

Productivity and Profitability of Hybrid Rice (*Oryza Sativa* L.) As Influenced by Spacing and Age of Seedling Under System of Rice Intensification

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Abstract – The field experiment was conducted during *kharif* season of 2014 at Navsari to evaluate suitable spacing (20 x 15 cm, 25 x 25 cm) and age of seedling (18 and 28 days old) of rice varieties (GNR 3 and US 312) under system of rice intensification. Spacing at 25 x 25 cm showed significantly higher yield attributes, viz., tillers hill⁻¹, effective tillers m⁻², grains panicle⁻¹ and grain weight per panicle and 1000 seed weight as compared to 20 x 15 cm except plant height. Further, grain yield, net returns, benefit: cost ratio was significantly higher under wider spacing. Of the rice varieties, hybrid US 312 exhibited significantly higher growth parameters, yield attributes, yields, net returns and benefit: cost ratio over GNR 3 except plant height. The 18 days old seedlings registered 9.96% higher grain yield than older seedlings, but growth and yield attributes like plant height, panicle length, grains panicle⁻¹ and straw yield found to be non-significant. The interaction effect of hybrid rice US 312 with spacing 25 x 25 cm produced significantly higher grain yield.

Keywords – Hybrid Rice, Spacing, Seedling Age, System of Rice Intensification

I. INTRODUCTION

Rice, being the staple food for more than half of the population worldwide (FAO, 2012) is cultivated on an area of 168.4 million ha with a production of 485.5 million tonnes of milled rice. In India has the largest area of 43.46 million ha and produces around 91.79 million tonnes of milled rice annually. In view of increasing scarcity and growing demand for fresh water resources, research efforts have so far been conducted on development of water saving technologies for the last few decades to sustain rice production. One of the water saving technology for rice cultivation in which the fields remain saturated through intermittent irrigation unlike the flooded conditions maintained in the traditional method.

At the current rate of population growth in India, the requirement of rice by the tune of century is estimated to be around 15 million tonnes. To make the India self-sufficient in rice, it is needed to improve the productivity to a great extent. The task is quite challenging and the options available are very limited. Among the various possible genetic approaches to achieve this target, introduction of hybrid rice for cultivation. Among the management factors, time of sowing and spacing play a vital role in boosting the yields. Environment factors could be governed possible by sowing time which has great bearing on the realization of the yield potential of the rice. Keeping this in view, a field study was taken to evaluate the productivity and profitability of hybrid rice as influenced by spacing and age of seedling under SRI.

II. MATERIALS AND METHODS

A field experiment was conducted during *kharif* season of 2014 at main rice research station, Soil and water management research unit, Navsari on clayey soil in texture having pH 7.5, low in organic carbon (0.35%) and available N, P and K were 300, 26 and 592 kg ha⁻¹, respectively. The treatments comprised of two rice varieties (GNR 3 and hybrid US 312), two spacing (20 x 15 cm and 25 x 25 cm) and two age of seedling (18 and 28 days old) with eight treatments. The treatments of an experiment were evaluated in factorial randomized block design with three replications. Raised nursery of rice on raise bed during 18 and 28 June, 2014 for respective treatments and seedling were transplanted as per treatments. Proper care of nursery was taken by watering, weeding and plant protection measures. Recommended dose of fertilizer i. e. 120: 40: 0 kg NPK ha⁻¹ was applied, in which full dose of P and 40% of N applied at transplanting in the form of Single Super Phosphate and Urea, respectively, while remaining N applied at tillering and panicle initiation stage in equal proportion to respective treatments. Single seedling along with soil was transplanted per hill. Soil kept moist not flooded during the vegetative growth stage till panicle initiation. Excess rain water was drained out as and when required. Irrigation was given only on appearing hair cracks in the field. Cono-weeder used for weed control twice at 20 and 35 DAS in both the direction. The crop was harvested at physiological maturity stage. Statistical analysis was done as per standard procedure.

III. RESULTS AND DISCUSSION

Effect of varieties

The results revealed that varieties showed significant influence on growth characters viz., plant height and total tillers. The maximum tillers registered in hybrid US 312, whereas taller plants observed in variety GNR 3. While, yield attributes like length of panicle, number of panicles per square metre, weight of panicle, grains per panicle were recorded significantly higher in hybrid (US 312), however higher test weight was noted in GNR 3. The differences in parameters between the varieties were mainly due to their genetic build up (Singh *et al.*, 2013). Grain and straw yields were found significant and hybrid variety US 312 produced 14.62 and 12.07 per cent more grain and straw yield, respectively as compared to variety GNR 3. This might be due to higher number of effective tillers, length of panicle, weight of panicle, number of grains per panicle which acted

synergistically and contributed to higher grain and straw yield. These results are similar to the findings of those reported by Munda *et al.* (2006), Basavaraja *et al.* (2010) and Chaudhary *et al.* (2010).

Effect of spacing

Growth and yield attributes *viz.*, plant height, tillers per hill, effective tillers and panicles per square metre as well as panicle weight were influence remarkably due to different spacing. These attributes recorded significantly higher values under wider spacing (25 x 25 cm) than closer spacing. Transplanting at 25 x 25 cm spacing recorded significantly higher grain yield (6003 kg/ha) and straw yield (7157 kg/ha) as compared to 20 x 15 spacing treatment. This may be due to the wider spacing that improves aeration and better utilization of resources by plants converting majority of the tillers into productive tillers. This individual plant could have efficiently utilized the available resources such as space, foraging area for root system, light interception and thus enhance the production of rice in wider space. These results are in accordance with those reported by Krishna (2008) and Veeramani (2010).

Effect of age of seedling

Growth and yield attributes as well as yields of rice were found significant due to age of seedling. Significantly higher values were obtained under the treatment of 18 days old seedling transplanted, while the maximum grain yield (5918 kg/ha) and straw yield (7027 kg/ha) were also produced under the same age of seedling treatment. This might be due to quick and better establishment of younger seedling leads to more utilization of nutrients and natural resources that provided excellent vegetative growth in term of tillers. However, the less root damage and minimum transplanting shock may also have benefited the younger seedlings for easy establishment after transplanting in the main field. These findings are in conformity with those of Manjunatha *et al.* (2010) and Rao *et al.* (2012).

Interaction effect

The interaction effect among varieties, spacing and age of seedling also brought out significant variations in plant height, number of effective tillers and panicles as well as grain yield of rice. The interaction effect between varieties and spacing was found significant for grain yield. Treatment combination V₂S₂ (hybrid US 312 with 25 x 25 cm spacing) produced significantly higher grain yield of 6001 kg/ha as compared V₁S₁. The optimum level of plant population coupled with better yield attributes might have resulted in higher grain yield. These results are in conformity with the finding of Uddin *et al.* (2011) and Basker *et al.* (2012).

Economics

The data furnished in Table-1 showed that hybrid US 312 recorded the highest net returns of Rs. 54355 ha⁻¹ with BCR of 2.27. The maximum net returns of Rs. 51402 ha⁻¹ and BCR of 2.13 was secure when rice seedling transplanted at 25 x 25 cm spacing. This is because wider spacing cut-down the cost of cultivation compared to closer spacing mainly due to less cost involved in transplanting. In case of age of seedling, 18 days old seedling accrued the highest net returns of Rs. 53789 ha⁻¹ and BCR of 2.30.

These results are in conformity with the result of Krishna *et al.* (2008).

IV. CONCLUSION

The results of the field study showed that hybrid rice US 312 should be transplanted at 25 x 25 cm spacing with 18 days old seedling securing higher productivity and profitability during *kharif* season under South Gujarat condition.

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Table 2. Interaction effect of spacing and rice varieties on grain yield (kg ha⁻¹)

| Treatment | Spacing (S) | | |
|---------------|-------------|------------|--------|
| | 20 x 15 cm | 25 x 25 cm | Mean |
| Varieties (V) | | | |
| GNR 3 | 4624.0 | 5907.0 | 5265.0 |
| US 312 | 5971.0 | 6099.0 | 6035.0 |
| Mean | 5297.0 | 6003.0 | |
| S. Em.± | 214.3 | | |
| C.D. (P=0.05) | 650.1 | | |

Table 1. Effect of different treatments on growth, yields and economics of rice

| Treatment | Plant height (cm) | No. of tillers hill ⁻¹ | Effective tillers m ⁻² | Panicle length (cm) | Weight of panicle (g) | Grains panicle ⁻¹ | 1000-grain weight (g) | Grain yield (kg ha ⁻¹) | Straw yield (kg ha ⁻¹) | Harvest index (%) | Net returns (Rs. ha ⁻¹) | Benefit: Cost ratio |
|----------------------------|-------------------|-----------------------------------|-----------------------------------|---------------------|-----------------------|------------------------------|-----------------------|------------------------------------|------------------------------------|-------------------|-------------------------------------|---------------------|
| Varieties(V) | | | | | | | | | | | | |
| GNR 3 | 131.5 | 10.8 | 324.5 | 24.6 | 7.0 | 187 | 27.4 | 5265 | 6449 | 81.8 | 43098 | 2.02 |
| US 312 | 128.7 | 11.9 | 353.0 | 27.5 | 7.8 | 220 | 25.0 | 6035 | 7228 | 84.7 | 54355 | 2.27 |
| S. Em.± | 0.7 | 0.3 | 9.0 | 0.6 | 0.1 | 4.8 | 0.4 | 151.5 | 209.7 | 3.7 | - | - |
| C.D.(P=0.05) | 2.1 | 0.9 | 27.3 | 1.8 | 0.4 | 15 | 1.2 | 459.6 | 636 | NS | - | - |
| Spacing (S) | | | | | | | | | | | | |
| 20 x 15 cm | 130.4 | 10.3 | 320.9 | 26.1 | 7.2 | 199 | 26.1 | 5297 | 6520 | 81.9 | 36506 | 1.74 |
| 25 x 25 cm | 129.8 | 12.4 | 356.6 | 26.0 | 7.6 | 208 | 26.3 | 6003 | 7157 | 84.6 | 51402 | 2.13 |
| S. Em.± | 0.7 | 0.3 | 9.0 | 0.6 | 0.1 | 4.8 | 0.4 | 151.5 | 209.7 | 3.7 | - | - |
| C.D.(P=0.05) | NS | 0.9 | 27.3 | NS | 0.4 | NS | NS | 459.6 | 636 | NS | - | - |
| Age of seedling (A) | | | | | | | | | | | | |
| 18 days old seedling | 130.2 | 11.9 | 352.4 | 26.4 | 7.6 | 270 | 26.1 | 5918 | 7027 | 89.5 | 53789 | 2.30 |
| 28 days old seedling | 130.2 | 10.8 | 325.1 | 25.8 | 7.2 | 197 | 26.3 | 5382 | 6650 | 77.1 | 45958 | 2.11 |
| S. Em.± | 0.7 | 0.3 | 9.0 | 0.6 | 0.1 | 4.8 | 0.4 | 151.5 | 209.7 | 3.7 | - | - |
| C.D.(P=0.05) | NS | 0.9 | 27.3 | NS | 0.4 | NS | NS | 459.6 | NS | 10.8 | - | - |