

## Effect of Long-term Herbicide Trial in Rice-Ground-nut Cropping Systems against Complex Weed Growth and Yield

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### ABSTRACT

The field experiment was conducted during kharif season of the year 2013-2014 on red lateritic soil of the Education-cum-experimental Farm, Department of Agronomy, College of Agriculture, Dapoli, Ratnagiri (M.S.) to study effect of Long term herbicide trial in Rice-Ground-nut cropping systems. The study reveals that weed growth of monocots reduced significantly due to weed free check as compared to all other weed control measures during the year 2014 and 2015. While during the year 2012 weed free check remained at par with fixed and rotational herbicide and in pooled results with fixed herbicide. Among the herbicide tried fixed herbicide recorded least growth of monocots and BLWs as compared to rotational herbicide. In respect of growth of BLWS at harvest, weed free check (2HW) remained at par with fixed herbicide and recorded significantly lowest weed growth during the year 2012 and in pooled results. However weed free check reduced significantly weed growth of BLWS during the years 2013, 2014 and 2015 over all other weed control measures tried. The highest weed control efficiency was recorded under weed free check followed by fixed herbicide and rotational herbicide during individual years and in pooled results. Interaction effects both green manuring and weed control measures on weed growth was found to be non significant. Rice equivalent yield of groundnut and REY of system did not influenced significantly due to green manuring. However, green manuring recorded higher rice equivalent yield of groundnut (134.66) and REY (178.44) of system than without green manuring.

**Key words:** Rice-Ground cropping System, Different herbicides, Weed growth, Yield attributing characters, Yields and chemical composition.

### INTRODUCTION

Crop sequence is an order in which the chosen cultivated crop follow integrated approach over a definite period for their growth. Different kind of crop sequences are being adopted under diverse aro-climatic conditions

with high production, net returns and sustainable approach. Herbicides flowed by Intercultures operation play an important role in integrated weed management in rice-ground nut cropping system.

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In early season weed competition significantly reduces rice & ground nut grain yield and pre-emergence herbicides application are widely used. But most weeds seed germinate over long time and pre-emergence herbicides having short residual life so that used combinations of herbicides and approach integrated weed managements.

**MATERIALS AND METHODS**

The field experiment was conducted during *kharif* season of the year 2011-2012 on red lateritic soil of the Education-cum-experimental Farm, Department of Agronomy, College of Agriculture, Dapoli, Ratnagiri (M.S.) to study effect of Long term herbicide trial in Rice-Ground-nut cropping system against complex weed density and Yield attributing characters. The experiment was conducted on *kharif* rice (Ratnagiri-24) and *rabi* groundnut (konkan tapora) cropping system. The experiment included eight treatment combination laid down in split plot design (SPD) with three replications. The main plot treatment included green manuring viz *Sesbania rostrata* (in-situ application after 45 DAS) and without green manuring

(control), while the subplot treatment included weed control measure such as handweeding at 20 and 40 DAS, fixed herbicide pretilachlor-S0.75 kg/ha 3-7 days after transplanting (DAT) for rice crop and Pendimethalin 30EC @ 1.0 kg/ha PE for groundnut crop and different rotational herbicide (For rice crop, Pyrazosulfuron 10 WP @ 0.25kg/ha 8-10 DAT(I yr) Fenoxaprop 10 EC @ 80 kg/ ha25-30 DAT (IIyr), Oxadiargyl 80 WP@ 0.100 kg/ha 0-5 DAT (IIIyr) and for groundnut crop Oxadiargyl 80 WP@0.12 kg/ha 0-2 DAS (Iyr), Butachlor 50 EC @ 1.0 kg/ha 0-3 DAS (IIyr), Alachlor 50 EC @ 1.5 kg/ha0-3 DAS (IIIyr), weedy check. The relative equivalent (REY) was calculated by the mixture yields of component crop expressed as a portion of its yield as a sole crop from the same replacement series is the relative yield of the crop and some of the relative yields of component crop. The experimental data were subjected to analysis of variance (ANOVA) and treatment means were compared, significant differences were tested at p=0.05 using split plot design (SPD) as given by Panse and Sukhatme (1985) using computer design.

**Table 1: Effects of green manuring & weed control measures on weed growth in *Rabi Groundnut* 30 DAS (g/0.25m<sup>2</sup>) (four years pooled mean).**

Treatments	Grasses and sedges					Broad leaved weeds					Total					Weed control efficiency				
	2012	2013	2014	2015	Pooled	2012	2013	2014	2015	Pooled	2012	2013	2014	2015	Pooled	2012	2013	2014	2015	Pooled
Main plot treatment : Green manuring	0.93 (1.20)	2.37 (1.61)	1.85 (1.59)	2.11 (1.57)	1.82 (1.46)	0.03 (0.73)	0.17 (0.81)	0.51 (1.00)	0.34 (0.91)	0.27 (0.86)	0.96	2.54	2.36	2.45	2.09	-	-	-	-	-
M <sub>1</sub> : Green manuring	0.57 (0.99)	2.03 (1.54)	1.82 (1.49)	1.92 (1.52)	1.58 (1.39)	0.00 (0.71)	0.81 (1.01)	0.45 (0.87)	0.41 (0.94)	0.42 (0.90)	0.57	2.84	2.27	2.33	2.00	-	-	-	-	-
M <sub>2</sub> : without green manuring	- (0.06)	- (0.08)	- (0.07)	- (0.07)	- (0.05)	- (0.01)	- (0.05)	- (0.06)	- (0.02)	- (0.01)	-	-	-	-	-	-	-	-	-	-
Sem ±	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	-	-	-	-	-	-	-	-	-	-
LSD (P=0.05)																				
Sub plot: Weed control measures																				
T <sub>1</sub> : Fixed herbicide - Pendimethalin(PE)	0.88 (1.15)	2.32 (1.66)	2.13 (1.78)	2.23 (1.65)	1.89 (1.52)	0.00 (0.71)	0.02 (0.72)	0.28 (0.88)	0.15 (0.80)	0.11 (0.78)	0.88	2.34	2.41	2.38	2.00	24.79	54.38	28.27	37.53	40.12
T <sub>2</sub> : Rotational herbicide - Alachlor	1.00 (1.24)	2.58 (1.73)	2.26 (1.66)	2.42 (1.70)	2.09 (1.58)	0.02 (0.71)	0.22 (0.84)	0.35 (1.02)	0.41 (0.95)	0.31 (0.89)	1.02	2.80	2.86	2.83	2.40	12.82	45.42	14.88	25.72	28.14
T <sub>3</sub> : Weed free check	0.00 (0.71)	0.39 (0.83)	0.54 (1.02)	0.47 (0.97)	0.35 (0.91)	0.00 (0.71)	0.10 (0.77)	0.10 (0.77)	0.10 (0.77)	0.07 (0.76)	0.00	0.49	0.64	0.57	0.42	100.0	90.45	80.95	85.04	87.43
T <sub>4</sub> : Weedy check	1.12 (1.28)	3.51 (1.99)	2.41 (1.81)	2.96 (1.85)	2.47 (1.69)	0.05 (0.74)	0.05 (1.31)	1.62 (1.20)	0.95 (1.16)	0.85 (1.10)	1.17	5.13	3.36	3.81	3.34	-	-	-	-	-
Sem ±	- (0.06)	- (0.10)	- (0.08)	- (0.06)	- (0.04)	- (0.01)	- (0.15)	- (0.08)	- (0.02)	- (0.04)	-	-	-	-	-	-	-	-	-	-
LSD (P=0.05)	- (0.20)	- (0.31)	- (0.22)	- (0.19)	- (0.13)	- (N.S.)	- (N.S.)	- (0.28)	- (0.05)	- (0.12)	-	-	-	-	-	-	-	-	-	-
Interaction effects																				
Sem ±	- (0.08)	- (0.14)	- (0.11)	- (0.09)	- (0.06)	- (0.01)	- (0.21)	- (0.12)	- (0.02)	- (0.06)	-	-	-	-	-	-	-	-	-	-
LSD (P=0.05)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	-	-	-	-	-	-	-	-	-	-

Figures in parentheses indicate square root transformations  $\sqrt{x + 0.5}$

**Table 2: Effects of green manuring & weed control measures on weed growth in Rabi Groundnut at harvest (g/0.25m<sup>2</sup>) (four years pooled mean).**

Treatments	Grasses and sedges					Broad leaved weeds					Total					Weed control efficiency					
	2012	2013	2014	2015	Pooled	2012	2013	2014	2015	Pooled	2012	2013	2014	2015	Pooled	2012	2013	2014	2015	Pooled	
<b>Main plot treatment :</b>																					
<b>Green manuring</b>	0.00 (0.71)	0.43 (0.91)	0.94 (1.17)	5.84 (2.23)	1.80 (1.26)	6.91 (2.54)	10.86 (2.86)	0.81 (1.13)	0.69 (1.06)	4.82 (1.92)	6.91	11.29	1.75	6.53	6.62	-	-	-	-	-	
<b>M<sub>1</sub>: Green manuring</b>	4.33 (1.25)	0.18 (0.80)	1.34 (1.33)	3.33 (1.82)	2.29 (1.30)	7.58 (2.81)	6.03 (2.35)	0.63 (1.04)	0.97 (1.18)	3.80 (1.81)	11.91	6.21	1.97	4.30	6.09	-	-	-	-	-	
<b>M<sub>2</sub>: without green manuring</b>	- (0.38)	- (0.08)	- (0.07)	- (0.17)	- (0.04)	- (0.24)	- (0.22)	- (0.03)	- (0.01)	- (0.08)	-	-	-	-	-	-	-	-	-	-	
<b>Sem ±</b>	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	-	-	-	-	-	-	-	-	-	-	
<b>LSD (P=0.05)</b>																					
<b>Sub plot: Weed control measures</b>																					
<b>T<sub>1</sub>: Fixed herbicide – Pendimethalin(PE)</b>	0.00 (0.71)	0.58 (1.01)	1.23 (1.30)	2.66 (1.76)	1.12 (1.19)	3.23 (1.90)	4.81 (2.12)	0.51 (0.99)	0.91 (1.18)	2.37 (1.58)	3.23	5.39	1.74	3.57	3.49	82.51	66.52	38.73	63.87	70.47	
<b>T<sub>2</sub>: Rotational herbicide – Alachlor</b>	0.00 (0.71)	0.05 (0.74)	1.43 (1.38)	7.02 (2.51)	2.13 (1.34)	9.70 (3.10)	12.96 (3.44)	1.07 (1.26)	0.74 (1.11)	6.12 (2.19)	9.70	13.01	2.50	7.76	8.25	47.48	19.19	11.97	21.46	30.20	
<b>T<sub>3</sub>: Weed free check</b>	0.00 (0.71)	0.00 (0.71)	0.22 (0.84)	0.31 (0.99)	0.13 (0.79)	6.23 (2.35)	0.48 (0.98)	0.14 (0.79)	0.11 (0.78)	1.74 (1.23)	6.23	0.48	0.36	0.42	1.87	66.27	97.02	87.32	95.75	84.18	
<b>T<sub>4</sub>: Weedy check</b>	8.67 (1.79)	0.58 (0.96)	1.67 (1.47)	8.34 (2.94)	4.81 (1.80)	9.80 (3.36)	15.52 (3.89)	1.17 (1.29)	1.54 (1.43)	7.01 (2.46)	18.47	16.10	2.84	9.88	11.82	-	-	-	-	-	
<b>Sem ±</b>	- (0.54)	- (0.07)	- (0.06)	- (0.24)	- (0.15)	- (0.33)	- (0.31)	- (0.04)	- (0.04)	- (0.14)	-	-	-	-	-	-	-	-	-	-	
<b>LSD (P=0.05)</b>	- (N.S)	- (0.22)	- (0.18)	- (0.73)	- (0.48)	- (1.01)	- (0.97)	- (0.09)	- (0.13)	- (0.43)	-	-	-	-	-	-	-	-	-	-	
<b>Interaction effects</b>																					
<b>Sem ±</b>	- (0.77)	- (0.10)	- (0.07)	- (0.34)	- (0.22)	- (0.46)	- (0.44)	- (0.03)	- (0.06)	- (0.20)	-	-	-	-	-	-	-	-	-	-	
<b>LSD (P=0.05)</b>	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	-	-	-	-	-	-	-	-	-	-	

Figures in parentheses indicate square root transformations  $\sqrt{x + 0.5}$

**D) Effects on weed growth of Groundnut crop**

The weed growth of monocots and BLWs in rabi groundnut was not significantly influenced due to green manuring at any stage of observation during all the years and in pooled results. Weed free check (2HW) at 30 DAS was found to be the most efficient and significantly superior in reducing weed growth of monocots over all other weed control measures during individual years and in pooled results followed by fixed herbicide which was at par with rotational herbicide. Weed growth of BLWS at 30 DAS also reduced significantly due to weed free check as compared weedy check during the year 2014. However weed free check reduced significantly the growth of BWLs over weedy check and rotational herbicide during the year 2015 and in pooled results. At harvest weed growth of monocots reduced significantly due to weed free check as compared to all other

weed control measures during the year 2014 and 2015. While during the year 2012 weed free check remained at par with fixed and rotational herbicide and in pooled results with fixed herbicide. Among the herbicide tried fixed herbicide recorded least growth of monocots and BLWs as compared to rotational herbicide. In respect of growth of BLWS at harvest, weed free check (2HW) remained at par with fixed herbicide and recorded significantly lowest weed growth during the year 2012 and in pooled results. However weed free check reduced significantly weed growth of BLWS during the years 2013, 2014 and 2015 over all other weed control measures tried. The highest weed control efficiency was recorded under weed free check followed by fixed herbicide and rotational herbicide during individual years and in pooled results. The Interaction effects both green manuring and weed control measures on weed growth was found to be non significant.

**Table 3: Effects of green manuring & weed control measures on yield of Groundnut (four years pooled mean)**

Treatments	Dry pod yield q/ha					Haulm yield q/ha					WCI%				
	2012	2013	2014	2015	Pooled	2012	2013	2014	2015	Pooled	2012	2013	2014	2015	Pooled
<b>Main plot treatment : Green manuring</b>															
M <sub>1</sub> : Green manuring	33.08	28.93	29.98	29.43	32.15	13.95	10.18	10.26	10.20	45.07	-	-	-	-	-
M <sub>2</sub> : without green manuring	34.62	28.52	30.42	29.51	31.29	11.73	9.78	11.32	11.32	44.09	-	-	-	-	-
Sem ±	1.17	0.58	0.28	0.26	0.65	0.66	0.25	0.15	0.29	1.18	-	-	-	-	-
LSD (P=0.05)	N.S	N.S	N.S	N.S.	N.S	N.S	N.S	N.S.	N.S.	N.S.	-	-	-	-	-
<b>Sub plot: Weed control measures</b>															
T <sub>1</sub> : Fixed herbicide – Pendimethalin(PE)	32.90	27.90	27.70	27.80	33.18	12.73	11.90	11.74	11.74	47.03	5.40	8.58	9.38		
T <sub>2</sub> : Rotational herbicide – Alachlor	31.85	26.22	27.88	27.05	30.97	12.60	9.00	10.73	10.64	42.59	19.69	10.71	15.57		
T <sub>3</sub> : Weed free check	34.70	29.28	30.47	29.81	35.99	12.90	9.80	11.89	11.85	49.28	-	-	-	-	-
T <sub>4</sub> : Weedy check	35.93	31.50	34.75	33.22	26.76	13.13	9.23	8.81	8.81	39.41	14.34	31.76	23.97		
Sem ±	1.96	1.60	0.39	1.33	0.90	0.82	0.83	0.40	0.55	0.86	-	-	-	-	-
LSD (P=0.05)	N.S	N.S	1.21	4.09	2.77	N.S	N.S	1.24	1.69	2.64	-	-	-	-	-
<b>Interaction effects</b>															
Sem ±	2.77	2.26	0.56	1.88	1.27	1.16	1.17	0.58	0.77	1.21	-	-	-	-	-
LSD (P=0.05)	N.S.	N.S	N.S	N.S.	N.S	N.S	N.S	N.S	N.S.	N.S.	-	-	-	-	-

**Composition of weed flora. Rabi G'nut**

Sr.No.	Year	Grasses & sedges	Broad leaved weeds
1.	2011-2012	<i>Ischamum globosa</i> , <i>Leptocloa chinensis</i> , <i>Cyperus iria</i> , <i>Eriocolum hexangulare</i> , <i>Eiusine.indica</i>	<i>Ludwigia octovalvis</i> , <i>Ageratum conyzoides</i> , <i>Altermenthra sessilis</i> , <i>Blumea lacer</i>
2.	2012-2013	<i>Oryza sativa</i> , <i>Leptochloa.chinensis</i> , <i>Cyperus rotundus</i> , <i>Eiusine.indica</i>	<i>Ludwigia octovalvis</i> , <i>Ageratum conyzoides</i> , <i>Aitermenthra sessilis</i> , <i>Cleome viscosa</i> , <i>Portulaca oleracea</i> , <i>Cardiospermum.halicacabum</i> , <i>Convolvusarvensis</i> , <i>Celotiaargentea</i> , <i>Chinopodium album</i>
3.	2013-2014	<i>Cyperus rotundus</i>	<i>Cocks comb</i> , <i>Altermenthra sessilis</i> , <i>Physalis minima</i> , <i>Mimosa pudica</i> , <i>Amaranthus spinosus</i> , <i>Cleoma viscosa</i>

**II) Effects on yield attributes and yield of Groundnut**

Green manuring to *Kharif* rice did not significantly influence dry pod and haulm yield of groundnut. However, green manuring to *Kharif* rice produced highest dry pod yield of groundnut during individual year and in pooled results. The pooled results indicated that among the different weed control measures tried, weed free check recorded significantly higher plant height than rotational herbicide and remained at par with use of fixed herbicide. Various weed control measures tried produced significantly higher dry pod and haulm yield qu. ha<sup>-1</sup> over weedy check. In rabi groundnut weed free check (2 HW) was found most efficient and significantly superior in producing dry pod yield qu. ha<sup>-1</sup> followed by

fixed and rotational herbicide. Among the herbicide tried use of fixed herbicide produce significantly higher dry pod yield as compared to rotational herbicide. The haulm yield of groundnut in use of different weed control measures i.e. (fixed and rotational) herbicide and weed free check were at par with each other and produced significantly higher haulm yield over weedy check. Thus, compared to best treatment of weed free check the percent reduction in pod yield (WCI) was found to be least in case of use of fixed herbicide (Pendimethalin) (7.81%) followed by rotational herbicide (13.94%). Interaction effects between green manuring and weed control measures were found to be non significant.

Green manuring to kharif rice did not influenced the weed density and growth of monocots and BLWs. While the various weed control measures significantly influenced the weed growth at 30 DAS and at harvest. The fixed and rotational herbicides reduced weed density resulted in increased dry pod yield of

groundnut (33.18 & 30.97 q.ha<sup>-1</sup>) respectively over weedy check (26.76 q.ha<sup>-1</sup>). The results are in conformity with the work of Jat R.S. et al. (2011). They reported that various weed control measures such as herbicides and hand weeding reduces weed growth and increase the yield of groundnut.

**Table 4: Effects of green manuring & weed control measures on weed growth in rice at 30 DAT (No/0.25m<sup>2</sup>)**

Treatments	Grasses and sedges					Broad leaved weeds					Total					Weed control efficiency				
	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled
Main plot treatment : Green manuring	1.00 (1.15)	2.71 (1.64)	0.84 (1.10)	1.14 (1.27)	1.74 (1.41)	0.83 (1.05)	0.18 (0.80)	0.01 (0.71)	0.54 (1.02)	0.39 (0.89)	1.83	2.89	0.85	1.68	2.13	-	-	-	-	-
M <sub>1</sub> : Green manuring	1.50 (1.35)	1.28 (1.34)	2.14 (1.56)	1.15 (1.28)	1.19 (1.27)	0.58 (0.95)	0.63 (0.93)	0.01 (0.71)	0.41 (0.95)	0.41 (0.88)	2.08	1.91	2.15	1.56	1.60	-	-	-	-	-
M <sub>2</sub> : without green manuring	- (0.06)	- (0.17)	- (0.05)	- (0.01)	- (0.04)	- (0.07)	- (0.07)	- (0.01)	- (0.03)	- (0.01)	-	-	-	-	-	-	-	-	-	-
Sem ±	- (N.S.)	- (N.S.)	- (0.29)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	-	-	-	-	-	-	-	-	-	-
LSD (P=0.05)																				
Sub plot: Weed control measures																				
T <sub>1</sub> :Fixed herbicide – Pendimethalin(PE)	1.83 (1.50)	0.86 (2.12)	0.93 (1.17)	1.10 (1.26)	1.18 (1.26)	0.50 (0.94)	0.29 (0.85)	0.00 (0.72)	0.47 (0.98)	0.31 (0.87)	2.33	1.15	0.93	1.57	1.49	39.16	65.77	46.9	20.70	45.02
T <sub>2</sub> : Rotational herbicide – Alachlor	1.17 (1.26)	1.77 (1.38)	1.72 (1.38)	1.17 (1.22)	1.45 (1.32)	0.50 (0.90)	0.78 (0.84)	0.00 (0.72)	0.51 (1.00)	0.45 (0.89)	1.67	2.55	1.72	1.68	1.90	56.40	24.11	3.61	15.15	29.89
T <sub>3</sub> : Weed free check	0.00 (0.71)	2.37 (1.74)	1.65 (1.39)	0.99 (1.22)	1.25 (1.27)	0.00 (0.71)	0.16 (0.79)	0.04 (0.73)	0.26 (0.87)	0.11 (0.78)	0.00	2.53	1.69	1.25	1.36	100	24.70	1.81	36.87	49.82
T <sub>4</sub> : Weedy check	2.00 (1.52)	2.98 (1.74)	1.66 (1.38)	1.31 (1.34)	1.99 (1.50)	1.83 (1.43)	0.38 (0.87)	0.00 (0.71)	0.67 (1.07)	0.72 (1.02)	3.83	3.36	1.66	1.98	2.71	-	-	-	-	-
Sem ±	- (0.15)	- (0.18)	- (0.19)	- (0.02)	- (0.05)	- (0.19)	- (0.13)	- (0.01)	- (0.03)	- (0.05)	-	-	-	-	-	-	-	-	-	-
LSD (P=0.05)	- (0.45)	- (N.S)	- (N.S)	- (0.05)	- (0.15)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	-	-	-	-	-	-	-	-	-	-
Interaction effects																				
Sem ±	- (0.21)	- (0.26)	- (0.27)	- (0.02)	- (0.07)	- (0.27)	- (0.19)	- (0.01)	- (0.03)	- (0.07)	-	-	-	-	-	-	-	-	-	-
LSD (P=0.05)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	-	-	-	-	-	-	-	-	-	-

Figures in parentheses indicate square root transformations  $\sqrt{x + 0.5}$

**Table 5: Effects of green manuring & weed control measures on weed growth in rice at harvest (No/0.25m<sup>2</sup>)**

Treatments	Grasses and sedges					Broad leaved weeds					Total					Weed control efficiency				
	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled	2011	2012	2013	2014	Pooled
Main plot treatment : Green manuring	2.55 (1.51)	3.85 (1.78)	0.07 (0.75)	1.22 (1.31)	2.82 (1.52)	0.33 (0.85)	1.39 (1.29)	1.84 (1.49)	1.03 (1.26)	1.15 (1.21)	2.88	5.24	1.91	2.25	3.97	-	-	-	-	-
M <sub>1</sub> : Green manuring	2.96 (1.68)	6.63 (2.13)	3.71 (1.50)	1.32 (1.34)	2.73 (1.48)	0.91 (1.13)	7.20 (2.23)	1.96 (1.54)	0.90 (1.18)	2.74 (1.52)	3.87	13.83	5.67	2.22	5.47	-	-	-	-	-
M <sub>2</sub> : without green manuring	- (0.24)	- (0.31)	- (0.37)	- (0.01)	- (0.10)	- (0.04)	- (0.42)	- (0.07)	- (0.01)	- (0.10)	-	-	-	-	-	-	-	-	-	-
Sem ±	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (0.27)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	-	-	-	-	-	-	-	-	-	-
LSD (P=0.05)																				
Sub plot: Weed control measures																				
T <sub>1</sub> :Fixed herbicide – Pendimethalin(PE)	2.57 (1.68)	0.72 (0.98)	0.11 (0.77)	1.34 (1.36)	1.18 (1.20)	0.95 (0.13)	6.00 (2.20)	2.30 (1.65)	1.07 (1.31)	2.58 (1.56)	3.52	6.72	2.41	2.41	3.76	40.84	59.27	64.87	3.21	52.47
T <sub>2</sub> : Rotational herbicide – Alachlor	0.00 (0.71)	3.44 (1.64)	0.50 (0.91)	1.08 (1.25)	1.25 (1.13)	0.00 (0.71)	0.36 (0.80)	1.94 (1.56)	0.83 (1.15)	0.79 (1.06)	0.00	3.80	2.44	1.91	2.04	100	76.97	64.43	23.29	74.21
T <sub>3</sub> : Weed free check	5.02 (2.09)	10.22 (2.68)	5.16 (1.64)	1.49 (1.41)	5.43 (1.96)	0.93 (1.15)	6.28 (2.12)	1.70 (1.41)	1.09 (1.34)	2.48 (1.48)	5.95	16.50	6.86	2.49	7.91	-	-	-	-	-
T <sub>4</sub> : Weedy check	- (0.22)	- (0.64)	- (0.40)	- (0.01)	- (0.13)	- (0.12)	- (0.40)	- (0.19)	- (0.04)	- (0.11)	-	-	-	-	-	-	-	-	-	-
Sem ±	- (0.66)	- (N.S)	- (N.S)	- (0.03)	- (0.40)	- (N.S.)	- (N.S.)	- (N.S.)	- (0.11)	- (0.33)	-	-	-	-	-	-	-	-	-	-
LSD (P=0.05)																				
Interaction effects																				
Sem ±	- (0.30)	- (0.90)	- (0.57)	- (0.01)	- (0.18)	- (0.17)	- (0.56)	- (0.27)	- (0.05)	- (0.15)	-	-	-	-	-	-	-	-	-	-
LSD (P=0.05)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	- (N.S.)	-	-	-	-	-	-	-	-	-	-

Figures in parentheses indicate square root transformations  $\sqrt{x + 0.5}$

**II) Effect on weed growth of *kharif* rice**

Green manuring did not influenced significantly the growth of monocots and BLWS at all the stages of observation during all the years of experimentation and in pooled results. Various weed control measures tried significantly influence weed growth of monocots at harvest during individual years and in pooled results except during the years 2012 and 2013. Weed free check reduced significantly the weed growth of monocots during the year 2011 over all other weed control measures tried however it was at par with use fixed herbicide during the year 2014 while it was identical with rotational herbicide and fixed herbicide in pooled results. Growth of BLWs did not significantly influence due to

weed control measures tried during all the years as well as in pooled results. At harvest weed free check reduced significantly the weed growth of monocots over all other treatments during the year 2011 and 2014, where as in pooled results weed free check remained at par with rotational herbicide and recorded significantly lowest weed growth than fixed herbicide and weedy check. Weed free check reduced significantly the weed growth of BLWs during the year 2014 and in pooled results as compared to weedy check and rotational herbicide but it was at par with fixed herbicide. The interaction effects between green manuring and weed control measures on weed growth were found to be non significant.

**Table 6: Effects of green manuring & weed control measures on yield of *Kharif* rice**

Treatments	Grain				Pooled	Straw				Pooled	WCI%				Pooled
	2011	2012	2013	2014		2011	2012	2013	2014		2011	2012	2013	2014	
<b>Main plot treatment: Green manuring</b>															
M <sub>1</sub> : Green manuring	37.69	48.72	30.71	31.31	38.62	38.34	48.94	36.18	37.36	38.69	-	-	-	-	
M <sub>2</sub> : without green manuring	24.41	36.50	29.70	30.00	31.65	20.98	37.68	30.40	35.98	29.77	-	-	-	-	
Sem ±	0.79	0.94	0.19	0.26	0.34	0.39	1.10	1.39	0.23	0.70	-	-	-	-	
LSD (P=0.05)	4.83	5.71	N.S	N.S	2.09	2.38	6.70	N.S	N.S	4.28	-	-	-	-	
<b>Sub plot: Weed control measures</b>															
T <sub>1</sub> :Fixed herbicide Pendimethalin(PE)	31.53	41.81	28.17	31.40	34.39	33.18	46.01	33.25	36.07	35.96	13.69	9.21	11.83	14.84	
T <sub>2</sub> : Rotational herbicide – Alachlor	34.25	43.33	31.80	28.65	35.42	33.51	40.99	33.67	33.93	34.19	6.24	5.91	0.47	21.01	
T <sub>3</sub> : Weed free check	36.53	46.05	31.95	34.90	39.15	27.81	44.57	32.66	44.33	34.98	-	-	-	-	
T <sub>4</sub> : Weedy check	21.90	40.25	28.89	22.67	31.57	24.13	41.67	33.60	28.34	31.78	40.05	12.60	9.58	35.62	
Sem ±	2.07	1.18	1.51	0.60	0.98	1.45	1.63	3.75	0.72	1.19	-	-	-	-	
LSD (P=0.05)	6.37	3.65	N.S	1.84	3.03	4.46	N.S	N.S	2.20	N.S.	-	-	-	-	
<b>Interaction effects</b>															
Sem ±	2.93	1.67	2.14	0.84	1.39	2.05	2.31	5.31	1.01	1.69	-	-	-	-	
LSD (P=0.05)	N.S.	N.S.	N.S	N.S	N.S.	N.S.	N.S.	N.S	N.S	N.S.	-	-	-	-	

**Composition of weed flora**

Base year <i>Kharif</i> ,2011		<i>Kharif- Rice</i> ,2014	
Grasses and Sedges	BLWs	Grasses and Sedges	BLWs
<i>Ischamum globosa</i>	<i>Ludwigia octovalvis</i>	<i>Cyperus iria</i>	<i>Altermenthra sessilis</i>
<i>Leptocloa chinensis</i>	<i>Eiusine indica</i>	<i>Erioculum hexangularis</i>	<i>Physalis minima</i>
<i>Cyperus iria</i>	<i>Ageratum conyzoides</i>	<i>Ischamum globosa</i>	<i>Ludwigia octovalvis</i>
<i>Erioculum hexangularis</i>	<i>Altermenthra sessilis</i>		
	<i>Blumea lacera</i>		

### III) Effect on yield of *kharif* rice

Green manuring recorded significantly higher grain and straw yield of *kharif* rice than the without green manuring during the year 2011, 2012 and in pooled results. Various weed control measures tried, significantly influence grain yield of rice during the year 2011, 2012 and also in pooled results. Weed free check produced significantly highest grain yield of rice over all other treatments. However, use of rotational herbicide and fixed herbicide were remained at par with each other and produced significantly higher grain yield over weedy check. Thus, compared to best treatment of weed free check the percent reduction in grain yield in terms of WCI was found to be the best in case of use of rotational herbicide (8.41%) followed by fixed herbicide (12.39). Various weed control measures did not influence straw yield of rice. The interaction effects between green manuring and weed control measures on grain yield of *Kharif* rice was found to be non significant.

From this is clear that that green manuring did not influenced the weed density and weed

growth at 30, and at harvest during all the years of experimentation and also in pooled results. Similarly it was not influenced the yield attributes except plant height. However green manuring recorded significantly higher grain and straw yield of rice. Weed density of monocots was reduced significantly due to the application of fixed and rotational herbicides at 50 and at harvest. The weed growth of monocots and BLWs was also significantly influenced due to various weed control measures. The grain yield of rice was significantly highest in weed free check (39.15 q ha<sup>-1</sup>) followed by rotational herbicide (35.42). The same results are reported by Gull hasan (2005) who found rice yield significantly influenced by herbicides treatments. The same has been reported by Hashimetal (2002) and Montazeri (1994). They reported that herbicide treatments significantly increased the grain yield of wheat. The interaction effects between green manuring and weed control measures on grain yield of *Kharif* rice was found to be non-significant.

**Table 7: Effects of green manuring & weed control measures on REY and total REY of rice-groundnut cropping system**

Treatments	Pooled grain yield of rice (q/ha)	Pooled straw yield of rice (q/ha)	Pooled dry pod yield (q/ha)	Pooled Hualm yield of Gr.nut (q/ha)	REY of Gr.nut (q/ha)	Total REY of system (q/ha)
<b>Main plot treatment : Green manuring</b>						
M <sub>1</sub> : Green manuring	38.62	38.69	32.15	45.07	<b>134.66</b>	178.44
M <sub>2</sub> : without green manuring	31.65	29.77	31.29	44.09	<b>131.04</b>	166.65
Sem ±	0.34	0.70	0.65	1.18	2.77	2.35
LSD (P=0.05)	2.09	4.28	N.S	N.S.	N.S.	N.S.
<b>Sub plot: Weed control measures</b>						
T <sub>1</sub> :Fixed.herbicide – Pendimethalin(PE)	34.39	35.96	33.18	47.03	<b>139.01</b>	178.20
T <sub>2</sub> : Rotational herbicide – Alachlo	35.42	34.19	30.97	42.59	<b>129.54</b>	169.52
T <sub>3</sub> : Weed free check	39.15	34.98	35.99	49.28	<b>150.54</b>	194.35
T <sub>4</sub> : Weedy check	31.57	31.78	26.76	39.41	<b>112.30</b>	148.11
Sem ±	0.98	1.19	0.90	0.86	3.66	4.11
LSD (P=0.05)	3.03	N.S.	2.77	2.64	11.26	12.65
<b>Interaction effects</b>						
Sem ±	1.39	1.69	1.27	1.21	5.17	5.81
LSD (P=0.05)	N.S.	N.S.	N.S	N.S.	N.S.	NS

**Table 8: Effects of green manuring & weed control measures on economics of rice-groundnut cropping system**

Treatment combination	Total REY of system	Gross Return (Rs/ha)	Cost of cultivation (Rs/ha)	Net Returns (Rs/ha)	B:C Ratio
M1T1	186.76	280140	148980	131160	1.88
M1T2	175.73	263595	150110	113485	1.76
M1T3	195.09	295635	165100	130535	1.79
M1T4	156.16	234240	143100	91140	1.63
M2T1	169.63	254445	148180	106265	1.71
M2T2	163.30	244950	149310	95640	1.64
M2T3	193.62	290430	164300	126130	1.77
M2T4	140.05	210075	142300	67775	1.47

### Rice equivalent yield of groundnut and total REY of the system:-

The data presented in Table 7 revealed that rice equivalent yield of groundnut and REY of system did not influenced significantly due to green manuring. However, green manuring recorded higher rice equivalent yield of groundnut (134.66) and REY (178.44) of system than without green manuring. As compared to weedy check, all the weed control measures significantly increased the rice equivalent yield of groundnut. Among the weed control measures tried, 2 HW recorded highest rice equivalent yield of rice (150.54 q/ha) followed by fixed herbicide and rotational herbicide (139.01 and 129.54 q/ha) respectively. In case of total REY of system, weed free check recorded significantly higher grain yield over all other. Further use of fixed herbicide and rotational herbicide produced significantly higher total REY of system over weedy check and remained at par with each other. The interaction effects between green manuring and weed control measures were found to be non significant.

### Economics of different treatment combination:-

The data presented in Table 7 that the economics of different treatment combinations M<sub>1</sub>T<sub>1</sub> recorded higher net returns (Rs. 1,31,160) with B:C ratio 1.88 followed by M<sub>1</sub>T<sub>3</sub> treatment combination.

### CONCLUSION

Under konkan region in rice groundnut cropping system eight various combinations of green manuring with weed control measures were tested and from four years study it can be

concluded that, incorporation of Green manuring and application of fixed herbicide pretilachlor for kharif rice and pendimethalin for rabi groundnut reduced weed growth with increase in total REY of the rice groundnut cropping system.

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