International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(5): 2597-2599

Received: 19-07-2020
Accepted: 21-08-2020

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# Effect of age of seedlings and planting geometry on yield attributes and yield of rice *(Oryza sativa* L.)

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**DOI:** https://doi.org/10.22271/chemi.2020.v8.i5aj.10709

**Abstract**
The present investigation entitled was conducted at Agronomy Research Farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during *Kharif* season of 2019. The experiment was laid out in Split Plot Design with three replications keeping three age of seedlings viz., three weeks old seedlings, four weeks old seedlings and five weeks old seedlings in main plots and four planting geometries 20 cm × 10 cm, 25 cm × 10 cm, 20 cm × 15 cm and 20 cm × 15 cm in sub plots. Healthy and bold seeds of rice variety NDR-2064 was sown for nursery and transplanted as per treatment. Result revealed that yield attributes as effective tillers/$m^2$, panicle length and numbers of grains per panicle were significantly superior in paddy transplanted in three weeks old seedlings. Three weeks old seedlings proved significantly superior in terms of grain, straw and biological yield when compared to rest of age of seedling. Planting geometry of 20 cm × 10 cm produced significantly more number of tillers/$m^2$ and number of effective tillers, yield attributes and yield of rice. Therefore, three weeks old seedlings with the planting geometry of 20 cm × 10 cm was recorded higher yield attributes and yield of rice crop.

**Keywords:** Effect of age, *(Oryza sativa* L.), Agriculture and Technology

## Introduction
Rice (*Oryza sativa* L.) is one of the most important food grain crops of more than 60 percent of the world's population. About 90 percent of all rice grown in the world is produced and consumed in the Asian region. It is the world's leading food crop in terms of area and production. Among the rice growing countries, India has the largest area followed by China and Indonesia. India ranks second in production after China. Andhra Pradesh, Bihar, Uttar Pradesh, Madhya Pradesh and West Bengal are leading states in the area of rice. In India, it is grown over an area of 43.79 million hectares having production of 112.91 million tonnes with average productivity of 2578 kg $ha^{-1}$. In Uttar Pradesh, it is grown on 5.95 million hectares area with production of 13.27 million tonnes and productivity of 2230 kg $ha^{-1}$ (Anonymous 2018). Rice provides 35–60% of the dietary calories and 50-80% of the energy intake of the people in developing countries (Fageria *et al*., 2003) [4]. As the population rises, so does the demand for rice. Yet, yields of the crop are levelling out. In India, it plays a major role in diet, economy, employment, culture and history.

Age of seedlings at transplanting is an important factor for uniform stand of rice (Paddalia, 1980) and regulating its growth and yield (Bassi *et al.,* 1994) [2]. Tillering is an important agronomic trait which finally determines the number of panicles, grains and grain yield per unit land area (Li *et al.,* 2003) [5]. When seedlings stay for a longer period of time in the nursery beds, the primary tiller buds on the lower nodes of the main culm become degenerated leading to reduced tiller production (Mobasser *et al.,* 2007) [7]. Also, early transplantation allows better plant growth with short phyllochrons interval due to less transplanting shock. This short phyllochrons interval facilitates more number of tillers produced per hill as two phyllochrons produces another tiller later under favorable growing conditions (Singh *et al.*, 2007). When rice seedlings are transplanted at the right time in terms of age, tillering and growth precede normally but late transplanting results in lower tiller number during vegetative growth (Mobasser *et al.,* 2007) [7].

Crop geometry plays a significant role for optimization of rice yield due to efficient utilization of solar radiation as well as nutrients in rice (Siddiqui *et al.*, 1999) [12]. Closer spacing hampers intercultural operations and as such more competition arises among the plants for nutrients, air and light as a result, plant becomes weaker and thinner producing lower yield. The plant geometry and spatial configuration exploit the initial vigor of the genotypes with enhanced soil aeration creating congenial condition for better establishment (Shukla *et al.*, 2014). A planting density that can bring down the seed requirement without sacrificing productivity would go a long way in popularizing the rice cultivation. Since seed of hybrid cultivar is expensive so selection of ideal plant spacing has also to be adopted for getting optimum plant stand in the field which results in higher yield. In view of the above observations a field experiment was conducted to find out the effect of age of seedlings and planting geometry on yield attributes and yield of rice *(Oryza sativa* L.)

## Materials and Methods

The experiment was conducted at Agronomy Research Farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during *Kharif* season of 2019. It was laid out in split plot design with three replications keeping three age of seedlings viz., three weeks old seedlings, four weeks old seedlings and five weeks old seedlings in main plots and four planting geometries 20 cm x 10 cm, 25 cm x 10 cm, 20 cm x 15 cm and 20 cm x 15 cm in sub plots. Land preparation was started after commencement of monsoon or in case of late monsoon pre-sowing irrigation was applied in the experimental field. One deep ploughing was done by disc plough followed by two ploughing by tractor drawn cultivator and planking was done after each ploughing and then layout was done. A common procedure was followed in raising seedlings in the seedbed. Area of $1/10^{th}$ required for paddy nursery to transplant one hectare land. The seedbed was prepared by puddling with repeated ploughing followed by laddering. Weeds were removed and irrigation was gently provided to the bed as and when necessary. Nursery bed was fertilized with recommended dose of fertilizer (120:60:40). Half N, full P and K applied as basal at last harrowing before puddling and half N was top dressed at 15 day after sowing the nursery. Healthy and bold seeds of rice variety NDR-2064 was sown for nursery and transplanted as per treatment. The moisture was maintained in the seedbed properly two to three day interval, which ensured proper growth of all the seedlings in the seedbed. Half dose of nitrogen, total phosphorus and potash were applied as basal application before puddling and incorporated in the top 15 cm soil. Remaining dose of nitrogen was applied as top dressing in two equal splits each at tillering and panicle initiation stages, respectively. The crop was harvested manually by serrated edged sickles at physiological maturity when panicles had about 85% ripened spikelet's and upper portion of spikelet's look straw coloured. At the time of harvesting the grains were subjected to hard enough, having less than 16% moisture in the grains. The harvesting of net plot area was done separately and the harvested material from each plot was carefully bundled and tagged after drying for three days in the field and then brought to the threshing floor. Threshing of each bundle of individual plot was done manually by wooden sticks. The grain yield of individual plot after winnowing was weighed. The quantity of straw per plot was calculated by subtracting the weight of grains from biological produce.

## Result and Discussion

The data pertaining to yield attributing characters namely number of effective tillers ($m^{-2}$), Panicle length (cm), Panicle weight (g), Number of grains $panicle^{-1}$ and Test weight (g) has been presented in Table-1. The yield of rice crop as influenced by different treatments has been presented in Table-2.

**Table 1:** Effect of yield attributes as influenced by different treatments.

| Treatments | Number of effective tillers ($m^{-2}$) | Panicle length (cm) | Panicle weight (g) | Number of grains $panicle^{-1}$ | Test weight (g) |
|---|---|---|---|---|---|
| **Age of seedlings** | | | | | |
| Three weeks old seedlings | 260.99 | 21.18 | 2.18 | 89.44 | 23.19 |
| Four weeks old seedlings | 257.31 | 20.98 | 2.11 | 87.68 | 22.97 |
| Five weeks old seedlings | 248.47 | 20.11 | 1.99 | 85.19 | 22.25 |
| S.Em ± | 4.473 | 0.275 | 0.058 | 0.949 | 0.598 |
| C.D. at 5% | 11.331 | 0.695 | 0.146 | 2.403 | NS |
| **Planting geometry** | | | | | |
| 20 cm x 10 cm | 262.62 | 20.29 | 2.00 | 82.56 | 22.60 |
| 25 cm x 10 cm | 258.38 | 20.37 | 2.05 | 85.12 | 22.88 |
| 20 cm x 15 cm | 245.51 | 20.99 | 2.09 | 87.56 | 22.71 |
| 25 cm x 15 cm | 227.38 | 21.17 | 2.24 | 94.51 | 23.04 |
| S.Em ± | 4.419 | 0.364 | 0.032 | 1.762 | 0.486 |
| C.D. at 5% | 9.612 | 0.78 | 0.069 | 3.833 | NS |

**Table 2:** Yield of rice crop as influenced by age of seedlings and planting geometry

| Treatments | Grain yield (q $ha^{-1}$) | Straw yield (q $ha^{-1}$) | Total biological yield (q $ha^{-1}$) | Harvest index (%) |
|---|---|---|---|---|
| **Age of seedlings** | | | | |
| Three weeks old seedlings | 46.23 | 61.91 | 108.14 | 42.76 |
| Four weeks old seedlings | 45.29 | 58.43 | 103.72 | 43.66 |
| Five weeks old seedlings | 40.65 | 56.56 | 97.12 | 41.85 |
| S.Em ± | 1.115 | 1.716 | 1.908 | 1.511 |
| C.D. at 5% | 2.826 | 4.341 | 4.833 | NS |
| **Planting geometry** | | | | |
| 20 cm x 10 cm | 49.85 | 68.30 | 118.15 | 42.17 |
| 25 cm x 10 cm | 45.53 | 62.90 | 102.43 | 44.44 |

| | | | | |
|---|---|---|---|---|
| 20 cm x 15 cm | 42.23 | 55.21 | 94.35 | 44.75 |
| 25 cm x 15 cm | 38.60 | 52.12 | 93.81 | 41.13 |
| S.Em ± | 0.969 | 2.940 | 1.804 | 1.354 |
| C.D. at 5% | 2.108 | 6.395 | 3.924 | NS |

**Effect of age of seedlings on yield attributes and yield of rice.**

The three weeks old seedlings was recorded significantly highest effective number of tillers ($m^{-2}$) (Table 1) which was at par with the four weeks old seedlings while significantly superior over the five weeks old seedlings. This can be attributed to the fact that the trauma of root damage received during uprooting and transplanting of the seedlings was comparatively less under young seedlings (21 days old) than the older seedlings. Chaudhari *et al.* (2015) [3] and Vishwakarma *et al.* (2016) reported similar results. Further, length of panicle was also influenced by the age of seedlings at transplanting (Table 1). Regarding length of panicle, three weeks old seedlings and four weeks old seedlings were at par with each other and they were significantly superior over five weeks old seedlings. Similar trends were found with other yield attributing characters namely panicle weight (g) and number of grains $panicle^{-1}$(Table 1). This was due to better partitioning or translocation of photosynthates from source to sink under three weeks old seedlings than four weeks old seedlings and five weeks old seedlings particularly during grain development. These findings are in line with those reported by Singh and Singh (2009) [13]. In respect of grain yield, straw yield and biological yield (Table 2) three weeks old seedlings and four weeks old seedlings were at par with each other and they were significantly superior over five weeks old seedlings. This may be due to the three weeks old seedlings recorded significantly more number of effective tillers ($m^{-2}$), Panicle length (cm), Panicle weight(g) and Number of grains $panicle^{-1}$ which was at par with four weeks old seedlings while significantly superior over the five weeks old seedlings., Chaudhari *et al.* (2015) [3] reported similar results.

**Effect of planting geometry on yield attributes and yield of rice.**

The number of effective tillers ($m^{-2}$) (Table 1) was significantly higher in planting geometry of 20 cm x 10 cm than rest of the planting geometry. This might be due to the plant population of rice under 20 cm x 10 cm was more than rest of the planting geometry. These findings are in confirmation with those reported by Rasool *et al.* (2013) [9] and Pawar (2017). Further, greater availability of the source for every plant due to less plant population under 25 cm x 15 cm was significantly higher over rest of the planting geometry had resulted in creation of greater sink under 25 cm x 15 cm. Therefore, significantly higher length of panicle (cm), panicle weight (g) and number of grains $panicle^{-1}$ (Table 1) were recorded under 25 cm x 15 cm than rest of planting geometry. These findings are in confirmation with those reported by Rasool *et al.* (2013) [9] and Pawar (2017). However, in terms of grain (q $ha^{-1}$), straw yield (q $ha^{-1}$) and total biological yield (q $ha^{-1}$). The spacing 20 cm x 10 cm recorded significantly more grain, straw and biological yield of rice (Table 2) than rest of planting. This was due to more plant population of rice under 20 cm x 15 cm than rest of the planting geometry. Though the yield attributes like length of panicle (cm), panicle weight (g) and number of grains $panicle^{-1}$ (Table 1) were significantly higher under 25 cm x 15 cm than rest of the planning geometry but their magnitude was not high enough to overcome more than plant population existing under 20 cm x 10 cm. Similar results were reported by Mahato *et al.* (2007) [6] and Salahuddin *et al.* (2009) [10].

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