all, it can be concluded that from the present investigation, post emergence application of bispyribac sodium 20 g a.i. ha⁻¹ in combination with hand weeding at 40 DAT can be recommended for effective weed control and higher yield of transplanted rice.

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