Indian Journal of Weed Science **50**(4): 324–328, 2018

Print ISSN 0253-8040 Online ISSN 0974-8164

Management of complex weed flora in transplanted rice by herbicide rotation and green manuring

S.S. Pinjari*, S.B. Gangawane, M.S. Jadhav, U.V. Mahadkar and S.A. Chavan

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra 415 712

Email: pinjari94222@gmail.com

Article information

DOI: 10.5958/0974-8164.2018.00070.9

Type of article: Research article

Received : 2 August 2018
Revised : 27 September 2018
Accepted : 9 November 2018

Key words
Green manuring
Herbicides
Transplanted rice
Weeds

ABSTRACT

A field study was conducted at Dr. Balasdaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (Maharashtra) during *Kharif* 2011 to 2014 to evaluate the effect of green manuring with *Sesbania rostrata* and different herbicide on complex weed flora in transplanted rice. The experimental field was infested with *Ludwigia octovalis*, *Cloem viscosa*, *Cyperus iria*, *Amaranthus sessils*, *Isachne globosa* and *Eriocaulon hexangularis*. Four year pooled data revealed that green manuring did not influence the dry matter of monocots and BLWs at all the stages of observation. Green manuring significantly influenced the grain and straw yields of rice and produced significantly higher grain and straw yields (3.86 grain and 3.87 straw t/ha) as compared to without green manuring. Pre-emergence application of pretilachlor-S 0.75 kg/ha at 3-7 DAT recorded the highest weed control efficiency (36.40% at 30 DAT and 48.18% at 50 DAT) and rice grain yield (3.54 t/ha).

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food of more than 60% of the world population and more than 70 % of the Indian population. In India, rice occupies an area of 43.39 mha with production and productivity of 104.32 million tons (mt) and 2.4 t/ha, respectively (Anonymous 2016. India should add 1.7 mt of additional rice every year to ensure national food security (Das and Chandra 2013). Though, India has the largest area under rice in the world but its productivity is very low. This might be due to several constraints. Among them weeds pose a major threat. Uncontrolled weed growth causes 33-45% reduction in grain yield of transplanted rice (Singh *et al.* 2007, Manhas *et al.* 2012). There is tremendous scope of incorporation of legume green manuring in rice because of its weed smothering efficiency. Therefore, the present investigation was carried out to study the influence of green manure and weed control measures in transplanted rice.

MATERIALS AND METHODS

A field experiment was conducted during 2011 to 2014 at Dr. Balasdaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (Maharashtra). The experimental site was located at west coast 250 m height from mean sea level having annual average rainfall 3500 mm with 95 to 100 rainy days throughout *Kharif* season.

The experiment was laid out in a strip-plot design with three replications. The two main plot treatment comprised of application of green manuring and without green manuring and four sub-plot treatments comprised of fixed herbicide (pretilachlor-S 0.75 kg/ha at 3-7 DAT), rotational herbicide (pyrazosulfuron 0.030 kg/ha at 8-10 DAT (I year)**,** fenoxaprop -p-ethyl 0.056 kg/ha at 25-30 DAT (II year)**,** oxadiargyl 0.100 kg/ha at 0-5 DAT (III year), weed free check [two hand weeding (HW)] at 20 and 40 DAT and weedy check.

The soil of the experimental plot was sandy clay loam in texture, acidic in pH and medium in organic carbon content. It was low in available nitrogen (282 kg/ha), medium in available phosphorus (10.8 kg/ha) and high in available potassium (236 kg/ha). The gross main plot size was 10 × 10 m. and net plot size 2.3 × 10 m. The seed of rice variety *'Ratnagiri-24'* was treated with thairum at the rate of 3 g/kg of seed used for sowing. Twenty one days old rice seedlings were transplanted in puddled field. The recommended dose of fertilizer (100:50:50 N, P_2O_5, and K_2O kg/ha) was applied to all the plots. Half dose of nitrogen and

full dose of phosphorus and potassium was applied at the time of puddling while remaining half dose of nitrogen was applied at 30 DAT. The uniform representative samples of crop as well as weeds were randomly collected from each plot. Data were analyzed (pooled analysis) statistically by using standard methods of Panse and Sukhatme (1984). The significant differences between treatments were compared by critical difference at 5% level of probability. The data on weed density and biomass were subjected to square root transformation for comparison.

RESULTS AND DISCUSSION

The experimental field was comprised with major weed, *viz. Ludwigia octovalis, Cloem viscosa, Cyperus iria, Amaranthus sessils, Isachne globosa, Eriocaulon hexangularis, Cyperus rotundus, Eleusine indica, Echinochloa colona, Ischemum rugosum, Mimosa pudica, Physalis minima,* and *Celocia argentea.*

Weed density

Weed density of monocots and broad-leaved weeds in rice at 30 and 50 DAT did not influence significantly due to green manuring (**Table 1 and 2**). However, less number of weeds was observed in green manuring than without green manuring. These results are in line with the findings of Gnanavel and Kathiresan (2002) who reported that green manuring with *Sesbania aculeata* reduced the weed density and increased the weed control index in the succeeding rice crops. In rice-wheat cropping systems, inclusion of *Sesbania aculeata* in summer resulted in least grasses and sedges in the succeeding crops (Singh *et al.* 2008).

Weed control measures did not significantly influence density of monocots and BLWs at 30 DAS, except during 2014 (**Table 1**) and pooled results in respect of BLWs. Weed free check two hand weeding (HW) significantly reduced the weed density of monocots and BLWs over weedy check and application of rotational herbicide (pyrazo-sulfuron 0.030 kg/ha at 8-10 DAT (I year)**,** fenoxaprop -p-ethyl 0.056 kg/ha at 25-30 DAT (II year), oxadiargyl 0.100 kg/ha at 0-5 DAT (III year) but it was at par with application of pretilachlor-S herbicide during 2014.

Weed free check two hand weeding significantly reduced the density of monocots and BLWs, but it was at par with application of pretilachlor-S herbicide at 50 DAT (**Table 2**) and remained at par with rotational herbicide (pyrazosulfuron 0.030 kg/ha at 8-10 DAT (I year), fenoxaprop -p-ethyl 0.056 kg/ha at 25-30 DAT (II year), oxadiargyl 0.100 kg/ha at 0-5 DAT(III year). Higher weed control efficiency was observed in weed free check [two hand weeding (HW)] followed by application of pretilachlor-S herbicide. Duary *et al.* (2015) also reported similar results.

Table 1. Effects of green manuring and weed control measures on weed density in rice at 30 DAT (no./m^2) (four years pooled mean)

Treatment	Grasses and sedges					Broad-leaved weeds					Weed control efficiency				
	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled
Green manuring															
Green manuring	10.5 (3.04)	11.7 (3.28)	23.7 (4.65)	22.3 (4.72)	17.7 (4.20)	2.6 (1.48)	1.3 (1.08)	1.0 (0.94)	8.3 (2.87)	3.5 (1.96)					
Without green manuring	13.5 (3.45)	23.3 (4.31)	22.0 (4.27)	25.0 (5.01)	20.3 (4.49)	2.3 (1.29)	2.3 (1.43)	1.0 (1.01)	10.3 (3.22)	3.8 (2.06)					
LSD (p=0.05)	- (NS)	- (NS)	- (NS)	- (NS)	- (NS)	- (NS)	- (NS)	- (NS)	- (NS)	- (NS)					
Weed control measure															
Fixed herbicide – pretilachlor-S (PE)	10.6 (3.09)	12.0 (3.19)	20.7 (4.49)	19.3 (4.44)	18.9 (4.32)	2.7 (1.41)	1.3 (1.08)	0 (0.71)	8.0 (2.86)	3.5 (1.98)	46.6	56.5	32.6	42.3	17.97
Rotational herbicide	13.0 (3.12)	18.7 (4.00)	26.7 (4.84)	22.0 (4.66)	21.7 (4.63)	2.7 (1.27)	2.0 (1.31)	0 (0.71)	9.3 (3.08)	3.3 (1.93)	37.4	32.6	13.0	33.82	8.20
Weed free check	4.0 (1.64)	11.3 (3.29)	17.3 (4.09)	16.7 (4.13)	13.2 (3.67)	0 (0.71)	1.3 (1.08)	0 (0.71)	5.3 (2.39)	2.7 (1.76)	84.0	58.7	43.5	53.53	42.02
Weedy check	20.3 (3.93)	28.0 (4.71)	26.7 (4.41)	32.7 (5.75)	22.2 (4.75)	4.6 (2.14)	2.7 (1.55)	4.0 (1.78)	14.7 (3.86)	5.2 (2.36)					
LSD (p=0.05)	- (NS)	- (NS)	- (NS)	4.4 (0.44)	- (NS)	- (NS)	- (NS)	- (NS)	3.9 (0.64)	1.5 (0.37)					

Figures in parentheses indicate square root transformations $\sqrt{x+0.5}$; NS: Non-significant, Note: Interaction between green manuring and weed control measures were non-significant during all the stages of observations; PE: pre-emergence

Table 2. Effects of green manuring and weed control measures on weed density in rice at 50 DAT (no./m^2) (four years pooled mean)

Treatment	Grasses and sedges					Broad-leaved weeds					Weed control efficiency				
	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled
Green manuring															
Green manuring	18.80 (3.62)	5.00 (2.15)	26.67 (5.09)	29.33 (5.38)	24.28 (4.90)	0.02 (0.72)	3.00 (1.45)	8.33 (2.49)	22.33 (4.73)	8.42 (2.92)					
Without green manuring	39.83 (5.39)	8.33 (2.69)	44.00 (6.56)	28.33 (5.25)	25.79 (4.98)	1.34 (1.13)	4.00 (1.83)	7.33 (2.35)	19.67 (4.44)	8.08 (2.88)					
LSD (p=0.05)	(NS)	(NS)	(NS)	(NS)	(NS)	(0.29)	(NS)	(NS)	(NS)	(NS)					
Weed control measure															
Fixed herbicide – pretilachlor-S (PE)	23.32 (3.95)	7.33 (2.58)	36.00 (5.88)	22.00 (4.70)	23.00 (4.72)	1.33 (1.18)	2.67 (1.41)	8.67 (2.73)	20.00 (4.49)	6.34 (2.57)	53.4	37.5	16.2	40.6	38.5
Rotational herbicide	36.35 (5.25)	7.33 (2.44)	39.33 (6.17)	33.33 (5.80)	28.25 (5.30)	0.02 (0.72)	3.33 (1.68)	10.00 (2.95)	20.67 (4.56)	8.50 (2.98)	31.3	33.4	7.5	23.6	23.0
Weed free check	6.01 (1.89)	4.67 (2.02)	24.67 (4.91)	17.33 (4.20)	13.17 (3.68)	0.02 (0.72)	1.33 (1.18)	0.67 (0.94)	15.33 (3.96)	6.17 (2.55)	88.6	62.5	52.4	53.8	59.5
Weedy check	51.58 (6.94)	9.33 (3.35)	41.33 (6.33)	42.67 (6.56)	35.73 (6.00)	1.34 (1.08)	6.67 (2.29)	12.00 (3.06)	28.00 (5.32)	12.00 (3.49)					
LSD (p=0.05)	(NS)	(NS)	(NS)	(0.72)	(1.05)	(NS)	(NS)	(NS)	(0.53)	(0.66)					

Figures in parentheses indicate square root transformations $\sqrt{x+0.5}$; NS: Non-significant, Note: Interaction between green manuring and weed control measures were non-significant during all the stages of observations; PE: pre-emergence

Table 3. Effects of green manuring and weed control measures on weed dry matter in rice at 30 DAT (no./m^2) (four years pooled mean)

Treatment	Grasses and sedges					Broad-leaved weeds					Weed control efficiency				
	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled
Green manuring															
Green manuring	3.99 (1.83)	5.10 (2.19)	3.36 (1.77)	4.54 (2.24)	4.76 (2.27)	2.34 (1.30)	0.70 (0.95)	0.04 (0.73)	2.17 (1.62)	1.56 (1.37)		-	-	-	-
Without green manuring	5.99 (2.32)	10.83 (3.09)	8.56 (2.84)	4.58 (2.25)	6.98 (2.69)	3.34 (1.57)	2.51 (1.44)	0.04 (0.73)	1.63 (1.44)	1.63 (1.38)		-	-	-	-
LSD (p=0.05)	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)					
Weed control measure															
Fixed herbicide – pretilachlor-S (PE)	4.64 (2.15)	7.06 (2.57)	6.58 (2.46)	4.41 (2.21)	5.66 (2.49)	2.00 (1.32)	1.16 (1.10)	0.00 (0.71)	1.87 (1.52)	1.26 (1.29)	56.7	46.0	6.4	20.5	36.4
Rotational herbicide	7.30 (2.72)	9.46 (3.10)	6.65 (2.38)	4.67 (2.27)	7.05 (2.78)	2.01 (1.19)	1.52 (1.11)	0.00 (0.71)	1.25 (1.39)	1.79 (1.48)	39.2	27.9	5.4	25.1	18.7
Weed free check	0.02 (0.72)	3.43 (1.79)	3.72 (1.98)	3.94 (2.11)	5.00 (2.30)	0.02 (0.72)	0.64 (0.94)	0.00 (0.71)	1.03 (1.23)	0.46 (0.96)	99.7	73.3	47.1	37.1	49.8
Weedy check	7.99 (2.72)	11.91 (3.12)	6.89 (2.40)	5.23 (2.39)	8.00 (2.98)	7.33 (2.52)	3.32 (1.97)	0.14 (0.80)	2.67 (1.77)	2.88 (1.78)	-	-	-	-	-
LSD (p=0.05)	(NS)	(NS)	(NS)	(0.11)	(0.39)	(NS)	(NS)	(NS)	(0.21)	(0.51)					

Figures in parentheses indicate square root transformations $\sqrt{x+0.5}$; NS: Non-significant, Note: Interaction between green manuring and weed control measures were non-significant during all the stages of observations; PE: pre-emergence

Weed dry matter

Four year pooled data revealed that green manuring did not influence the dry matter of monocots and BLWs at all the stages of observation (**Table 3**). However, least weed dry matter was observed in green manuring than without green manuring. These results were in line with the findings of Mathew and Alexander (1995) who reported that intercropping with *Sesbania aculeata* and manual incorporation of the same at 35 DAS in semi-dry rice recorded the lowest weed dry matter compared with sole paddy crop. Similar results were recorded by Nalini *et al.* (2008).

Weed free check (two hand weeding) significantly reduced the weed dry matter of monocots and BLWs at 30 DAT (**Table 3**), however, it was at par with the use of application of pretilachlor-S herbicide during 2014 (**Table 4**) .Among the herbicides, pretilachlor-S reduced weed dry matter of monocots than application of rotational herbicide pyrazosulfuron 0.030 kg/ha at 8-10 DAT (I year)**,** fenoxaprop -p-ethyl 0.056 kg/ha at 25-30 DAT (II year)**,** oxadiargyl 0.100 kg/ha at 0-5 DAT (III year). However, dry matter of BLWs was not affected due to various weed control measures. Higher weed control efficiency was observed in weed

Table 4. Effects of green manuring and weed control measures on weed dry matter in rice at 50 DAT (no./m²)

Treatment	Grasses and sedges					Broad-leaved weeds					Weed control efficiency				
	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled
Green manuring															
Green manuring	5.06 (2.00)	5.00 (2.15)	26.67 (5.09)	29.33 (5.38)	17.51 (4.31)	0.02 (0.72)	3.04 (1.40)	0.55 (0.96)	3.01 (1.86)	1.65 (1.39)		-	-	-	-
Without green manuring	12.40 (3.06)	8.33 (2.69)	44.00 (6.56)	28.33 (5.25)	25.79 (4.98)	2.68 (1.35)	5.71 (1.99)	0.49 (0.95)	2.57 (1.74)	2.86 (1.67)		-	-	-	-
LSD (p=0.05)	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)					
Weed control measure															
Fixed herbicide – pretilachlor-S (PE)	7.67 (2.12)	7.33 (2.58)	36.00 5.88	22.00 (4.70)	18.25 (4.30)	2.54 (1.41)	3.72 (1.53)	0.01 (0.72)	2.87 1.83	2.29 (1.53)	40.2	40.7	14.3	45.5	48.2
Rotational herbicide	11.45 (3.03)	7.33 (2.44)	39.33 6.17	33.33 (5.80)	23.00 (4.77)	0.02 (0.72)	3.40 (1.62)	0.92 (1.13)	3.15 1.89	1.87 (1.49)	32.8	42.4	4.2	20.0	37.3
Weed free check	1.53 (1.23)	4.67 (2.02)	24.67 4.91	17.33 (4.20)	13.17 (3.68)	0.02 (0.72)	1.17 (1.13)	0.47 (0.96)	2.20 1.64	0.96 (1.19)	90.9	68.7	40.2	57.2	64.3
Weedy check	14.26 (3.73)	9.44 (3.05)	41.33 6.33	42.67 (6.56)	35.73 (6.00)	2.82 (1.29)	9.20 (2.49)	0.68 (1.02)	2.93 1.85	3.91 (1.89)	-	-	-	-	-
LSD (p=0.05)	(NS)	(NS)	(NS)	(0.72)	(1.05)	(NS)	(NS)	(NS)	(NS)	(NS)					

Figures in parentheses indicate square root transformations $\sqrt{x+0.5}$; NS: Non-significant, Note: Interaction between green manuring and weed control measures were non-significant during all the stages of observations; PE: pre-emergence

free check (two hand weeding) (49.82% and 64.35% at 30 and 50 DAT respectively) followed by application of pretilachlor-S.

Grain and straw yields

Green manuring significantly influenced the grain and straw yields of rice and produced significantly higher grain and straw yields (3.86 grain and 3.87 straw t/ha) as compared to without green manuring (**Table 5**). This was due to effective suppression of weeds, restricting the nutrient drain by weeds and nutrient addition due to incorporation of green manuring. Apart from better weed control, mineralization of nutrients from incorporated green manuring might have resulted in higher grain yield (Matiwade and Sheelavantar 1994, Nalini *et al*. 2008).

Weed control measures significantly influence the grain yield of rice (**Table 5**). Weed free check (two hand weeding) produced significantly the highest grain yield (3.92 t/ha pooled) of rice over use of fixed application of pretilachlor-S (3.54 t/ha pooled) and rotational herbicides (pyrazosulfuron 0.030 kg/ha at 8-10 DAT, I year)**,** fenoxaprop -p-ethyl 0.056 kg/ha at 25-30 DAT, II year**,** oxadiargyl 0.100 kg/ha at 0-5 DAT, III year, (3.44 t/ha pooled), while it was at par with application of pretilachlor-S and rotational herbicides during 2011 and 2012 with rotational herbicide. Various weed control measures did not influence significantly the straw yield of rice. Use of pretilachlor-S recorded only 8.41% reduction in grain yield compared to weed free check, (two hand weeding) followed rotational use of herbicide (pyrazosulfuron 0.030 kg/ha at 8-10 DAT, I year),

Table 5. Effects of green manuring and weed control measures on yield of rice

Treatment	Grain (t/ha)					Straw (t/ha)					Weed index (%)				
	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled
Green manuring															
Green manuring	3.77	4.87	3.07	3.13	3.86	3.83	4.89	3.62	3.74	3.87	-	-	-	-	
Without green manuring	2.44	3.65	2.97	3.00	3.17	2.10	3.77	3.04	3.60	2.98	-	-	-	-	
LSD (p=0.05)	0.48	0.57	(NS)	(NS)	0.21	0.24	0.67	(NS)	(NS)	0.43	-	-	-	-	
Weed control measure															
Fixed herbicide – pretilachlor-S (PE)	3.43	4.33	3.18	3.14	3.54	3.32	4.46	3.36	3.61	3.50	3.57	4.56	0.46	14.77	6.38
Rotational herbicide	3.15	4.18	2.89	2.87	3.44	2.78	4.17	3.33	3.39	3.42	15.29	9.34	5.33	20.96	8.78
Weed free check	3.65	4.61	3.20	3.49	3.92	3.35	4.60	3.37	4.43	3.60	-	-	-	-	
Weedy check	2.19	4.03	2.82	2.27	3.16	2.41	4.09	3.27	2.83	3.18	34.29	11.83	7.31	35.61	15.69
LSD (p=0.05)	0.64	0.37	(NS)	0.18	0.30	0.45	(NS)	(NS)	0.22	(NS)	-	-	-	-	

NS: Non-significant, Note: Interaction between green manuring and weed control measures were non-significant during all the stages of observations; PE: pre-emergence

fenoxaprop -p-ethyl 0.056 kg/ha at 25-30 DAT, II year, oxadiargyl 0.100 kg/ha at 0-5 DAT, III year, (pooled of three years 12.39%). Similar findings were also reported by Teja *et al*. (2016).

From four years study, it was concluded that incorporation of green manure reduced the weed growth and application of fixed herbicide pretilachlor-S reduced the weed growth and increased the yield of rice under Konkan region of Maharashtra, India.

REFERENCES

Anonymous 2016. *Annual Report*. Department of Agriculture, Co-operation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, Krishi Bhawan, New Delhi.

Duary B, Mishra MM, Dash R and Teja KC. 2015. Weed management in lowland rice. *Indian Journal of Weed Science* **47**(3): 224–232.

Das A and Chandra S. 2013. Irrigation, spacing and cultivar effects on net photosynthetic rate, dry matter partitioning and productivity of rice under system of rice intensification in mollisols of northern India. *Experimental Agriculture* **49**(4): 504–523.

Gnanavel and Kathiresan RM. 2002. Sustainable weed management in rice-rice cropping system. *Indian Journal of Weed Science* **34**(3&4): 192–196.

Teja KC, Duary B and Dash S. 2016. Sole and combined application of herbicides on composite weed flora of transplanted rice. *Indian Journal of Weed Science* **48**(3): 254–258.

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

Manhas SS, Singh G, Singh D and Khajuria V. 2012. Effect of tank mixed herbicides on weeds and transplanted rice (*Oryza sativa* L.). *Annals of Agricultural Research New Series* **33**: 25–31.

Mathew G and Alexander GD. 1995. Influence of intercropped green manure crops on weed population and grain yield of semi-dry rice. *Madras Agricultural Journal* **82**(1): 66–67.

Matiwade PS and Sheelavantar MN. 1994. Growth analysis of rice as influenced by green manuring (*Sesbania rostrata*). *Oryza* **31**: 196–198.

Panse VG and Sukhatme PV. 1984. *Statistical Methods for Agricultural Research Workers.* ICAR, New Delhi.

Singh I, Ram M and Nandal DP. 2007. Efficacy of new herbicides for weed control in transplanted rice under rice–wheat system. *Indian Journal of Weed Science* **39**(1&2): 28–31.

Singh RK, Bohra, JS, Srivastava VK and Singh RP. 2008. Effect of diversification of rice-wheat system on weed dynamics in rice. *Indian Journal of Weed Science* **40**: 128–131.