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# EFFECT OF SEED RATE AND SPACING ON GRAIN YIELD OF RICE UNDER AEROBIC SITUATION (*Oryza sativa* L.)

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## ABSTRACT

**The field experiment was conducted during *kharif* season of 2017 to study the effect of seed rate and spacing on growth and yield of aerobic rice (*Oryza sativa* L.). It was observed from present investigation that the seed rate 40 kg ha$^{-1}$ and spacing 30 cm was found to be singnificantly superior over rest of the seed rates and spacings in respect to growth attributing characters viz., number of tillers m$^{-1}$ row length and number of panicles plant$^{-1}$. The seed rate 60 kg ha$^{-1}$ and spacing 25 cm was found to be significantly superior over rest of the seed rates and spacings in respect to grain yield (q ha$^{-1}$) and straw yield (ha$^{-1}$).**

**(Key words: Rice, seed rate, spacing, growth and yield)**

## INTRODUCTION

Rice is the most important staple food in Asia. More than 90% of the world's rice is grown and consumed in Asia, where 60% of the world's population lives. Food security for vast contry like India with high density of human population is of vital importance. Rice provides 43 per cent of calorie requirement of more than 70 per cent of Indian population. It occupies largest area among all the crops grown in India. Total geographical area under rice in India is 43.38 million hectares with annual production of 108.85 million tones and productivity of 2.46 tons ha$^{-1}$ in 2016-2017 (Anonymous, 2017) crop year, hence a significant portion of the world's argicultural research has been focused on rice.

For almost three decades since the Green Revolution, the rice yield growth rate was approximately 2.5 year$^{-1}$. During the 1990s, however, this has decreased to only 1.1% (Riveros and Figures, 2000). Improper spacing reduces yield up to 20-30%. The optimum spacing ensures the plant to grow in their both aerial and underground parts through efficient utiliztion of solar rediation and nutrients (Khan *et al.,* 2005; Mohaddesi *et al.*, 2011). Plant spacing directly effects the normal physiological activities through intra-specific competion.

The optimum seed rate is required for dircet seeded rice, the plant should be planted neither too thick nor too thin, so that imput use efficiency may be enhanced to maximum production as 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).

## MATERIALS AND METHODS

The Present investigation entitled "Effect of seed rate and spacing on growth and yield of aerobic rice (*Oryza sativa*)" was conducted at Department of Agronomy farm, College of Agriculture, Nagpur during *kharif* season f 2017-2018. The soil was clayey in nature with pH 7.6 indication slightly alkaline in reaction, low in available nitrogen; medium in available phosphorus and very high in available potassium.

The experiment was laid out in factorial randomized block design with three seed rates viz., $S_2$ (40 kg ha-$^1$), $S_2$ (50 kg ha$^{-1}$) and $S_3$ (60 ha$^{-1}$) and three treatments of drilling distance viz. $D_1$ (20 cm), $D_2$ (25 cm) and $D_3$ (30 cm). There were nine treatment combinations replicated thrice. Early duration rice variety Sye-1 was sown on 4$^{th}$ July, 2017. In order to represent the plot, five plants of rice from each net plot were selected randomly, labeled properly. The growth attibuting character number of tillers m$^{-1}$ row length was recorded at 30,60,90 DAS and at harvest and yield contributing parameter viz., number of panicle plant$^{-1}$, number of grains panicle$^{-1}$, weight of grains panicle$^{-1}$, test weight, grain and straw yield were also recorded.

## RESULTS AND DISCUSSION

### Effect of seed rate

Date pertaining to various yield attributes studied as influenced by seed rate treatments are presented in table 1.

### Number of tillers m$^{-1}$ row length

Number of tillers m$^{-1}$ row length as influenced by different treatments are presented in table 1. At 30 DAS,

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number of tillers plant$^{-1}$ were not influenced significantly due to seed rate. At 60, 90 DAS and at harvest number of tillers m$^{-1}$ row length was significantly influenced with the various seed rates. Seed rate of 40 kg ha$^{-1}$ found significantly superior over seed rate of 60 kg ha$^{-1}$ but it was found at par with 50 kg ha$^{-1}$. This might be due to availability of nutrient, moisture and space which resulted into increased tillers under lower seed rates as compared to higher seed rates.

These results are is conformity with the findings of Nwokwu *et al*. (2016), who reported that the use of 40 kg ha$^{-1}$ seed rate consistently recorded the higher number of tillers that was statistically at par with 80 kg ha$^{-1}$. Whereas 120 kg ha$^{-1}$ seed rate recorded the least number of tillers but was at par with 80 kg ha$^{-1}$ at 9 weeks after sowing.

**Number of panicles plant$^{-1}$**

The number of panicles plant$^{-1}$ were significantly influenced due to seed rate at harvest. Effect of seed rate on number of panicles plant$^{-1}$ was found to be significant. Maximum number of panicles were reported with 40 kg ha$^{-1}$ and found signigicantly superior over seed rate of 60 kg ha$^{-1}$ but was found at par with 50 kg ha$^{-1}$.

**Length of panicle (cm)**

The data on length of panicle as influenced by various treatments are presented in the table 1. Seed rate significantly not influenced the length of panicle plant$^{-1}$. Seed rate of 40 kg ha$^{-1}$ recorded maximum length of panicle which was followed by seed rate of 60 kg ha$^{-1}$ and 50 kg ha$^{-1}$.

Similar results were observed by Payman *et al*. (2008), who reported that the use of 40, 50 and 60 kg ha$^{-1}$ seed rate consistently not influenced the lenght of panicle.

**Number of grains panicle$^{-1}$**

Effect of seed rate on number of grains panicle$^{-1}$ was found to be significant. Seed rate of 40 kg ha$^{-1}$ recorded maximum number of grains panicle$^{-1}$ which was significantly superior over seed rate of 60 kg ha$^{-1}$ but was at par with 50 kg ha$^{-1}$.

Similar to this result Jadhav *et al.* (2014) reported that significantly maximum filled grains panicle$^{-1}$ were observed with low seed rate of 25 kg ha$^{-1}$ and was comparable with 30 kg ha$^{-1}$ seed rate for number of filled grains. The competition among plants for nutrients, light and space at each higher level of seed rate decreased the number of leaves, leaf area which ultimately reduced the grains panicle$^{-1}$.

**Weight of grains panicle$^{-1}$**

Effect of seed rate on weight of grains panicle$^{-1}$ was found to be significant. However seed rate of 40 kg ha$^{-1}$ recorded highter weight of grains panicle$^{-1}$ which was significantly superior over seed rate of 60 kg ha$^{-1}$ but found at par with seed rate of 50 kg ha$^{-1}$.

Similar to this result Jadhav *et al.* (2014) reported that significantly maximum panicle weight and filled grains panicle$^{-1}$ were observed with low seed rate of 25 kg ha$^{-1}$ and was comparable with 30 kg ha$^{-1}$ and 35 kg ha$^{-1}$ seed rate for panicle weight and number of filled grain. The competition among plants for nutrients, light and space at each higher level of seed rate decreased the number of leaves, leaf area which ultimately reduced the grains panicle$^{-1}$, panicle weight, filled grains panicle$^{-1}$ and increased unfilled grains panicle$^{-1}$.

**Test weight**

Data presented in table 1 recorded the mean test weight of 15.40 g. Effect of seed rate on test weight was found to be non-significant.

Similar results were reported by Jadhav et al. (2014) that test weight was not significantly influenced by different seed rates viz., 25, 30, 35, 40 and 60 kg ha$^{-1}$.

**Grain yield (q ha$^{-1}$)**

The grain yield was significantly influenced with seed rate. Seed rate of 60 kg ha$^{-1}$ recorded higher grain yield of 27.05 (q ha$^{-1}$) which was significantly superior over the grain yield obtained with seed rate of 40 kg ha$^{-1}$ and was at par with the grain yield obtained with 50 kg ha$^{-1}$. The maximum plant population was observed with 60 kg ha$^{-1}$. For higher yield optimum plant population is necessary.

The findings are in conformity with Dongarwar et al. (2018), who reported that the increase in plant density increases the yield. Among different seed rates 75 kg seeds ha$^{-1}$ recorded 3548 kg ha$^{-1}$ of grain yield which was significantly higher over other seed rates but was at per with 50 kg seeds ha$^{-1}$ which obtained 3485 kg ha$^{-1}$ of yield.

**Straw yield (q ha$^{-1}$)**

Effect of seed rate on straw yield was found significant. Highest straw yield of 40.57 q ha$^{-1}$ was produced with 60 kg seed rate ha$^{-1}$ and found signigicantly superior over 40 q ha$^{-1}$ but found at par with 50 kg ha$^{-1}$.

The findings are in conformity with Jadhav *et al.* (2014), who reported that the straw yield was significantly more under seed rate of 60 kg ha$^{-1}$ due to higher population which gave higher biomass unit$^{-1}$ area than lower seed rates. This might be due to improper sink - source relationship which might have resulted in higher dry matter accumulation in plants under higher seed rates unit$^{-1}$ area. The significantly lower straw yield was observed under 25 kg ha$^{-1}$.

**Effect of spacing**

Data pertaining to various yield attributes studied as influenced by spacing treatments are presented in table 1.

**Number of tillers m$^{-1}$ row length**

Number of tillers m$^{-1}$ row length increased with the increasing are of the crop up to harvest. At 30, 60, 90 DAS and at harvest number of tillers increased as the drilling distance increased up to 30 cm. Drilling distance between rows of 30 cm was significantly superior over 20 cm and with 25 cm drilling distance.

These results are in comformity with the findings of Kumar *et al*. (2006) and Ram *et al*. (2014), who reported that the tillers hill$^{-1}$ were significantly higher with wider spacing of 30 cm X 30 cm compared to closer spacing (25 cm X 25 cm) due to advantage of space and less competition for nutrition under wider spacing.

**Number of panicles plant$^{-1}$**

Effect of drilling distance on number of panicles plant$^{-1}$ was found to be significant. The maximum number of panicles were produced with 30 cm drilling distance which was significantly superior over 20 cm drilling distance but was at par with 25 cm drilling distance.

The findings are in conformity with Ram *et al.* (2014) and Kumar *et al*. (2006), who reported that the panicles hill$^{-1}$ were significantly higher with wider spacing of 30 cm X 30 cm compared to closer spacing (25 cm X 25 cm) due to advantage of space and less competition for nutrition under wider spacing.

**Length of panicle (cm)**

Length of panicle plant$^{-1}$ was significantly not influenced due to different spacing. The maximum length of panicle plant$^{-1}$ produced with 30 cm spacing than 20 cm spacing and 25 cm spacing.

Similar results were observed by Payman and Singh (2008), who reported that the 20 and 25 cm spacing not influenced the length of panicle.

**Number of grains panicle$^{-1}$**

Data pertaining to number of grains panicle$^{-1}$ as influenced by different treatments are presented in table 1. Effect of drilling distance on number of grains panicle$^{-1}$ was found to be significant. However, drilling distance of 30 cm recorded higher number of grains panicle$^{-1}$ which was significantly superior over drilling distance of 20 cm but was at par with 25 cm drilling distance.

Similar results were reported by Basavaraja et al. (2010), who observed that aerobic rice sown at 45 cm X 20 cm spacing recorded significantly higher number of grains panicle$^{-1}$ which was superior over the spacing of 25 cm X 25 cm and 20 cm X 10 cm. This may be due to higher availability of nutrients, light and moisture to the plants which leads to vigorous growth, less competition for nutrients, light and moisture between the plants due to less plant population.

**Weight of grains panicle$^{-1}$**

Data pertaining to weight of grains panicle$^{-1}$ as influenced by different treatments are presented in table 1. Effect of drilling distance on weight of grains panicle$^{-1}$ was found to be significant. Drilling distance of 30 cm recorded higher weight of grains panicle$^{-1}$ which was significantly superior over drilling distance of 20 cm and at par with 25 cm drilling distance.

The findings are in conformity with Jadhav *et al*. (2014), who reported that panicle weight, number of filled grains panicle$^{-1}$ were significantly higher in wider spacing of 30 cm over the spacing of 20 cm, however, it was at par with 25 cm. The competition among plants for nutrients, light at each lower level of spacing reduced the weight of grains panicle$^{-1}$, panicle weight, filled grains panicle$^{-1}$.

**Test weight**

Data pertaining to test weight as influenced by different treatments are presented in table 1. Effect of drilling distance on test weight was found to be non-significant. The findings are in conformity with Jadhav *et al*. (2014), who reported that the test weight was not significantly influenced by 20, 25 and 30 cm spacing.

**Grain Yield (q ha$^{-1}$)**

Data pertaining to grain yield as influenced by different treatments are presented in table 1. Effect of drilling distance on grain yield was found significant. Highest grain yield of 26.64 q ha$^{-1}$ was recorded with drilling distance of 25 cm and found significantly superior over drilling distance of 20 cm but at par with 30 cm drilling distance.

The result partially coincided with the results of Jalil (2008), who stated that the rice crop (cv. BRRI dhan-29) drilled with 25 cm row spacing produced highest grain yield under aerobic system of cultivation.

**Straw yield (q ha$^{-1}$)**

Data pertaining to straw yield as influenced by different treatments are presented in table 1. Effect of drilling distance on straw yield was found significant. Highest straw yield of 39.91 q ha$^{-1}$ was recorded with drilling distance of 25 cm and found significantly superior over drilling distance of 20 cm but found at par with 30 cm drilling distance. Straw yield was more under 25 cm drilling distance due to optimum population which gave higher biomass unit$^{-1}$ area than lower drilling distance but optimum plant population was necessary. This might be due to optimum plant population, less competition compared to low drilling distance which might have resulted in higher dry matter accumulation in plants under 25 cm drilling distance.

The result partially coincided with the results of Jalil (2008), who stated that the rice crop (cv. BRRI dhan-29) grown with 25 cm row spacing produced highest straw yield under aerobic system of cultivation.

It is referred from the data that seed rate of 40 kg ha$^{-1}$ and drilling distance of 30 cm reported significantly increased growth attributing characters. The grain yield was significantly influenced with different seed rate. Application of 60 kg ha$^{-1}$ seed rate recorded highest grain yield. The grain yield was significantly influenced with different drilling distance. The grain yield recorded highest at spacing 25 cm than 20 cm and 30 cm.

**Table 1. Effect of seed rate and spacing on yield of aerobic rice**

| Treatments | Total number of tillers $m^{-1}$ row length | | | | Number of panicles $plant^{-1}$ | Length of panicle (cm) | Number of grains $panicle^{-1}$ | Weight of grains $panicle^{-1}$ | Test weight (g) | Grain yield ($qha^{-1}$) | Straw yield ($qha^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Seed rate | | | | | | | | | | | |
| S1-40 kg seed $ha^{-1}$ | 33.02 | 59.23 | 76.04 | 77.15 | 5.74 | 20.56 | 137.82 | 2.36 | 15.52 | 24.50 | 36.80 |
| S2-50 kg seeed $ha^{-1}$ | 32.04 | 56.25 | 74.76 | 74.93 | 5.51 | 20.38 | 136.99 | 2.27 | 15.47 | 26.27 | 39.40 |
| S2-60 kg seeed $ha^{-1}$ | 31.78 | 55.50 | 68.39 | 69.49 | 5.20 | 20.20 | 135.34 | 2.20 | 15.20 | 27.05 | 40.57 |
| SE (m) ± | 0.50 | 1.03 | 1.30 | 1.29 | 0.09 | 0.08 | 0.38 | 0.04 | 0.09 | 0.38 | 0.49 |
| C.D. at 5% | - | 3.05 | 3.86 | 3.79 | 0.26 | - | 1.13 | 0.11 | - | 1.11 | 1.45 |
| Drilling distance | | | | | | | | | | | |
| D1- Drilling at 20 cm | 31.38 | 53.96 | 68.46 | 69.52 | 5.23 | 20.23 | 135.78 | 2.16 | 15.20 | 25.02 | 37.80 |
| D2- Drilling at 25 cm | 32.34 | 57.58 | 72.38 | 73.41 | 5.51 | 20.39 | 137.04 | 2.32 | 15.47 | 26.64 | 39.96 |
| D3- Drilling at 30 cm | 33.12 | 59.43 | 77.63 | 78.65 | 5.71 | 20.52 | 137.33 | 2.35 | 15.44 | 26.16 | 39.24 |
| SE (m) ± | 0.50 | 1.03 | 1.30 | 1.29 | 0.09 | 0.08 | 0.38 | 0.04 | 0.09 | 0.38 | 0.49 |
| C.D. at 5% | - | 3.05 | 3.86 | 3.79 | 0.26 | - | 1.13 | 0.11 | - | 1.11 | 1.45 |
| Interaction (S X D) | | | | | | | | | | | |
| SE (m) ± | 1.06 | 2.19 | 2.77 | 2.75 | 0.19 | 0.20 | 0.81 | 0.09 | 0.19 | 0.82 | 1.05 |
| C.D. at 5% | - | - | - | - | - | - | - | - | - | - | - |
| G.M. | 32.28 | 56.99 | 72.83 | 73.86 | 5.48 | 20.30 | 136.72 | 2.24 | 15.40 | 25.94 | 38.91 |

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