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RESEARCH ARTICLE :

Weed dynamics of red rice + *Sesbania aculeate* intercropping system

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SUMMARY : Field experiments were conducted during *Rabi* 2015-2016 to study the effect different levels of fertilizers in green manure (*Sesbania aculeate*) inter cropping four drum seeded red rice varieties, *viz.*, Chandikar, Nourguan, TKM 9 and TPS 1 on weed flora, total weed density and weed dry biomass. Among the four varieties, land race chanikar recorded the lowest grasses, sedges and broad leaf weed density. *In-situ* incorporation drum seeded daincha (*Sesbania aculeate*) at 30 DAS and application 75 % RDF significantly reduced the total weed density and total weed dry biomass. Among the different combinations drum seeding variety Chandikar with *Sesbania aculeate* at 75% recommended dose of fertilizer (50:25:25 kg NPK ha^{-1}) in two split application recorded the lowest total weeds density and lowest total weed dry biomass production.

KEY WORDS :
Red rice, Weed density, Drum seeding, Nutrient management, Intercropping

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BACKGROUND AND OBJECTIVES

Rice is the leading food supplier of the world; Asia alone accounts about 90% of world rice production and consumption. In Indian rice is cultivated in 44 m.ha with a annual production of 103.04 mt and productivity of 3.52 t ha^{-1}. In India, rice is grown mainly under rainfed upland, rainfed lowland, puddle direct seeded and puddled transplanted ecosystem (Sharma, 2007). Among this, transplanting is the most dominant and traditional method of establishment in irrigated low land rice since, it require more water for nursery preparation, main field preparation and consume more labour. While direct seeding of rice needs only 34% of the total labour requirement and saves 29% of the total cost of the transplanted crop (Ho and Romali, 2000). Direct seeding of pre-germinated seeds using drum seeder has additional advantages like cost reduction, easiness in intercultural operation, lesser seed rate and higher yield compared to broadcasting method. Excess use of fertilizer nutrients implies increase of cost and decrease of returns and risk of environmental pollution. On the other hand, under use of nutrients depress the scope for increasing the present level of nutrients to the economically optimum level to exploit production potential to a larger extent (Singh *et al.*, 2001). Since the traditional red rice cultivars initial slow crop establishment leads to heavy infestation of weeds. The drum seeding of rice with green manure crop helps in, to reduce initial weed density and also supply nutrient to crop after *in-situ* incorporation. Therefore, this study was conducted to findout the weeds dynamics under different fertilizer levels in different crop establishment techniques, with and without green manure cropping in traditional red rice.

RESOURCES AND METHODS

In Agricultural college and research institute, Madurai wetland Farm a field experiment was conducted during *Rabi* 2015 - 2016 to study the influence of different nutrient levels on drum seeded red rice cultivars on weed dynamics. The experiment was laid out in split - split design and replicated thrice. In main plot four red rice four varieties, V_1 - Chandikar and V_2 - Norungan V_3 - TKM 9 and V_4 - TPS 1, in sub plot drum seeding of pre germinated red rice using TNAU model rice cum danchia seeder S_1 - Rice + Daincha and S_2 - Rice alone drum seeding, and in sub-sub plot, three nutrient management practices *viz.*, N_1 - 75 % of Recommended Dose of Fertilizer (RDF) N_2 - 100% RDF and N_3- 125% RDF taken for research. The recommended dose fertilizers of 50:25:25 kg NPK ha^{-1} was applied in two splits as 50% of N and K with full dose of P was applied as basal. Remaining fertilizer was top dressed at 30 Days After Sowing (DAS). One hand weeding was taken 30 DAS commonly to all plots. Weed flora of each plot were identified and grouped as grasses, sedges and broad leaved weeds. The weed species in each plot were identified and the weed population in each plot was counted at four randomly selected spots using a quadrate (0.25 m^2) on 30, 60 and 90 DAS and weed density was worked out. Dry weight of weeds was calculated after oven dried at 80°C for 72 hours or till a constant weight is reached. The data collected from the experiment were analyzed statistically using analysis of variance (ANOVA) using AGRES (Data Entry Module for Ag Res Statistical software version 3.01, 1994 Pascal Intl. Software Solutions).

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Weed flora :

The weed flora of the experimental field consisted of *Cynodon dactylon*, *Echinochloa colona* and *Panicum repens* under grasses, *Cyperus rotandus*, *Cyperus difformis*, *Cyperus iria* and *Fimbristylis miliaceae* under sedges and *Ammania baccifera*, *Eclipta alba*, *Ipomoea aquatica*, *Bergia capensis* and *Marsilea quadrifolia* under broad leaved weeds. Similarly, Subbulakshmi and Pandian (2005) also reported the weed species such as *Echinochloa colona*, *Cynodon dactylon*, *Panicum repens*, *Cyperus rotundus*, *Cyperus difformis*, *Cyperus iria*, *Fimbristylis miliaceae*, *Ammania baccifera*, *Ipomoea aquatica*, *Marsilea quadrifolia* and *Monochoria vaginalis* in puddled lowland rice. Singh *et al*. (2004) and Thendral (2015) reported the dominance of grass weeds than broad leaved weeds and sedges in drum seeded rice. Wide spectrum of weeds in direct seeded rice was reported by Singh and Singh (2010) and Rao *et al*. (2008).

Total weed density :

There was a significant difference in total weed density was observed under different red rice varieties cultured with green manure and different nutrient management practices. Among the different red rice varieties, land races Chandikar (V_1) significantly reduced total weed density of 68.45, 35.33 and 39.88 numbers m^{-2} at 30, 60 and 90 DAS, respectively. This might be due to fast initial crop growth rate and more biomass production ability of land races. The improved red rice variety TKM 9 (V_3) recorded the maximum weed density (88.88, 47.24 and 50.52 numbers m^{-2}) at all growth stages because of early slow growth and shorter plant height. The difference in weed density between Chandikar and TKM 9 red rice varieties due to higher competitive ability of tall rice cultivar than dwarf cultivar against weed. Similar findings also reported by Parvez *et al*. (2013) in aman rice cultivars.

Drum seeding of rice with and without green manure using TNAU drum seeder had a significant effect on total weed density. Drum seeding rice with *Sesbania* (S_1) registered lower weed density of 67.61, 38.28 and 41.97 numbers m^{-2} at 30, 60 and 90 DAS, respectively. This might be due to competition between *Sesbania* and weeds, synergistic effect of green manure by smothering weeds and *Sesbania* intercropping suppressed the weed infestation due to faster canopy cover. This result also

Table 1: Effect of different fertilizer levels on weed density of drum seeded red rice + legume intercropping system

Treatments	30 DAS				60 DAS				90 DAS			
	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
V_1	57.01	67.49	80.84	68.45	29.79	35.48	40.71	35.33	33.55	39.47	46.62	39.88
	(7.68)	(8.32)	(9.09)	(8.36)	(5.64)	(6.12)	(6.54)	(6.10)	(5.96)	(6.44)	(6.97)	(6.46)
V_2	57.98	71.43	83.34	70.92	30.42	35.99	40.45	35.62	33.59	40.23	47.06	40.30
	(7.73)	(8.56)	(9.23)	(8.51)	(5.69)	(6.16)	(6.51)	(6.12)	(5.96)	(6.50)	(7.00)	(6.49)
V_3	76.33	89.12	101.19	88.88	41.11	47.69	52.93	47.24	44.67	50.67	56.20	50.52
	(8.84)	(9.54)	(10.15)	(9.51)	(6.57)	(7.05)	(7.36)	(6.99)	(6.83)	(7.26)	(7.63)	(7.24)
V_4	64.10	73.86	83.30	73.75	33.33	37.23	43.11	37.89	36.56	43.56	50.78	43.63
	(8.09)	(8.69)	(9.22)	(8.67)	(5.94	(6.26)	(6.72)	(6.31)	(6.21)	(6.75)	(7.26)	(6.74)
Mean	63.86	75.47	87.17		33.66	39.10	44.30		37.09	43.49	50.17	
	(8.09)	(8.78)	(9.42)		(5.96)	(6.40)	(6.78)		(6.24)	(6.74)	(7.22)	
S_1	56.51	66.90	79.43	67.61	33.09	38.38	43.37	38.28	35.87	42.11	47.94	41.97
	(7.64)	(8.28)	(9.01)	(8.31)	(5.91)	(6.34)	(6.70)	(6.32)	(6.14)	(6.63)	(7.06)	(6.61)
S_2	71.21	84.05	94.91	83.39	34.24	39.81	45.23	39.76	38.32	44.86	52.39	45.19
	(8.53)	(9.27)	(9.83)	(9.21)	(6.01)	(6.46)	(6.86)	(6.44)	(6.34)	(6.84)	(7.37)	(6.85)
Mean	63.86	75.47	87.17		33.66	39.10	44.30		37.09	43.49	50.17	
	(8.09)	(8.78)	(9.42)		(5.96)	(6.40)	(6.78)		(6.24)	(6.74)	(7.22)	
V_1S_1	55.96	58.07	74.19	62.74	28.49	34.71	41.12	34.77	32.15	38.24	44.52	38.31
	(7.61)	(7.75)	(8.73)	(8.03)	(5.52	(6.06)	(6.57)	(6.05)	(5.84)	(6.34)	(6.82)	(6.34)
V_1S_2	51.90	63.26	77.01	64.06	31.10	36.25	40.30	35.88	34.95	40.70	48.72	41.46
	(7.34)	(8.08)	(8.89)	(8.10)	(5.75	(6.18)	(6.50)	(6.15)	(6.08)	(6.53)	(7.12)	(6.58)
V_2S_1	50.84	64.16	74.38	63.12	28.64	33.83	38.06	33.51	32.20	38.60	43.57	38.12
	(7.27)	(8.13)	(8.74)	(8.05)	(5.54	(5.99)	(6.33)	(5.95)	(5.85)	(6.37)	(6.75)	(6.32)
V_2S_2	58.07	76.91	87.49	74.16	32.21	38.14	42.85	37.73	34.99	41.86	50.55	42.47
	(7.75)	(8.88)	(9.46)	(8.70)	(5.85	(6.34)	(6.70)	(6.29)	(6.08)	(6.62)	(7.25)	(6.65)
V_3S_1	67.32	82.10	92.13	80.52	32.03	37.86	44.21	38.03	44.14	48.90	53.27	48.77
	(8.33)	(9.17)	(9.70)	(9.07)	(5.83	(6.31)	(6.80)	(6.31)	(6.79)	(7.13)	(7.43)	(7.12)
V_3S_2	85.34	96.14	110.24	97.24	41.64	46.99	53.56	47.39	45.20	52.45	59.13	52.26
	(9.35)	(9.91)	(10.59)	(9.95)	(6.61	(7.00)	(7.45)	(7.02)	(6.87)	(7.38)	(7.82)	(7.36)
V_4S_1	64.06	79.59	89.67	77.78	34.64	36.60	42.01	37.75	34.98	42.71	50.39	42.69
	(8.13)	(9.03)	(9.57)	(8.91)	(6.05	(6.21)	(6.63)	(6.30)	(6.08)	(6.69)	(7.24)	(6.67)
V_4S_2	77.37	83.56	92.22	84.38	40.58	48.40	52.30	47.09	38.14	44.41	51.18	44.58
	(8.91)	(9.25)	(9.71)	(9.29)	(6.53	(7.10)	(7.26)	(6.96)	(6.34)	(6.81)	(7.29)	(6.81)
Mean	63.86	75.47	87.17		33.66	39.10	44.30		37.09	43.49	50.17	
	(8.09)	(8.78)	(9.42)		(5.96)	(6.40)	(6.78)		(6.24)	(6.74)	(7.22)	

	S.E.±	C.D. (P=0.05)	S.E.±	C.D. (P=0.05)	S.E.±	C.D. (P=0.05)
V	0.45	0.83	0.008	0.020	0.012	0.029
S	0.38	0.73	0.006	0.013	0.017	0.039
F	0.33	0.64	0.011	0.023	0.014	0.029
V × S	0.36	0.69	0.011	0.028	0.027	0.064
V × F	0.32	0.61	0.020	0.043	0.026	0.055
S × F	0.67	NS	0.089	NS	0.051	NS
V × S × F	0.34	0.67	0.026	0.055	0.039	0.080

( ) = $\sqrt{x + 0.5}$ NS= Non-significant

Table 2 : Effect of different fertilizer levels on weed dry matter of drum seeded red rice + legume intercropping system

Treatments	30 DAS				60 DAS				90 DAS			
	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
V_1	106.65	117.84	122.81	115.77	29.69	35.07	40.05	34.94	33.19	36.69	38.79	36.22
	(10.36)	(10.90)	(11.13)	(10.80)	(5.61)	(6.07)	(6.47)	(6.05)	(5.92)	(6.21)	(6.37)	(6.16)
V_2	109.80	116.67	125.30	117.26	29.40	32.64	36.08	32.71	35.24	39.21	41.63	38.70
	(10.52)	(10.85)	(11.24)	(10.87)	(5.59)	(5.87)	(6.15)	(5.87)	(6.10)	(6.41)	(6.60)	(6.37)
V_3	133.31	139.54	146.84	139.90	30.91	36.54	39.80	35.75	39.31	43.47	46.28	43.02
	(11.60)	(11.87)	(12.16)	(11.88)	(5.72)	(6.20)	(6.46)	(6.13)	(6.43)	(6.74)	(6.95)	(6.70)
V_4	108.38	118.93	124.63	117.31	28.24	31.27	34.20	31.24	31.97	34.43	37.65	34.68
	(10.47)	(10.96)	(11.22)	(10.88)	(5.50)	(5.77)	(6.01)	(5.76)	(5.83)	(6.03)	(6.30)	(6.05)
Mean	114.54	123.25	129.90		29.56	33.88	37.53		34.93	38.45	41.09	
	(10.74)	(11.14)	(11.44)		(5.60)	(5.98)	(6.28)		(6.07)	(6.35)	(6.55)	
S_1	93.30	102.60	108.90	101.60	25.85	30.42	34.65	30.31	32.50	35.92	38.51	35.64
	(9.74)	(10.22)	(10.52)	(10.16)	(5.27)	(5.69)	(6.05)	(5.67)	(5.87)	(6.15)	(6.36)	(6.12)
S_2	135.78	143.89	150.89	143.52	33.27	37.35	40.42	37.01	37.36	40.98	43.67	40.67
	(11.73)	(12.07)	(12.36)	(12.05)	(5.93)	(6.26)	(6.50)	(6.23)	(6.27)	(6.55)	(6.75)	(6.52)
Mean	114.54	123.25	129.90		29.56	33.88	37.53		34.93	38.45	41.09	
	(10.74)	(11.14)	(11.44)		(5.60)	(5.98)	(6.28)		(6.07)	(6.35)	(6.55)	
V_1S_1	82.75	96.73	100.69	93.39	24.88	27.43	30.97	27.76	28.34	31.67	33.06	31.02
	(9.21)	(9.94	(10.13)	(9.76)	(5.18)	(5.42)	(5.74)	(5.45)	(5.51)	(5.80)	(5.92)	(5.74)
V_1S_2	127.45	138.19	142.74	136.12	28.55	31.04	33.00	30.86	31.81	34.14	36.72	34.22
	(11.38)	(11.84)	(12.03)	(11.75)	(5.52)	(5.75)	(5.91)	(5.73)	(5.81)	(6.01)	(6.22)	(6.02)
V_2S_1	87.73	94.96	104.27	95.65	24.09	29.07	35.00	29.39	32.13	34.72	38.58	35.14
	(9.47)	(9.85	(10.31)	(9.88)	(5.11)	(5.57)	(6.08)	(5.59)	(5.84)	(6.06)	(6.37)	(6.09)
V_2S_2	131.88	138.38	146.33	138.86	27.93	31.50	35.40	31.61	38.04	41.72	44.52	41.43
	(11.57)	(11.85	(12.18)	(11.87)	(5.47)	(5.79)	(6.11)	(5.79)	(6.33)	(6.61)	(6.82)	(6.59)
V_3S_1	113.40	119.05	124.12	118.85	35.32	39.42	42.38	39.04	38.59	42.30	44.90	41.93
	(10.74)	(11.00	(11.23)	(10.99)	(6.11)	(6.43)	(6.66)	(6.40)	(6.37)	(6.66)	(6.85)	(6.62)
V_3S_2	153.23	160.03	169.57	160.94	35.28	41.07	45.11	40.49	40.99	45.75	48.53	45.09
	(12.46)	(12.73)	(13.10)	(12.76)	(6.10)	(6.56)	(6.86)	(6.51)	(6.56	(6.91)	(7.11)	(6.86)
V_4S_1	89.32	99.68	106.52	98.50	26.51	33.67	37.23	32.47	31.90	36.12	38.37	35.46
	(9.56)	(10.08)	(10.42)	(10.02)	(5.34)	(5.97)	(6.26)	(5.86)	(5.82)	(6.17)	(6.35)	(6.12)
V_4S_2	130.55	138.96	144.94	138.15	33.92	37.86	41.19	37.66	37.63	41.19	44.04	40.95
	(11.51)	(11.87	(12.12)	(11.84)	(5.99)	(6.31)	(6.57)	(6.29)	(6.29)	(6.57)	(6.78)	(6.55)
Mean	114.54	123.25	129.90		29.56	33.88	37.53		34.93	38.45	41.09	
	(10.74)	(11.14)	(11.44)		(5.60)	(5.98)	(6.28)		(6.07)	(6.35)	(6.55)	

	30 DAS S.E. ±	30 DAS C.D. (P=0.05)	60 DAS S.E. ±	60 DAS C.D. (P=0.05)	90 DAS S.E. ±	90 DAS C.D. (P=0.05)
V	0.009	0.022	0.017	0.042	0.088	0.215
S	0.007	0.017	0.009	0.021	0.060	0.138
F	0.009	0.017	0.012	0.025	0.072	0.147
V × S	0.014	0.033	0.021	0.052	0.122	0.295
V × F	0.017	0.036	0.027	0.057	0.147	0.316
S × F	0.087	NS	0.089	NS	0.24	NS
V × S × F	0.022	0.047	0.033	0.070	0.191	0.404

( ) = $\sqrt{x + 0.5}$ NS= Non-significant corroborate with the findings of Nalini *et al*. (2008), Gnanavel and Natarajan. (2014) and Ravisankar (2002).

Application of 75, 100 and 125 % of the recommended dose fertilizer had a significant influence on the weed count at all growth stages of red rice. Among this application 75% of RDF (F_1) at two splits recorded the reduced weed density of 63.86, 33.66 and 37.09 numbers m^{-2} at 30, 60 and 90 DAS. This might be due to decrease in amount of nutrient application may increase in the intra-species competition of weeds and weeds also grow more slowly. Similar result also reported by Jiang *et al*. (2014).

Total weed density of different red rice cultivars with *S. aculeata* intercropping and nutrient management practices showed a significant difference. Among the different combinations, red rice variety Chandikar with *S. aculeata* (V_1S_1) drum seeding recorded significantly reduced the weed density of 56.37, 33.09 and 35.87 m^{-2} at various growth stages of red rice. The same variety applied with 75 per cent RDF (V_1F_1) had recorded significant lower total weed density (59.01, 29.79 and 33.55 m^{-2}, respectively) at all growth stage of crop. Cultivation of red rice variety Chandikar with *S. aculeata* using TNAU drum seeder and 75 per cent RDF ($V_1S_1F_1$) in two equal splits registered significantly the lowest total weed density of 55.96, 28.49 and 32.15 m^{-2} at 30, 60 and 90 DAS, respectively when compared with rice alone and 100 and 125 per cent RDF applications. This might be due to favorable influence of N 100 per cent through organic (*S. aculeata* and *Azolla*) and inorganic and mechanical incorporation of green manure created a conducive atmosphere in terms of weed-free condition and there by reduction in weed dry biomass (Subramanian *et al*., 2005).

Total weeds dry matter production :

Weed dry biomass is an important parameter to indentify the effects of weed on crop growth and yield. Red rice varieties sown using drum seeder with different nutrient management practices had significant effect on total weed dry matter production at all crop growth stages. At 30, 60 and 90 DAS the lowest total weed dry weight of 115.77, 39.94 and 36.22 g m^{-2} was recorded in variety Chandikar (V_1). The maximum weed dry weight was registered in variety TKM 9 (V_3). This is because of the tall nature of land races and droopy leaves, provided maximum shading to nearby weed plants, reduce the total weed density when comparing with other varieties. The above result is in conformity with the findings of Parvez *et al*. (2013). Drum seeding of red rice with and without *S. aculeata* had a significant effect on total weed dry matter production.

Drum seeding of rice with *S. aculeata* (S_1) recorded lowest weed density of 101.60, 30.31 and 35.64 g m^2 at 30, 60 and 90 DAS, respectively. This may be due to lower weed dry weight accumulation as a result of reduction in weed density by smothering effect of green manure. These results are supported by the findings of Nalini *et al*. (2008) and Ravisankar (2002). By 25 per cent reduction of RDF (F_1) registered the lower total weed dry matter content of 114.54, 29.56 and 34.93 g m^{-2} at 30, 60 and 90 DAS, respectively and this was followed by RDF and 25 per cent increased RDF application. The decrease in dry weight of weeds may be attributed to less nutrition available to the weeds. Similar report was obtained by Ullah *et al.* (2009).

The land race Chandikar with *S. aculeata* (V_1S_1) drum seeding recorded reduced total weed dry weight of 93.39, 27.76 and 31.02 g m^{-2} followed by land race Norungan with *S. aculeata* cropping at all crop growth stages of rice. The interaction between variety Chandikar with 75 per cent RDF recorded lower total weed dry biomass production at 30, 60 and 90 DAS (106.65, 29.69 and 33.19 g m^{-2}, respectively). Variety Chandikar + *S. aculeata* + 75 per cent RDF ($V_1S_1F_1$) combination recorded the lower weed dry biomass of 82.75, 24.88 and 28.34 g m^{-2}at vegetative, maximum tillering and reproductive stages, respectively. This was followed by variety Norungan with *S. aculeata* and 75 per cent RDF application ($V_2S_1F_1$) at all growth stages of rice. Similar findings on the impact of *S. aculeata* intercropping in reducing dry weight were reported by Ravisankar (2002) and Divakaran and Sundaram (1998) as well as reported on the reduction of weed density and dry weight in dual cropping of *Azolla* with reduced N application.

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REFERENCES

Divakaran, K. R. and Sundaram, M.D. (1998). Weed control efficiency of *Azolla* in lowland rice ecosystem. *Madras Agric. J.*, **1** (85) : 123-124.

Gnanavel, I. and Natarajan, S. K. (2014). Eco-friendly weed control options for sustainable agriculture - A review. *Agric. Review,* **35** (3): 172-183.

Ho and Romali (2000). Impact of direct of direct seeding of rice cultivation: lessen from the Madaara of Malaysia, In: direct seeding research strategies and opportunities Eds: Proceedings of international workshop on direct seeding in Asia rice system, held during 25-28 January, Bangkok, Thailand.

Jiang, M., Shen, X.P., Gao, W. Shen, M. X. and Dai, Q. G. (2014). Weed seed-bank responses to long-term fertilization in a rice - wheat rotation system. *Plant Soil Environ.,* **60** (8): 344-350.

Nalini, K., Jayanthi, C. and Vennila, C. (2008). Weed management through dual cropping of green manure in semi-dry rice. *Indian J.Weed Sci.,* **40** (1&2) : 50-51.

Parvez, M. S., Salam, M. Abdus,Noguchi, H. K. and Begum, M. (2013). Effect of cultivar and weeding regime on the performance of transplant aman rice. *Internat. J. Agric. & Crop Sci.,* **6**(11): 654-666.

Rao. A.S., Ratnam, M. and Reddy, T.Y. (2008). Weed management in direct seeded semi dry rice. Indian J. Weed Sci., **40** (3&4): 153-156.

Ravisankar, N. (2002). Efficacy of seeding methods, in situ incorporation of dhaincha and application time of pretilachlor plus on weed management and productivity of wet seeded rice. Ph. D. Thesis, Tamil Nadu Agricultural University, Coimbatore, T.N. (INDIA).

Sharma, R. (2007). Integrated weed management in wheat and rice crop. *Indian Farm.,* pp.29-34.

Singh, G. R.,Chaure, N.K. and Parihar, S.S. (2001). Organic farming for sustainable agriculture. *Indian Farm.,* **12** : 14-17.

Singh, M. and Singh, R. P. (2010). Efficacy of herbicides under different methods of direct-seeded rice establishments. *Indian J. Agric. Sci.,* **80** : 815-819.

Singh, U.P., Singh, Y. and Kumar, V. (2004). Effect of weed management and cultivars in boro rice (*Oryza sativa*) and weeds. *Indian J. Weed Sci.,* **36** (1&2): 57-59.

Subbulakshmi, S. and Pandian, B. J. (2005). Influence of irrigation regime and planting methods on weed flora and performance of puddle lowland rice. *Madras Agric. J.,* **92** (4-6): 218-223.

Subramanian, E., Martin, G. James and Ramasamy, S. (2005). Effect of weed and nitrogen management on weed control and productivity of wet seeded rice. *Indian J. Weed Sci.,* **37** (1 & 2): 61-64.

Thendral, S. (2015). Bio-efficacy of herbicides and combinations in drum seeded rice under puddled condition. M.Sc., (Ag.) Thesis, Agricultural College and Research Institute, Madurai, T.N. (INDIA).

Ullah, E., Rehman, A. U., Rarshad, Q. and Shah, S. S. H. (2009). Yield response of fine rice to NP fertilizer and weed management practices. *Pakistan J. Bot.,* **41**(3): 1351-1357.