

Effect of Date of Sowing and Variety of Rice and Liming to Horsegram on Yield, Nutrient Uptake, Consumptive Use and Water Use Efficiency of Rice-horsegram Sequence

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Abstract: A field experiment was conducted to study the effect of date of sowing and in variety upland rice with or without lime application to subsequent horsegram crop on yield, system productivity, land use and production efficiency, nutrient uptake and water use efficiency of rice-horsegram crop sequence under rain fed upland conditions. The experiment was laid out in split-plot design for rice and horsegram with three replications at the Central Research Station, OUAT, Bhubaneswar during June 2012 to January 2013. Four combinations of two dates of sowing (18 June and 4 July) and two early maturing (80-95) rice varieties (ZHU-XI-26 and Vandana) were allotted to the main-plots. Two liming treatments in horsegram i.e., no lime and 0.2 LR were allotted to the sub plots. The rice growing season in **Kharif** received 1167mm of rain distributed in 69 rainy days which was almost similar to that of 10 years average. Grain yield of rice was reduced by 20.8% due to delayed sowing by 16 days from 18 June to 4 July. Total uptake of nutrients (57 kg N, 11 kg P and 106 kg K/ha) and both rain and crop water use efficiency were higher with 18 June sown rice (D1V1L1). Application of paper mill sludge in line (0.2 LR) marginally improved seed yield of horsegram. System productivity (6504 kg rice/ha), production and use efficiency (33.5 kg rice/ha), total uptake of nutrients (160 kg N, 23 kg P and 173 kg K/ha) and use efficiency of both rainwater (5.59 kg/ha-mm) and consumptive use of water (9.97 kg/ha-mm) for rice-horsegram sequence were maximum when horsegram followed by 18 June sown ZHU-XI-26 rice along with lime application.

Key words: Liming, Nutrient uptake, Rice-Horsegram sequence, WUE.

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food of more than 70 percent of the world population. The average-yield of upland rice in India ranges between 0.6 to 1.5 t/ha in spite of the development of suitable genotypes with yield potential of 2.5 to 05 .0 t/ha [3]. A number of factors like soil moisture stress delayed sowing. Heavy weed infestation, poor native soil fertility status and poor spread of improved upland cultivars have been identified as important constraints in realization of enhanced productivity levels under rain fed upland situations [6].

Manipulation of sowing time may help the crop to avoid the co-incidence of stress at critical period. The crop should be sown in optimum time as that sown too early usually encounters with initial stress,

whereas, the delayed sown one suffers much from terminal drought [2], [7].

So selection of suitable variety, time sowing may help upland rice crop to alleviate the adverse effect of moisture stress whose occurrence during the cropping season is most unpredictable.

Performance of horse gram (*Macrotyloma uniflorum* lam. verd), under rain-fed condition is markedly affected by variation in its seedling dates [9]. upland rice varieties of different duration when were sown in various dates will vacate the yield for the subsequent crop in staggered manner greatly affecting the overall performance of rice horse gram sequence. Liming an acid soil encourages root growth with the added advantages of water and nutrient availability [1]. Horse gram crop grown on residual soil moisture has been benefited by residual effect

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of lining to preceding Kharif maize in acid soils [8]. Keeping this in view, the present study was undertaken to assess the productivity and resource use efficiency and performance of horse gram with or without lining in rice-horse gram crop sequence.

MATERIALS AND METHODS

Field experiment was carried out during 2012-13 at OUAT, Bhubaneswar. The rice growing season in Kharif received 1167mm of rain distributed in 69 rainy days which was almost similar to that of 10 years average. The soil of this plot was loamy sand in texture, poor in nutrient content and low in water holding capacity, slightly acidic in reaction (pH-5.20), low in organic carbon (0.36), high available nitrogen (544kg/ha) low in available phosphorus (15.60kg/ha), low in available potassium (126.70kg/ha). The experiment was conducted in a split-plot design with three replications, four combinations of two early varieties of rice (ZHU-XI-26 and Vandana) sown in two different dates were allotted to the main plots and two levels of lime treatments (no lime and 0.2 LR) to horse gram following rice were allotted to the sub-plots. The rice seeds were sown in line with a spacing of 15cm using a recommended seed rate of 100kg/ha and horse gram crop was sown in line at a spaing of 30cm using a seed rate of 30kg/ha. 40kg N, 20kg P₂O₅ and 20kg K₂O/ha were applied for rice crop and 20:40:0 kg of N, P₂O₅, K₂O/ha was applied as basal. Paper mill sludge (75% CaCO₃ equivalent) at the rate of 0.2 LR was applied in line at the line of sowing of horse gram taking LR as 4.0 t/ha. Ten plants were selected randomly from the net plot area in both rice and horse gram were used for post harvest studies.

RESULT AND DISCUSSION

The data in respect in rice equivalent yield, land use efficiency. Production efficiency, nutrient uptake and total consumptive use of rice-horse gram sequence as affected by dates of sowing and varieties of preceding rice and line application to horse gram are presented in the table-1. Maximum rice equivalent yield of 6504kg/ha with production efficiency of 33.5kg rice equivalent yield/ day, uptake of 159.6kg N and 22.2kg P/ha, rain water use efficiency of 5.59kg/ha-mm and crop water use efficiency of 9.97 kg per ha-mm of water use were obtained from rice-horse gram sequence when horse gram crop with line application of 0.2 line requirement was sown following harvest of 18 June sown ZHU-XI-26 rice. However, the land use efficiency (54%), and

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Particular	Yield (kg/ha)		Nutrient uptake (kg/ha)		Consumptive use (mm)		P		K		Total		Horse gram	Rice	Total	Horse gram	Rice	Total	Horse gram	Rice	Total	Rain water use efficiency (kg/ha-mm)	Crop water use efficiency (kg/ha-mm)
	Rice	Horse gram	Rice	Horse gram	Rice	Horse gram	Rice	Horse gram	Rice	Horse gram	Rice	Horse gram											
D1V1L0	3819	1527	6364	53.1	32.8	62.81	95.39	158.2	12.01	11.03	23.04	113.37	62.02	175.39	414.8	231.4	646.2	5.47	9.85				
D1V1L1	3819	1611	6504	53.1	33.5	62.81	96.78	159.59	12.01	11.20	23.21	113.37	59.10	172.47	414.8	237.8	652.6	5.59	9.97				
D1V2L0	3031	1262	5134	54.0	26.1	50.47	69.58	120.05	10.28	7.78	18.06	98.07	38.50	136.57	476.5	193.3	669.8	4.17	7.66				
D1V2L1	3031	1198	5027	54.0	25.5	50.47	64.24	114.71	10.28	7.24	17.52	98.07	34.90	132.97	476.5	204.7	681.2	4.08	7.38				
D2V1L0	3151	852	4571	51.2	24.4	53.81	54.36	108.17	9.93	6.71	16.64	99.32	36.63	135.95	456.2	144.2	600.4	3.74	7.61				
D2V1L1	3151	959	4749	51.2	25.4	38.81	59.53	113.34	9.93	7.15	17.08	99.32	38.87	138.19	456.2	142.6	598.8	3.89	7.93				
D2V2L0	2272	996	3932	50.1	21.5	45.00	60.53	105.53	7.95	6.73	14.68	92.81	39.01	131.82	393.1	134.3	527.4	4.17	7.45				
D2V2L1	2272	1079	4070	50.1	22.2	45.00	59.28	104.28	7.95	6.71	14.66	92.81	33.38	126.19	393.1	135.7	528.8	4.32	7.70				

consumptive use of water (681.2 mm) were maximum when horse gram followed harvest of 18 June sown Vandana-rice. Almost all the values except rain water use efficiency were minimum for the sequence where horse gram with line treatment followed 4 July sown Vandana rice.

Significantly higher grain yield of both are variety ZHU-XI-26 sown on 18 June. Decrease in grain yield of upland rice due to late sowing and the succeeding horse gram crop with line application resulted in maximum rice equivalent yield, production efficiency and uptake of almost all the primary nutrients by the rice-horse gram sequence [4], [5]. Higher values of consumptive use as well as the land use efficiency in the sequence when horse gram followed cv. Vandana sown on 18 June was due to comparatively longer duration as well as receipt of more rainfall by Vandana rice. For the same reasons stated above, system productivity, production efficiency, consumptive use, total uptake of primary nutrients by rice-horse gram cropping sequence were the minimum when horse gram followed upland rice variety Vandana sown on 4 July.

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