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Effect of seed rate and different spacing on rice grain yield under aerobic situation (*Oryza sativa* L.)

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Abstract: *The field experiment was conducted during kharif season of 2012 at Upland Paddy Research Scheme Farm, VNMKV, Parbhani it was observed from present investigation that the seed rate 35 kg ha^{-1} with spacing 30 cm was found to be significantly superior over rest of the seed rate and spacing in respect to plant height (cm), leaf area (cm) effect tillers, no. of panicles, grain yield (kg ha^{-1}), straw yield (kg ha^{-1}), biological yield (kg ha^{-1}), harvest index (%).*

Key words: *rice, seed rate, spacing, yield*

INTRODUCTION

Rice plays pivoted role in reference to food security of Indian sub continent. Rice production in the tune of ever increasing population will be challenging for rice grower due to ever increasing populations, emerging alternative crops for rice which are more profitable that requires less water and labour. Short fall in rice production leads to economical, social and nutritional insecurity in India and this has been witnessed in last 4-5 years and will be acute in future.

The optimum seed rate is important factor that affects crop micro environment by influencing the degree of inter and intra plant competition. Therefore, optimum seed rate is required for direct seeded rice, the plant should be planted neither too thick nor too thin, so that input use efficiency may be enhanced to maximum production whereas, plant spacing affect the grain yield and other characters by influencing the availability of solar radiation, access to available moisture and nutrients and competition with weeds (Kumar *et al.* 2002). The high seed rate of 60-100 kg ha^{-1} is recommended for direct seeded rice particularly under rainfed situation. However, optimum seed rate under protective irrigation for optimum yield is an urgent need of different spacings with different seed rates are required to be tested for providing optimum plant geometry to the crop.

Direct sowing of rice is quicker, easier and economical one, but weed infestation is the main problem and weed pressure is often two to three times more in direct seeded rice as compared to transplanted one. The yield losses due to weed are 36 per cent in transplanted rice but as high as 84 per cent in direct sown rice (Ramachandrapa *et al.* 2011). The extent of yield reduction due to weed infestation was out at 15-20% under transplanted system, 30-35% under direct seeded low land system and more than 50% under upland situation.

MATERIALS AND METHODS

The field experiment was conducted during *kharif* season of 2012 and laid out in split plot design on the farm of upland paddy research scheme, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The soil of experiment plot was clayey in texture and slightly alkaline in reaction, while the fertility status of soil was low in nitrogen, medium in available phosphorus and high in available potassium and deficient in iron.

The experiment was laid out in spilt plot design with fifteen (15) treatment combinations and three replications, with five seed rates in main plot i.e. 25 kg ha^{-1} (C_1), 30 kg ha^{-1} (C_2), 35 kg ha^{-1} (C_3), 40 kg ha^{-1} (C_2) and 60 kg ha^{-1} (C_3) and in sub plot three spacings i.e. 20 cm (S_1), 25 cm (S_2), 30 cm (S_3). The rice variety Avishkar was sown on 2nd July 2012.

The recommended dose of fertilizer for upland rice is 80 kg N ha^{-1}, 50 kg P_2O_5 ha^{-1} and 50 kg K_2O

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ha^{-1}. The 50 per cent nitrogen and entire P_2O_5 and K_2O were applied as basal dose and remaining dose of nitrogen was given in two split i.e. at tillering (30 DAS) and inter node elongation stage (60 DAS). Urea (46% N), SSP (16% P_2O_5), MOP (60% K_2O) and ferrous sulphate as a source of nutrient for NPK and Fe respectively. Pre emergence (PE) application of pendimithalin (0.75 kg a.i. ha^{-1}) was carried out with one hand weeding at 25 DAS and one hoeing at 30 DAS. The data obtain were subjected to statically analysis and were tested at 5 % level of significance to interpret the treatment difference.

Biometric observations regarding were recorded up to harvest at various growth stages and at regular interval. Tillering starts from 25 - 30 days after sowing, therefore, this biometric observation was recorded from 30 days and afterwards regularly at periodic interval. Total number of tillers m^2 were measured and recorded at different stages of observation. Five spots of one square meter area randomly selected from each net plot were used for determining panicles per m^2

RESULT AND DISCUSSION

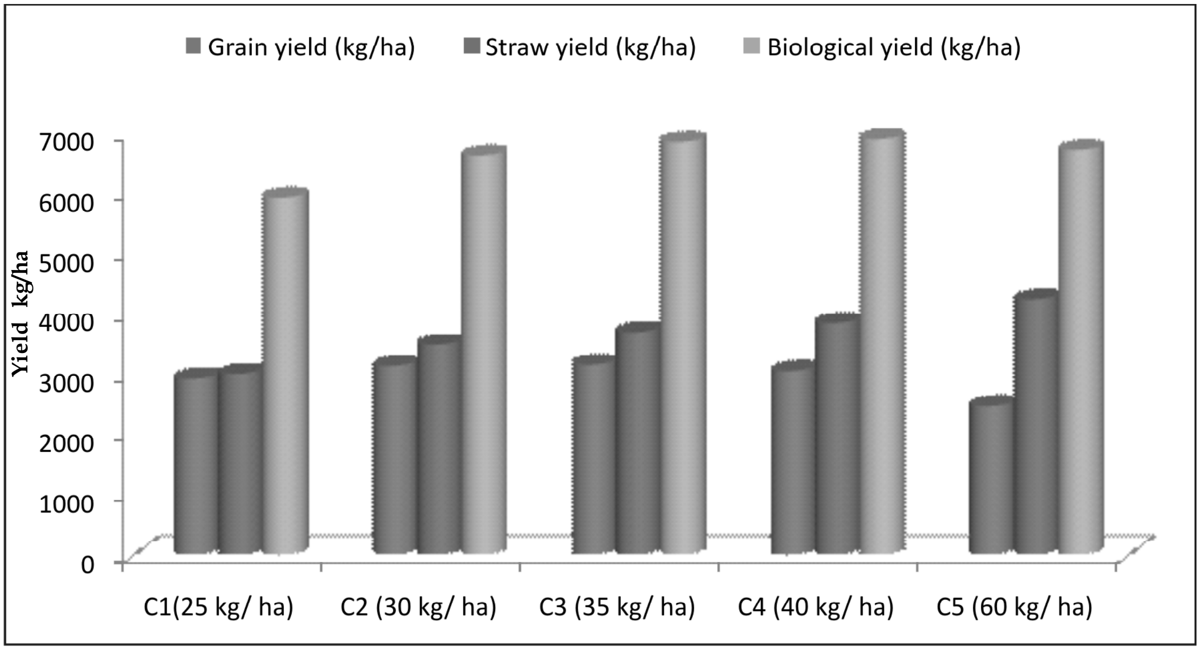
Effect of seed rate

The highest mean numbers of tillers per plant were observed under 35 kg ha^{-1} (C3) at 90 DAS and at harvest. At 30 DAS seed rate of 25 kg ha^{-1} (C1) recorded significantly more mean number of tillers over rest of the seed rates. Where as seed rate of 30 kg ha-1 (C2) recorded the significantly highest mean number of tillers at 60 DAS, however, it was at par with 35 kg ha^{-1} (C3) seed rate. The seed rate 60 kg ha^{-1} (C5) recorded the lowest tillers m-2 at 30, 60 DAS and at harvest but it was at par with seed rate of 25 kg ha^{-1} (C1) at 30, 60 DAS and harvest. At 90 DAS seed rate of 25 kg ha^{-1} recorded the lowest number of tillers m^{-2}.The significantly highest mean number panicle m^{-2} were recorded at seed rate of 35 kg ha^{-1} (C3) over other seed rates, however, it was at par with seed rate of 30 kg ha^{-1} (C2) and 40 kg ha^{-1} (C4). The lowest panicle m^{-2} were found with the seed rate of 25 kg ha^{-1} (C2). However, it was at par with seed rate 60 kg ha^{-1} (C5).

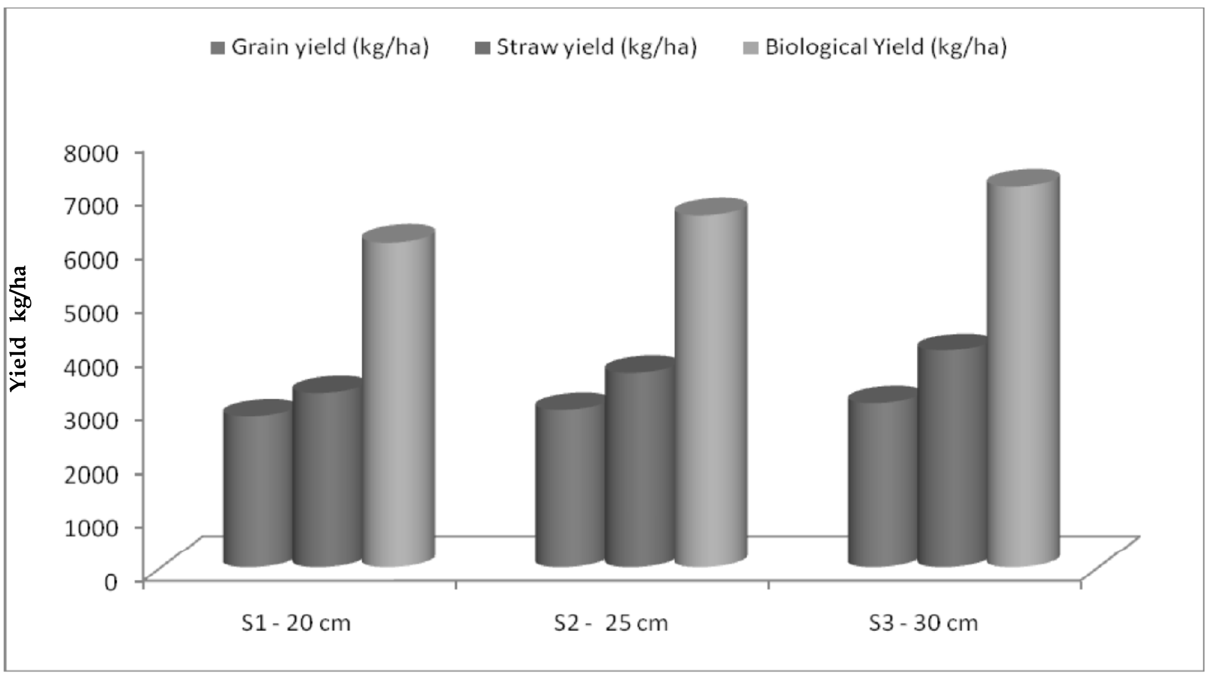
Grain yield and straw yield were significantly influenced due to different seed rates. The maximum grain yield was recorded in 35 kg ha^{-1} (C_3) (3145 kg ha^{-1}) and it was at par with seed rate of 30 kg ha^1, 40 kg ha^{-1} and 25 kg ha^{-1}. Comparable seed yields were observed for the seed rates (25-40 kg ha^{-1}) which might be due to increased values of yield attributes *viz* number of panicle m^{-2}, number of grains $panicle^{-1}$ and less number of unfilled grains $panicle^{-1}$ under low seed rates compared to higher seed rate which negotiated the grain yield obtained under 25-40 kg ha^{-1} of seed rate however, the seed rate of 60 kg ha^{-1} (C_5) produced the lowest grain yield. This might be due to inferior performance of individual plant under high seed rate. Similar result was noted by Jones and Syndes (1987) and Verma *et al.*,(1988). This indicated the plasticity of Rice crop under varying seed rates.

Table 1
Mean No. of Effective tillers, No. of Panicle/m^2 grain yield, straw yield, biological yield (kg ha^{-1}) and harvest index as influenced by various treatments

Treatment	*No. of Effective tillers m^2*	*No. of Panicle m^2*	*Grain Yield (kg ha^{-1})*	*Straw yield (kg ha^{-1})*	*Biological Yield (kg ha^{-1})*	*Harvest index (%)*
Main Plots (Seed rates)						
C_1 - 25 kg ha^{-1}	160.42	154.2	2917	2992	5909	49.36
C_2 - 30 kg ha^{-1}	168.70	165.0	3125	3477	6602	47.33
C_3 - 35 kg ha^{-1}	172.76	171.7	3145	3682	6827	46.06
C_4 - 40 kg ha^{-1}	166.73	167.6	3040	3835	6875	44.21
C_5 - 60 kg ha^{-1}	159.42	159.5	2466	4228	6694	36.83
SE±	0.90	2.76	88.13	128.02	188.12	-
CD at 5%	2.70	8.2	260.19	379.18	553.32	-
Sub Plots (row to row spacing)						
S_1 (20 cm)	161.24	156.4	2814	3256	6070	46.35
S_2 (25 cm)	164.34	164.0	2938	3627	6565	44.75
S_3 (30 cm)	171.24	170.1	3065	4045	7110	43.10
SE ±	2.87	2.24	65.24	113.72	131.14	-
CD at 5%	6.61	6.72	193.40	334.14	387.32	-
Interaction (C x S)						
SE±	3.14	5.01	1.47	2.54	2.93	-
CD at 5 %	NS	NS	N.S.	N.S	NS	-
General Mean	165.61	163.5	2934	3643	6581	44.10



Seed rates



Spacings

Figure 1: Mean grain yield, straw yield, biological yield (kg ha^{-1}) of rice in as influenced by various treatments

Straw yield was significantly more under seed rate of 60 kg ha^{-1} due to higher population which gave higher biomass per unit area than lower seed rates. The significantly lower straw yield was observed under 25 kg ha^{-1}. Straw yield was increased with increased seed rates under study. The highest biological yield was observed in seed rate 40 kg ha^{-1} while highest harvest index was recorded in seed rate 25 kg ha^{-1}.

Effect of spacing

The number of tillers m-2were significantly affected due to different plant spacings, except at 30 DAS. The plant spacing of 30 cm (S3) produced more number of tillers m-2 at 60, 90 DAS and harvest.The lowest number of tillers m-2 observed with the spacing of 20 cm (S1) at 60, 90 DAS and at harvest, however, it was at par with 25 cm (S2) spacing at 60 DAS and harvest. The number of tillers m^{-2}were significantly affected due to different plant spacings, except at 30 DAS. The plant spacing of 30 cm (S_3) produced more number of tillers m^{-2} at 60, 90 DAS and harvest. The lowest number of tillers m^{-2} observed with the spacing of 20 cm (S_1) at 60, 90 DAS and at harvest, however, it was at par with 25 cm (S_2) spacing at 60 DAS and harvest.

Due to wider spacing 30 cm (S_3) the higher number of panicle m^{-2} were produced significantly superior over other spacings and it was at par with 25 cm (S_2). The lowest number of panicle m^{-2} was found at 20 cm (S_1).

The grain and straw yield was significantly varied due to plant spacings. Significantly higher grain yield (3065 kg ha^{-1}) was observed under spacing of 30 cm (S_3) over closer spacing 25 cm and 20 cm respectively. However, it was at par with spacing 25 cm (S_2) for grain yield. This might be attributed to better root development and availability of nutrients, moisture and space which facilitated better growth of crop and also due to better management of weed under wider spacing due to better tillage operations as compared to the closer spacing which reflected into better yield attributes *viz*., number of panicle at harvest, number of grains per panicle and filled grains per panicle which ultimately gave more grain yield (3065 kg ha^{-1}) under wider spacing 30 cm (S_3) than both the closer spacing i.e. 25 cm (S_2) and 20 cm (S_1) similar results were obtained by Kumar *et al.,* (2002), Golingai, *et al.*, (1969)and (Mahajan *et al*.,2006). The highest biological yield was observed in 30 cm spacing (7110 kg ha^{-1}) while highest harvest index was recorded in closer spacing of 20 cm (46.35) followed by 25 cm (44.75), 30 cm (43.10).

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