# EFFECT OF LIGHT INTERCEPTION, SPAD VALUE, LEAF AREA INDEX, ROOT VOLUME AND ENERGETIC ON GROWTH CHARACTERS, GROWTH RATES AND YIELD OF SCENTED RICE UNDER SRI BASED CULTIVATION PRACTICES

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**Abstract:** The experiment was carried out at Raipur during season of 2012. The treatment ($T_2$) planting of 2-3 seedlings hill$^{-1}$ transplanted in the spacing of 25 cm x 25 cm in the age of 12 days recorded significantly highest i.e. light interception, SPAD value, LAI, root volume, root dry weight, grain yield and straw yield with good growth parameters, growth rates and energetic and yield.

**Keywords**: Growth, Energetic, yield

## INTRODUCTION

All over the world, the importance of agriculture, especially rice production, is increasing. To cope with the rising population, rice production needs to increase following vertical, instead of horizontal, expansion. Varieties have a great effect on the growth performance and yield contributing characters. India is second largest producer after china and has an area of over 42.2 million hectares and production of 104.32 million tonnes with productivity of 2372 kg ha$^{-1}$. The productivity of rice in Chhattisgarh is 1.80 t ha$^{-1}$ and its area is 3.65 million ha (Anonymous, 2013). Country has also emerged as a major rice consumer. Rice is consumed both in urban and rural areas and its consumption is growing due to high-income elasticity of demand. To meet the growing demand, a rapid increase in paddy production is needed. But, there is little scope to increase the area; hence increase in production and productivity with an improvement in efficiency of production act as a technological breakthrough to meet the growing demand. New approaches in international trade for aromatic rice's have to be developed. The national governments are required to design policies for grain qualities of aromatic rice's for both domestic and international trade. The major portion of rice area is devoted to the coarse and medium slender rice varieties. However, very less area (≥ 20 % of the total rice area) has been given to the fine and scented rice. The crop plant growing depends largely on temperature, solar radiation, moisture and soil fertility for their growth and nutritional requirements. An unsuitable population crop may have limitation in the maximum availability of these factors. It is, therefore necessary to determine the optimum density of plant population per unit area for obtaining maximum yield. There have been extensive studies on the relationship between yield and plant density. Leaf area index (LAI, leaf area per unit ground area) of paddy rice is an important crop biophysical parameter. It provides information on crop growth dynamics and is highly correlated with crop biomass and productivity (Venkateswarlu *et al.* 1976, Dobermann and Pampolino 1995). The optimum seedlings per hill ensure the plants to grow in their both aerial and underground parts through efficient utilization of solar radiation, water and nutrients (Miah *et al.*, 2004). When the planting densities exceed the optimum level, competition among plants becomes severe and consequently the plant growth slows and the grain yield decreases. As the tiller production in scented rice is very low and most of them are low yielding. So, it is essential to determine suitable spacing and number of seedlings for scented rice varieties to maximize their yield. The main objective of the research work was to find out optimum planting geometry, seedling density and seedling age to obtain maximum production of rice.

## MATERIAL AND METHOD

The experiment was carried out at Research Cum Instructional Farm, I.G.K.V., Raipur (C.G.) during *kharif* 2012. The soil of experiment field was '*Inceptisols*' (sandy loam) which is locally known as '*Matasi*'. The soil was neutral in reaction and medium in fertility having low N, medium P, high K Climate of this region is sub- humid with an average annual rainfall of about 1200-1400 mm and the crop received 1315.9 mm of the total rainfall during its crop growth. The weekly average maximum and minimum temperature varied in between 25.8$^0$C – 31.9$^0$C and 12.75$^0$C – 25.8$^0$C, respectively. The experiment consisting of scented rice variety *Dubraj* with five levels of spacing *viz.* 25 cm x 25 cm, 25 cm x 20 cm, 25 cm x 15 cm, 20 cm x 20 cm and 25 cm x 10 cm and four levels of number of seedlings hill$^{-1}$ *viz.* 1 seedlings hill$^{-1}$, 2-3 seedlings hill$^{-1}$, 4-5 seedlings hill$^{-1}$ and 2 seedlings hill$^{-1}$. The experiment was laid out in randomized block design (RBD) with three replication and fourteen treatments. The treatment *viz.* 25 cm x 25 cm + $S_1$ ($T_1$), 25 cm x 25 cm + $S_{2-3}$ ($T_2$), 25 cm x 25 cm +$S_{4-5}$ ($T_3$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 20 cm + $S_{2-3}$ ($T_5$), 25 cm x 20 cm + $S_{4-5}$ ($T_6$), 25 cm x 15 cm + $S_1$ ($T_7$), 25 cm x15 cm + $S_{2-3}$($T_8$), 25 cm x 15 cm + $S_{4-5}$ ($T_9$), 25 cm x 10 cm + $S_1$ ($T_{10}$), 25 cm x 10 cm + S $_{2-3}$ ($T_{11}$), 25 cm x 10 cm + $S_{4-5}$ ($T_{12}$), 20 cm x 20 cm + $S_2$ ($T_{13}$), 20 cm x 10 cm + $S_{2-3}$ ($T_{14}$). Transplanting of one, two-three and three-four seedlings hill$^{-1}$, using seed rate of 10 kg ha$^{-1}$, 20 kg ha$^{-1}$, 35 kg ha$^{-1}$ and 40 kg ha$^{-1}$ at the spacing of 25 cm x 25 cm, 25 cm x 20 cm, 25 cm x 15 cm, 25 cm x10 cm, 20 cm x 20 cm, 20 cm x 10 cm respectively. The 12 days old seedlings were transplanted from $T_1$ to $T_{13}$ while 23 days old seedlings were transplanted in the treatment $T_{14}$. Cultural operations were done as and when necessary. Crop was transplanted on 23. 07. 2012 and harvested on 02.12.2012. Recommended dose of nutrient was 60 kg N + 40 kg $P_2O_5$ + 30 kg $K_2O$ ha$^{-1}$. The fertilizers were applied as per the treatments. Entire quantity of phosphorus and FYM was applied before transplanting. Nitrogen, Phosphorus and potassium applied through urea, single super phosphate and muriate of potash respectively. Nitrogen was applied in 3 splits (basal, tillering and panicle initiation stage (@ 50:25:25%). The plants of outer row and the extreme ends of the middle rows were excluded to avoid border effect. Five hills were randomly selected from each treatment for recording observations on plant height, number of tillers, dry matter accumulation, leaf area index, SPAD value, light interception, light transmission ratio and energetic. The straws were sun dried and the yield of grain and straw/plot were converted to t/ha. Collected data were analyzed statistically following ANOVA technique and the mean differences were adjudged by Duncan's multiple Range lest (Gomez and Gomez, 1984).

## RESULT AND DISCUSSION

Growth parameters were influenced by seedling density, planting geometry and seedling age, which are discussed in connection with plant height, tiller production, dry matter accumulation, LAI, SPAD, LI, root study, grain yield , straw yield and energetic.

### Effect on growth parameters

It is obvious from the data of plant height progressively increased with advancement of the age of crop and remains constant before some days of harvesting. The treatment 25 cm x 25 cm + S $_{2-3}$ ($T_2$) produced significantly highest plant height which was found to be at par with the treatments 25 cm x 25 cm +$S_1$ ($T_1$) , 25 cm x 25 cm + $S_{4-5}$ ($T_3$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 20 cm + $S_{2-3}$ ($T_5$), 25 cm x 20 cm + $S_{4-5}$ ($T_6$), 25 cm x 15 cm +$S_1$ ($T_7$) and 25 cm x 15 cm +$S_{2-3}$ ($T_8$). This result is in accordance with Singh *et al.* (2012). It is due to Younger seedling, optimum seedling density, seedling age and wider spacing helped to attain higher plant height due to fact that early transplanting preserves potential for crop growth and wider spacing provides efficient use of nutrients with less competition. Treatment 25 cm x 25 cm + S $_{2-3}$ ($T_2$) produced significantly the maximum number of tillers hill$^{-1}$ and the treatments 25 cm x 25 cm +$S_1$ ($T_1$), 25 cm x 25 cm + $S_{4-5}$ ($T_3$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 20 cm + S $_{2-3}$ ($T_5$), 25 cm x15 cm +$S_1$ ($T_7$), 25 cm x 15 cm +S $_{2-3}$ ($T_8$) and 25 cm x 15 cm + $S_{4-5}$ ($T_9$) was found to be at par with the same treatment. The lowest number of tillers was observed in treatment of 20 cm x 10 cm + $S_{2-3}$ ($T_{14}$) *i.e.* farmers practice of scented rice. These findings are in accordance with Balsubramanian *et al.* (2000). Younger seedlings (10-12 days old) with wider spacing also helped to attain higher number of tillers due to fact that early transplanting preserves potential for tillering and wider spacing provides efficient use of nutrients with less competition. This result is in accordance with Singh and Singh (2005). Dry matter accumulation is directly related to the growth pattern of the crop, which linearly influences the biological yield. Dry matter accumulation increased with the advancement of crop age. In the treatment 25 cm x 25 cm + $S_{2-3}$ ($T_2$) recorded significantly higher dry matter accumulation and it was significantly best over all the treatments except treatment 25 cm x 25 cm + $S_1$ ($T_1$) which was statistically similar with the highest dry matter produced treatment 25 cm x 25 cm + S $_{2-3}$ ($T_2$). The results are also in consonance with the findings of Sridevi and Chellamuthu (2007). The higher value of dry matter accumulation might be due to higher availability and translocation of nutrients during growth and development stages. It depends upon the photosynthesis and respiration rate which finally increase the plant growth with respect to plant height, tillers etc. Kim et al. (1999) observed that 10-day old seedlings had more vigorous stem elongation and higher tillering ability compared with 40-day old seedlings.

### Effect on Light interception (LI) and light transmission ratio (LTR) of scented rice

The plants grown with wider spacing had more solar radiation to absorb for better photosynthetic process and hence performed better as individual (Baloch *et al*., 2002). From the recorded observed data LI and LTR gave significant result between all other treatments. The treatment 25 cm x 25 cm + $S_1$ ($T_1$) recorded significantly highest light interception, which was statistically similar with the treatments 25 cm x 25 cm + $S_{2-3}$ ($T_2$), 25 cm x 15 cm + $S_{2-3}$ ($T_8$) and 25 cm x10 cm + $S_1$ ($T_{10}$). The treatment 25 cm x 15 cm + $S_{4-5}$ ($T_9$) was recorded maximum LTR which was found to be at par with the treatments 25 cm x 10 cm +$S_{2-3}$ ($T_{11}$), 25 cm x 10 cm + $S_{4-5}$ ($T_{12}$) and 20 cm x 10 cm + $S_{2-3}$ ($T_{14}$). Increased spacing and less seedling density might be the reason of more LI. It might be due to optimum seedling density and wider spacing more number of leaves exposed to sunlight which intercepted more light. More SPAD value results more light interception due to absorption of more sunlight. It might be due to increased plant height, ultimately plant get sufficient space to grow and increased light interception in the canopy leads to increase root: shoot ratio. The present findings are in conformity with results of Lin *et al*. (2005).

**Effect on SPAD value and leaf area index of scented rice**

The findings showed that there were the significant variations between the treatments at 90 DAT, the highest SPAD value was observed under treatment 25 cm x 25 cm +$S_2$ ($T_2$) which was significantly better over all other treatments except 25 cm x 25 cm + $S_1$ ($T_1$), 25 cm x 25 cm +$S_{4-5}$ ($T_3$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 20 cm + $S_{2-3}$ ($T_5$), 25 cm x 20 cm + $S_{4-5}$ ($T_6$) and 25 cm x 15 cm + $S_1$ ($T_7$). Highest SPAD value might be due to wider spacing which resulted in profuse tillering and facilitated plant for better utilization of resources, More space for growth and utilization of nutrients helps in better growth of leaves and better chlorophyll content which results into more SPAD value. Similar finding's observed by Thiyagarajan (2006) and Shrirame *et al.* (2000). Significantly highest LAI was recorded under the treatment 25 cm x 25 cm + $S_1$ ($T_1$) which was found to be at par with the treatments 25 cm x 25 cm + $S_{2-3}$ ($T_2$), 25 cm x 25 cm +$S_{4-5}$ ($T_3$), 25 cm x 20 cm + $S_1$ ($T_4$) and 25 cm x 20 cm + $S_{2-3}$ ($T_5$) and 25 cm x 15 cm + $S_1$ ($T_7$). LAI increased with the increase in seedling age up to four weeks and then reduced gradually (Das and Mukherzee1989). Higher plant height helps better light interception which results in higher absorption of specific wave length of light necessary for photosynthesis that ultimately increased the leaf area. Similar findings have also been reported by Krishna *et al.* (2008) and Alam *et al*. (2012).

**Effect on root volume and dry weight**

Planting geometry and seedling density had significant influence on growth and yield of aerobic rice. Root length, root weight and root volume differed significantly. The result indicated that different treatments significantly influence the root volume and root dry weight. The treatment 25 cm x 25 cm + $S_{2-3}$ ($T_2$) recorded significantly higher root volume and dry weight. However the above highest performing treatment was found at par with the treatments 25 cm x 25 cm +$S_1$ ($T_1$) and 25 cm x 20 cm + $S_{2-3}$ ($T_5$). Similarly, in case of root volume treatments 25 cm x 25 cm +$S_1$ ($T_1$), 25 cm x 25 cm + $S_{4-5}$ ($T_3$) and 25 cm x 15 cm +$S_1$ ($T_7$) was found comparable to treatment 25 cm x 25 cm + $S_{2-3}$ ($T_2$). Higher root dry weight and root volume in 25 cm x25 cm spacing, two seedling hill$^{-1}$ and 12 days old seedling was due to less competition among the plants for nutrients and moisture better aeration which encourages better root development. Similar results were reported by Bridgit and Potty, (2002). It might be due to vertical and horizontal distribution decides the size of the root system. It might to be due to younger seedlings, it sustained least injury to the roots because they quickly established after transplanting, wider spacing and use of mechanical weeding enhance the root system, the root growth and its activity. Similar finding's observed by Sridhara *et al*. (2011). It might be due to increased plant height, ultimately plant get sufficient space to grow and increased light interception in the canopy leads to increase root: shoot ratio. These findings are in accordance with and Verma (2009).

**Effects on growth rates of scented rice**

The CGR was observed 91 DAT - at harvest and the data presented on graph.1. this figure indicated that the highest CGR was recorded under the treatment 25 cm x 25 cm + S $_{2-3}$ ($T_2$) which was closely followed with the treatments 25 cm x 25 cm + $S_1$ ($T_1$), 25 cm x 25 cm +S $_{4-5}$ ($T_3$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 20 cm + S $_{2-3}$ ($T_5$) and 25 cm x 15 cm + S $_{2-3}$ ($T_8$). However at 91 DAT - at harvest stage the highest RGR was recorded in the treatment 25 cm x 25 cm + S $_{2-3}$ ($T_2$) which was followed the treatments 25 cm x 25 cm + $S_1$ ($T_1$), 25 cm x 25 cm +S $_{4-5}$ ($T_3$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 20 cm + S $_{2-3}$ ($T_5$), 25 cm x 20 cm + S $_{4-5}$ ($T_6$), 25 cm x 15 cm + $S_1$ ($T_7$), and 25 cm x 15 cm + S $_{2-3}$ ($T_8$). Similar observations were also reported by Verma *et al.* (2009).

**Effects on energetic of scented rice**

The data reveal that the maximum energy input was observed under the treatment 20 cm x 10 cm + $S_{2-3}$ ($T_{14}$), followed by the treatments 25 cm x 25 cm +$S_{4-5}$ ($T_3$), 25x10cm$^2$+$S_1$ ($T_{10}$ ) and 25x10cm$^2$+$S_3$ ($T_{12}$). Whereas, the net gain energy was found maximum under the treatment 25 cm x 25 cm + $S_{2-3}$ ($T_2$) followed by the treatment 25 cm x 25 cm + $S_1$ ($T_1$). The highest grain production efficiency was obtained under the treatment with 25 cm x 25 cm + $S_{2-3}$ ($T_2$). Whereas, the lowest energy input was obtained under the treatments 25 cm x 25 cm + $S_1$ ($T_1$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 15 cm + $S_1$ ($T_7$) and 25 cm x 10 cm + $S_1$ ($T_{10}$ ). Similar findings were found by Mittal *et al.* (1958).

**Effect on grain yield and straw yield**

The grain, straw yield were significantly influenced due to different treatments. The data are presented in Table C. The treatment 25 cm x 25 cm + $S_{2-3}$ ($T_2$) produced significantly highest grain yield, which was statistically similar with the treatments 25 cm x 25 cm + $S_1$ ($T_1$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 20 cm + $S_{2-3}$ ($T_5$), 25 cm x 15 cm + $S_1$ ($T_7$) and 20 cm x 20 cm + $S_2$ (2S) ($T_{13}$). Whereas the highest straw yield was recorded under the treatment 25 cm x 25 cm + $S_{2-3}$ ($T_2$) which was found to be at par with the treatment 25 cm x 25 cm + $S_1$ ($T_1$). The lowest grain yield and straw yield was obtained under narrow spacing with higher seedling density *i.e.* 20 cm x 10 cm + $S_{2-3}$ ($T_{14}$) *i.e*. farmers practice. Whereas, the treatment 25 cm x 10 cm + $S_{2-3}$ ($T_{11}$) recorded significantly highest harvest index which found to be at par with rest of all treatments except the treatment 25 cm x 25 cm + $S_{4-5}$ ($T_3$). The increase in yield attributes significantly increased the grain and straw yield. The higher grain and straw yield may be due to the application of organic sources of nutrients with inorganic sources of nutrients resulted to greater availability of essential nutrients to plants similar result were found by Porpavi *et al*. (2006). Transplanting of younger seedlings in optimum density at wider spacing facilitate the root growth leading to higher absorption of water and nutrients and ultimately resulting in higher yield. These results are in accordance with Shrirame *et al.* (2000) and Singh *et al.* (2012).

**Table A:** Growth parameters of scented rice as influenced by planting geometry and seedling density under SRI based cultivation practices

| Treatment | Plant height (cm) | No. of tillers | Dry matter accumulation |
|---|---|---|---|
| **$T_1$: 25x25cm$^2$+$S_1$** | 128.74 | 15.27 | 99.20 |
| **$T_2$: 25x25cm$^2$+$S_{2-3}$** | 129.64 | 15.70 | 102.65 |
| **$T_3$: 25x25cm$^2$+$S_{4-5}$** | 124.72 | 14.83 | 93.55 |
| **$T_4$: 25x20cm$^2$+$S_1$** | 123.90 | 14.27 | 91.01 |
| **$T_5$: 25x20cm$^2$+$S_{2-3}$** | 126.34 | 14.87 | 96.14 |
| **$T_6$ : 25x20cm$^2$+$S_{4-5}$** | 122.59 | 12.62 | 86.63 |
| **$T_7$ : 25x15cm$^2$+$S_1$** | 121.31 | 13.10 | 88.06 |
| **$T_8$ : 25x15cm$^2$+$S_{2-3}$** | 125.95 | 13.61 | 92.58 |
| **$T_9$ : 25x15cm$^2$+$S_{4-5}$** | 120.66 | 12.63 | 82.97 |
| **$T_{10}$ :25x10cm$^2$+$S_1$** | 118.88 | 11.07 | 74.71 |
| **$T_{11}$ :25x10cm$^2$+$S_{2-3}$** | 119.38 | 12.11 | 80.51 |
| **$T_{12}$: 25x10cm$^2$+$S_{4-5}$** | 114.84 | 9.99 | 69.35 |
| **$T_{13}$:20x20cm$^2$+$S_2$ (2S)** | 119.20 | 11.07 | 78.61 |
| **$T_{14}$: 20x10cm$^2$+$S_{2-3}$** | 115.59 | 8.60 | 63.96 |
| **SEm $\pm$** | 2.89 | 1.05 | 2.21 |
| **CD(P=0.05)** | 8.42 | 3.07 | 6.43 |

**Table B:** Light interception, SPAD value, Leaf area index, root volume and root dry weight of scented rice as influenced by planting geometry and seedling density

| Treatments | LI (%) | LTR | SPAD | LAI | Root dry | Root volume |
|---|---|---|---|---|---|---|
| **$T_1$ :25x25cm$^2$+$S_1$** | 97.81 | 2.19 | 31.80 | 5.52 | 23.00 | 92.67 |
| **$T_2$: 25x25cm$^2$+$S_{2-3}$** | 97.74 | 2.26 | 33.06 | 5.41 | 24.67 | 94.67 |
| **$T_3$ :25x25cm$^2$+$S_{4-5}$** | 95.44 | 4.56 | 31.50 | 4.96 | 21.50 | 93.00 |
| **$T_4$ :25x20cm$^2$+$S_1$** | 96.34 | 3.66 | 30.00 | 5.17 | 22.00 | 81.67 |
| **$T_5$ :25x20cm$^2$+$S_{2-3}$** | 96.02 | 3.98 | 29.77 | 4.76 | 22.80 | 88.67 |
| **$T_6$: 25x20cm$^2$+$S_{4-5}$** | 96.01 | 3.99 | 29.65 | 4.20 | 20.50 | 76.67 |
| **$T_7$ :25x15cm$^2$+$S_1$** | 96.44 | 3.56 | 30.71 | 4.87 | 22.23 | 92.00 |
| **$T_8$ :25x15cm$^2$+$S_{2-3}$** | 97.28 | 2.72 | 27.77 | 4.53 | 22.17 | 90.67 |
| **$T_9$ :25x15cm$^2$+$S_{4-5}$** | 95.10 | 4.90 | 28.93 | 4.25 | 20.53 | 87.33 |
| **$T_{10}$:25x10cm$^2$+$S_1$** | 97.30 | 2.70 | 27.02 | 4.60 | 22.50 | 87.67 |
| **$T_{11}$:25x10cm$^2$+$S_{2-3}$** | 94.96 | 5.04 | 26.78 | 4.52 | 21.40 | 88.33 |
| **$T_{12}$:25x10cm$^2$+$S_{4-5}$** | 95.13 | 4.87 | 26.38 | 3.79 | 22.03 | 84.33 |
| **$T_{13}$:20x20cm$^2$+$S_2$(2S)** | 96.15 | 3.85 | 28.89 | 4.51 | 21.87 | 65.00 |
| **$T_{14}$: 20x10cm$^2$+$S_{2-3}$** | 94.89 | 5.11 | 27.00 | 3.49 | 21.20 | 48.33 |
| **SEm $\pm$** | **0.28** | **0.28** | **1.41** | **0.30** | **0.70** | **1.00** |
| **C.D. (P=0.05)** | **0.81** | **0.81** | **4.12** | **0.90** | **2.05** | **2.92** |

**Table C**: Grain yield, straw yield, harvest index, Productivity rating index (PRI) and Production efficiency (PE) of scented rice as influenced by planting geometry and seedling density under SRI based cultivation practices.

| Treatment | Grain yield (q $ha^{-1}$) | Straw yield (q $ha^{-1}$) | PE | PRI |
|---|---|---|---|---|
| **$T_2$: 25x25$cm^2$+$S_{2-3}$** | 38.20 | 77.91 | 26.34 | 1.15 |
| **$T_3$ :25x25$cm^2$+$S_{4-5}$** | 34.35 | 71.97 | 23.69 | 1.04 |
| **$T_4$ :25x20$cm^2$+$S_1$** | 35.98 | 65.56 | 24.81 | 1.09 |
| **$T_5$ :25x20$cm^2$+$S_{2-3}$** | 36.84 | 72.33 | 25.40 | 1.11 |
| **$T_6$: 25x20$cm^2$+$S_{4-5}$** | 33.10 | 65.23 | 22.83 | 1.00 |
| **$T_7$ :25x15$cm^2$+$S_1$** | 36.40 | 66.40 | 25.11 | 1.10 |
| **$T_8$ :25x15$cm^2$+$S_{2-3}$** | 33.88 | 62.96 | 23.37 | 1.02 |
| **$T_9$ :25x15$cm^2$+$S_{4-5}$** | 33.51 | 60.36 | 23.11 | 1.01 |
| **$T_{10}$:25x10$cm^2$+$S_1$** | 34.25 | 64.95 | 23.62 | 1.03 |
| **$T_{11}$:25x10$cm^2$+$S_{2-3}$** | 32.89 | 59.81 | 22.69 | 0.99 |
| **$T_{12}$:25x10$cm^2$+$S_{4-5}$** | 32.58 | 57.42 | 22.47 | 0.98 |
| **$T_{13:}$20x20$cm^2$+$S_2$(2S)** | 35.59 | 64.68 | 24.54 | 1.07 |
| **$T_{14:}$ 20x10$cm^2$+$S_{2-3}$** | 30.79 | 56.21 | 21.24 | 0.93 |
| **SEm ±** | **1.28** | **2.18** | **0.88** | **0.03** |
| **CD(P=0.05)** | **3.74** | **3.09** | **2.58** | **0.11** |

**Table D:** Energetic of scented rice as influenced by planting geometry and seedling density under SRI based cultivation practices

| Treatment | Energy input (MJ X $10^{-3}$) | Energy output (MJ X $10^{-3}$) | | Net gain energy (MJ X $10^{-3}$) | Energy output-input ratio (MJ X $10^{-3}$) | | Grain production efficiency (q.MJ X $10^{-3}$) |
|---|---|---|---|---|---|---|---|
| | | **Grain** | **Straw** | | **Grain** | **Straw** | |
| **$T_1$ :25x25$cm^2$+$S_1$** | 12.43 | 54.26 | 93.80 | 148.06 | 4.36 | 7.54 | 2.97 |
| **$T_2$: 25x25$cm^2$+$S_{2-3}$** | 12.58 | 56.15 | 97.39 | 153.54 | 4.46 | 7.74 | 3.04 |
| **$T_3$ :25x25$cm^2$+$S_{4-5}$** | 12.80 | 50.49 | 89.96 | 140.46 | 3.94 | 7.03 | 2.68 |
| **$T_4$ :25x20$cm^2$+$S_1$** | 12.43 | 52.89 | 81.95 | 134.84 | 4.25 | 6.59 | 2.89 |
| **$T_5$ :25x20$cm^2$+$S_{2-3}$** | 12.58 | 54.15 | 90.41 | 144.57 | 4.30 | 7.19 | 2.93 |
| **$T_6$: 25x20$cm^2$+$S_{4-5}$** | 12.80 | 48.66 | 81.54 | 130.19 | 3.80 | 6.37 | 2.59 |
| **$T_7$ :25x15$cm^2$+$S_1$** | 12.43 | 53.51 | 83.00 | 136.51 | 4.30 | 6.68 | 2.93 |
| **$T_8$ :25x15$cm^2$+$S_{2-3}$** | 12.58 | 49.80 | 78.70 | 128.50 | 3.96 | 6.26 | 2.69 |
| **$T_9$ :25x15$cm^2$+$S_{4-5}$** | 12.73 | 49.26 | 75.45 | 124.71 | 3.87 | 5.93 | 2.63 |
| **$T_{10}$:25x10$cm^2$+$S_1$** | 12.43 | 50.35 | 81.19 | 131.54 | 4.05 | 6.53 | 2.75 |
| **$T_{11}$:25x10$cm^2$+$S_{2-3}$** | 12.58 | 48.35 | 74.76 | 123.11 | 3.84 | 5.94 | 2.61 |
| **$T_{12}$:25x10$cm^2$+$S_{4-5}$** | 12.80 | 47.89 | 71.78 | 119.67 | 3.74 | 5.61 | 2.54 |
| **$T_{13:}$20x20$cm^2$+$S_2$(2S)** | 12.58 | 52.32 | 80.85 | 133.17 | 4.16 | 6.43 | 2.83 |
| **$T_{14:}$ 20x10$cm^2$+$S_{2-3}$** | 12.92 | 45.26 | 70.26 | 115.52 | 3.50 | 5.44 | 2.38 |

**Fig 1:** Crop growth rate at different growth stages of scented rice as influenced by planting geometry and seedling density under SRI based cultivation practices

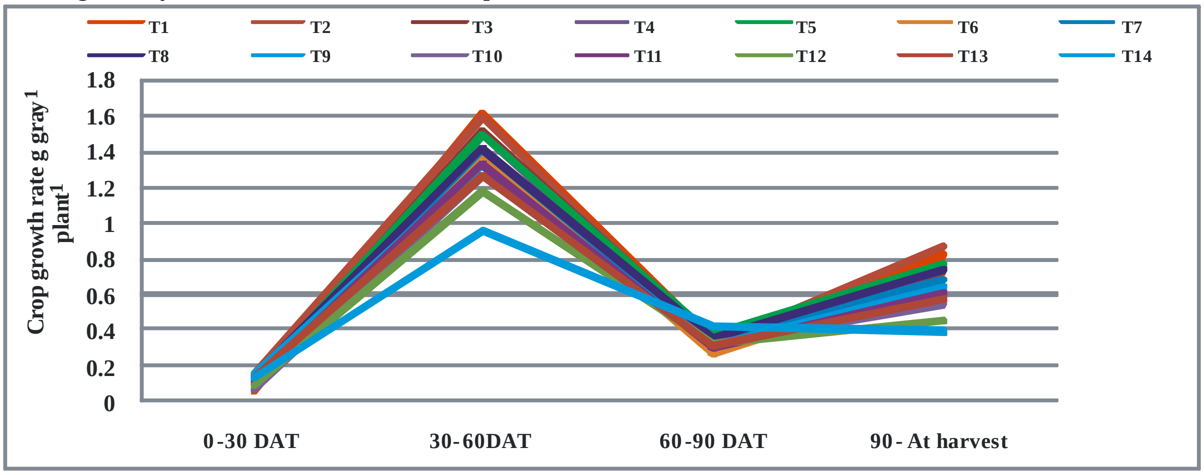
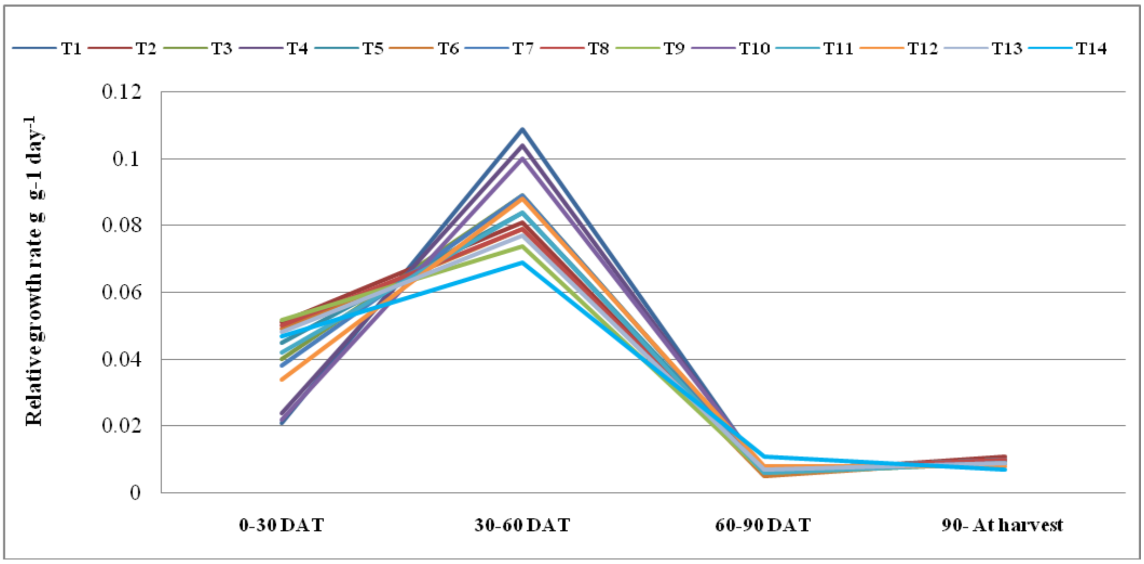



**Fig. 2:** Relative growth rate at different growth stages of scented rice as influenced by planting geometry and seedling density under SRI based cultivation practice

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