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Influence of Agronomic practices on rice yield and nutrient uptake under SRI

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Abstract

Field experiments were conducted during *Rabi* 2009 and *Kharif* 2010 in the experimental farm, Annamalai University to study the effect of age of seedlings and weed management practices on rice yield and nutrient uptake under SRI. The treatment consisted of Factor A - Age of seedlings - 10 days and 15 days and Factor B – weed management practices (S_1 - Conoweeding two times (10 and 20 DAT), S_2 - Conoweeding four times (10, 20, 30 and 40 DAT), S_3 - Butachlor @ 1.5 kg / ha + hand weeding on 35 DAT and S_4 - Unweeded control). The results revealed the significant effect of age of seedlings and weed management practices on rice yield and nutrient uptake. Transplanting of 15 days old seedlings recorded the highest rice yield and uptake of nutrients compared to 10 days old seedlings. The per cent increase in rice yield was 9.31 and 6.59 in *Rabi* and *Kharif* seasons respectively. Conoweeding four times recorded highest rice yield which was comparable with butachlor application @ 1.5 kg/ha + one hand weeding. The uptake of N, P and K in grain and straw was again highest with 1o days old seedling as well as with conoweeding four times.

Keywords: Age of seedlings, Nutrient uptake, Rice yield, SRI and weed management.

Introduction

Rice bowl of Tamil Nadu, the Thanjavur district in Cauvery deltaic zone, the study area accounts for 24.5 per cent of rice area of Tamil Nadu and the productivity in this district is 2.5 t / ha (Ramanathan, 2001) which is very low when compared to world average (4.25 / t ha). Rice crop and rice based cropping system are essential to everyone directly for food security, livelihood improvement, cultural heritage, sustainable development and for global peace (Viraktamath, 2006). Scarcity of resources in rice production resulted in stagnant or declining yield levels with low grain quality. Hence, producing more rice with less resource input is formidable challenge for ensuring the food, economic social and water security of the Asian region. To meet the world's food needs, the strategy developed in Madagascar is SRI which saves water and enhances the rice yield two to three times compared to conventional rice cultivation (Norman Uphoff, 2006). Early transplanting of rice seedlings assumes special significance and principal means in obtaining higher yield. In SRI, seedlings should be transplanted before the fourth phyllochron begins, to preserve the tillering potential (Rafaralahy, 2002). Seedling age is known to influence the seed yield (Singh *et al.,* 2004). Weeds are the major biotic constraint in rice production and they grow faster than crop plants and absorb the available nutrients earlier (Singh *et al.,* 2006). Hence the present study was undertaken to study the effect of age of seedlings and weed management practices on yield and nutrient uptake of rice under SRI.

Materials and Methods

Two field experiments were conducted during *Rabi* 2009 and *Kharif* 2010 with rice var. Co 43 and ADT 43 respectively at the Experimental Farm, Annamalai University, Tamil Nadu which is located at 11°24' North latitude, 79°44' East longitude and at an altitude of +5.79 m above MSL. The soil is clay loam belongs to Kondal series (Typic Haplusterts) having pH - 8.4, EC – 1.525/ m organic carbon, (2.39 / kg) $KMNO_4$-N (2217 kg / ha), Olsen-P (17 kg / ha) and NH_4OAC (346 kg / ha). The treatment consisted of two factors *viz.,* Factor A – M_1 –10 days old seedlings and M_2 - 15 days old seedlings and Factor B – Weed management practices (S_1 - Conoweeding two times (10 and 20 DAT), S_2 - Conoweeding four times (10, 20, 30 and 40 DAT), S_3 - Pre-emergence application of butachlor@ 1 . 5 kg a.i. /ha$^+$ hand weeding on 35 DAT and S_4 - Unweeded control). The experiments were conducted in factorial randomized block design with three replications. Standard cultivation practices were adopted for both the crops. The grain and straw yields were recorded at harvest. The grain and straw samples were powdered and analysed for nitrogen (Yoshida *et al.,* 1976) and P and K (Jackson, 1973). Nutrient uptake was computed by multiplying grain and straw yields with respective nutrient content and expressed as kg/ ha.

Results and Discussion

Rice yield

The grain and straw yields were significantly influenced by age of seedlings, weed management practices and both (Table 1). Grain and straw yield (6438, 7762 and 5365, 6674 kg / ha) obtained with 15 days old seedlings were significantly higher than 10 days old seedlings during *Rabi* and *Kharif* seasons, respectively. The per cent increase in grain yield was 9.31 and 6.59 in both the seasons, respectively. This might be due to better root development, production of more number of tillers and increased uptake of nutrients. Similar result was reported by Radhamani *et al.* (2012). With respect to weed management practices, grain yield recorded ranged from 3230 to 7737 kg / ha and straw yield from 4370 to 9102 kg ha^{-1} in *Rabi* 2009 and in *Kharif* 2010 the grain yield recorded ranged from 2925 to 6312 kg ha"[1] and straw yield from 4066 to 7703 kg / ha. The highest grain (7737, 6312 kg / ha) and straw yield (9102 and 7703 kg / ha) were noticed with conoweeding four times which was comparable with pre-emergence application of butachlor @ 1.5 kg a.i./ ha + one hand weeding on 35 DAT. The best treatment enhanced the grain and straw yield to the tune of 2.39, 2.16 and 2.08,1.89 times over unweeded control in *Rabi* and *Kharif* seasons, respectively. Due to incorporation of weeds, competition free environment was provided to rice crop by conoweeding four times, better root development, microbial activity, aeration, increased availability of nutrients and water could be the reason for enhanced yield. This was contirmed by significant positive correction between grain yield with n uptake (r = 0. 946^{xx}),p uptake (r = 0.959^{xx}) and k uptake (r = 0.955^{x}). Similar findings were reported by Hugar *et al.* (2009) and Radhamani *et al* (2012). However in interaction effect the highest grain and straw yield were noticed in plots which transplated with 15 days old rice seedlings and conoweeding was dorne four times.

Nutrient Uptake

Perusal of the Table 2 showed significant effect of age of seedlings, weed management practices and their interaction on the uptake of N, P and K by grain and straw. Fifteen days old rice seedlings recorded 116.1, 32.8, 121.8 kg N, P and K / ha respectively in *Rabi* and 112.4, 30.7, 125.5 kg N, P and K / ha, respectively during *Kharif* season. Production of more number of tillers by 15 days old seedlings resulted in the higher nutrient uptake compared to 10 days old seedlings. With respect to weed management practices, nitrogen uptake ranged from 99.8 to 122.7 kg / ha, 95.4 to 118.8 kg / ha), phosphorus uptake (22.9 to 37.3 kg / ha, 19.8 to 34.9 kg / ha) and potassium uptake (103.4 to 127.3 kg / ha, 105.3 to 133.5 kg / ha) during *Rabi* and *Kharif* seasons respectively. Conoweeding four times registered the highest nutrient uptake of 122.7,37.4 and 127.4 kg NPK / ha respectively during *Rabi* and 118.8, 34.9 and 133.5 kg NPK / ha respectively during *Kharif* season. This was comparable with butachlor application @ 1.5 kg a.i. / ha+ one hand weeding on 35 DAT. Conoweeding incorporatd the weeds at its early stage of growth before they compete with crops thereby restrict the depletion of nutrients by weeds and make its availability more to the crop plants. The highest nutrient uptake was noticed when conoweeding four times was done in the plots which were raised by transplanting 15 days old seedlings. The increase in nutrient uptake was mainly attributed to better aeration root development of rice and control of weeds which resulted in increased nutrients availability aeratiom moisture and light availability to the crop plants and it can be reflected in terms of better growth yield attributes and yield of rice.

Among the treatment combinations, 15 days old seedlings with conoweeding four times proved its superiority and resulted in the highest nutrient uptake and yield.

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Table 1: Influence of agronomic practices on rice yield under SRI

Treatment	*Rabi* 2009		*Kharif* 2010	
	Grain yield kg / ha	Straw yield kg / ha	Grain yield kg / ha	Straw yield kg / ha
Age of seedlings				
M_1	5890	7162	5033	6297
M_2	6438	7762	5365	6674
SEd	110.2	126.7	69.6	79.6
CD (P=0.05)	236.4	271.8	149.3	171.1
Weed management practices				
S_1	6253	7640	5459	6714
S_2	7737	9102	6312	7703
S_3	7435	8738	6101	7460
S_4	3230	4370	2925	4066
SEd	150.8	169.2	98.4	113.34
CD (P=0.05)	302.3	363.8	211.2	243.7
Interaction				
M_1S_1	6003	7365	5305	6531
M_1s_2	7499	8829	6145	7525
M_1S_3	7197	8465	5934	7282
M_1s_4	2859	3990	2750	3852
M_2S_1	6503	7915	5612	6897
M_2s_2	7875	9374	6480	7881
M_2s_3	7673	9010	6268	7638
M_2s_4	3600	4750	3100	4280
SEd	220.4	243.4	139.2	161.06
CD (P=0.05)	472.8	523.3	299.0	346.3

Table : 2 Influence of agronomic practices on nutrient uptake of rice under SRI

Treatment	*Rabi* 2009			*Kharif* 2010		
	Nitrogen Kg/ha	Phosphorus Kg/ha	Potassium Kg/ha	Nitrogen Kg/ha	Phosphorus Kg/ha	Potassium Kg/ha
Age of seedlings						
M_1	109.3	29.6	113.8	106.2	26.4	118.0
M_2	116.1	32.8	121.8	112.4	30.7	125.5
SEd	1.01	0.31	1.24	0.93	0.29	1.32
CD (P=0.05)	2.08	0.87	2.68	2.02	0.79	2.87
Weed management practices						
S_1	109.4	29.2	116.8	107.4	26.2	118.4
S_2	122.7	37.3	127.3	118.8	34.9	133.5
S_3	119.1	35.4	123.8	115.4	33.1	129.9
S_4	99.8	22.9	103.4	95.4	19.9	105.3
SEd	1.66	0.89	1.62	1.59	0.86	1.67
CD (P=0.05)	3.57	1.93	3.51	3.42	1.87	3.61
Interaction						
M_1S_1	106.2	28.2	113.1	104.0	24.2	114.5
M_1s_2	119.3	35.2	123.1	115.7	32.5	129.8
M_1S3	115.7	33.3	119.6	112.3	30.6	126.2
M_1s_4	96.1	21.5	99.4	92.8	18.2	101.6
M_2S_1	112.6	30.1	120.5	110.9	28.2	122.3
M_2s_2	126.0	39.4	131.5	122.0	37.4	137.2
M_2s_3	122.4	37.5	128.0	118.6	35.5	133.6
M_2s_4	103.4	24.1	107.3	98.0	21.8	109.0
SEd	2.60	1.41	3.25	2.78	1.48	3.32
CD (P=0.05)	6.31	3.11	6.99	6.01	3.24	7.20