International Journal of Plant & Soil Science

34(14): 68-73, 2022; Article no.IJPSS.86278
ISSN: 2320-7035

Effect of Different Age of Seedlings and Nitrogen Levels on Growth and Yield of Rice (*Oryza sativa* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i1430992

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/86278

Original Research Article

Received 04 February 2022
Accepted 14 April 2022
Published 16 April 2022

ABSTRACT

A field experiment was conducted during the *kharif* season (2021) at Crop Research Farm, Department of Agronomy, SHUATS, Allahabad (U.P.). The soil of experimental plot was sandy loam in texture. The treatment consisted of T_1- 14 Days age seedlings + Nitrogen 100 kg/ha, T_2- 14 Days age seedlings +Nitrogen 110 kg/ha, T_3-14 days age seedlings + Nitrogen 120 kg/ha, T_4- 21 Days age seedlings + Nitrogen 100 kg/ha, T_5- 21 Days age seedlings +Nitrogen 110 kg/ha, T_6-21 days age seedlings + Nitrogen 120 kg/ha, T_7- 28 Days age seedlings + Nitrogen 100 kg/ha, T_8- 28 Days age seedlings +Nitrogen 110 kg/ha, T_9-28 days age seedlings + Nitrogen 120 kg/ha. The experiment was laid out in Randomized Block Design, with 9 treatments replicated thrice. Results revealed that maximum plant height(100.40 cm), number of tillers per hill (14.80), plant dry weight(53.06 g/plant), panicle length(32.30 cm), panicle per m^2(320), no of panicle per hill (10.70), no of filled grains per panicle (165), test weight(26.40g), grain yield(4.16t/ha), stover yield(6.24t/ha), gross return (INR 1,11,904.00), net return (INR 78,275.400), B:C ratio (2.33) was recorded and significantly influenced with the treatment 21 days age seedlings +Nitrogen 120 kg/ha. Therefore, the treatment 21 days age seedlings + Nitrogen 120kg/ha was found more productive and cost effective.

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Keywords: Rice; age of seedlings; nitrogen levels; yield attributes; kharif.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is the second largest cereal crop and is the staple fond of nearly one-half of the world's population. Rice is one of the most important cereal crops of the world. Presently more than 90% of total rice production and consumption in Asia. In India, area under cultivation of rice is around 44 m ha and production of 109.70 million tonnes during 2016-2017 (Anonymous. 2018). World's rice demand is projected to increase by 25 percent from 2001 to 2025 to keep pace the population growth and therefore, meeting ever-increasing rice demand in the sustainable way with shrinking natural resources are a great challenge (Singh *et al.,* 2016). Time of planting is the most important factor in influencing the yield of the crop. Performance of a genotype entirely depends upon the time of planting. Delay in planting generally results in yield reduction which cannot be compensated by any other means [1-3]. Paddy has relatively higher degree of thermo sensitivity during flowering and grain filling stages as compared to high yielding varieties [4-6]. Too high or too temperature may cause damage un flowering and prevent pollen shedding leading to increased infertility and production of chaffy grains [7,8]. In order to ensure normal flowering, fertilization and avoid damage due to high or low temperature, it is necessary to properly organize the date of nursery sowing and transplanting of paddy.

2. MATERIALS AND METHODS

The experiment was conducted during *kharif* season of 2021-2022. The experiment was conducted in Randomized Block Design consisting of nine treatment combinations with three replications and was laid out with the different treatments allocated randomly in each replication. The soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 7.1) with low level of organic carbon (0.28%), available N (225 Kg/ha), P (19.50 kg/ha) and higher level of K (92.00 kg/ha). The treatment combinations are T_1 - 14 days age of seedling + Nitrogen 100 kg/ha, T_2 - 14 days age of seedling + Nitrogen 110 kg/ha, T_3 - 14 days age of seedling + Nitrogen 120 kg/ha, T_4 - 21 days age of seedling + Nitrogen 100 kg/ha, T_5 - 21 days age of seedling + Nitrogen 110 kg/ha, T_6 - 21 days age of seedling + Nitrogen 120 kg/ha, T_7 - 28 days age of seedling + Nitrogen 100 kg/ha, T_8 - 28 days age of seedling + Nitrogen 110 kg/ha, T_9 - 28 days age of seedling + Nitrogen 120 kg/ha. The crop was fertilized with recommended dose of NPK 120:60:60 kg/ha was applied. Full dose of phosphorus and potassium fertilizers were applied as basal while, half of nitrogen was applied as basal and remaining half was applied after transplanting in two split doses. Rice variety pusa basmati-1 was used with spacing of 20cm × 10cm in net plot area of 3m × 3m. A well-drained fertile land with good irrigation facility was selected for growing nursery. The plot was puddled manually and transplanting was done. The observations were recorded on different growth parameters at harvest *viz*. plant height(cm), number of tillers and grain yield(t/ha). One quadrate was harvested in every plot for the determination of results and data was subjected to statistical analysis separately by using analysis of variance technique. The difference among treatments means was compared by using least significant difference test at 5% probability levels.

3. RESULT AND DISCUSSION

3.1 Growth Attributes

At harvest, maximum plant height (100.40 cm) was recorded with application of 21 days age of seedling + Nitrogen 120 kg/ha which was significantly superior over all the treatments and statistically at par with application of 21 days age of seedling + Nitrogen 110 kg/ha (98.00 cm). The increase in plant height might be due to more vigour root growth and lesser transplant shock because of lesser leaf area during initial stages of crop growth, which stimulate increased cell division causing more stem elongation. (Pramanik and Bera, 2013). At harvest observed that maximum number of tillers per plant was recorded with application of 21 days age of seedling + Nitrogen 120 kg/ha (14.80) which were significantly superior over all except with treatment of application of 21 days age of seedling + Nitrogen 110 kg/ha (14.27) which were statistically at par with treatment of application of 21 days age of seedling + Nitrogen 120 kg/ha. The young seedlings recorded better root growth and facilitated increased cell division and cell enlargement due to increased photosynthetic rate subsequently increasing the plant height and number of tiller hill-1 (Shrirame et al., 2000). At harvest maximum plant dry weight (53.06 g) recorded with treatment of application of 21 days age of seedling + Nitrogen 120 kg/ha which was significantly superior over all other treatments except with treatment of application of 21 days age of seedling + Nitrogen 110 kg/ha (50.50 g) which were statistically at par with treatment of application of 21 days age of seedling + Nitrogen 120 kg/ha. This might be due to more number of leaves which occupied the same land area and consequently trapped more light and CO2 resulting in higher photosynthesis and producing more dry matter (Damodaran et al.,2012). The increased dry matter production with younger seedlings might be due to higher tiller production [9].

3.2 Yield Attributes

The yield attributes of basmati rice were significantly influenced by rate of N application and varieties (Table 1). Treatment with 21 days age of seedling + Nitrogen 120 kg/ha was recorded maximum number of panicle/m^2 (320) which was significantly superior over all other treatments. However, the treatment 21 days age of seedling + Nitrogen 110 kg/ha (310) which was statistically at par with 21 days age of seedling + Nitrogen 120 kg/ha. This might be due to the ability of younger seedlings to had a shorter period of transplanting stress and the plant's ability with faster resumption of the rate of phyllochron development over that of older seedlings due to the higher nitrogen content in the younger ones (Yamamoto *et al.,* 1998). Highest panicle length (32.30 cm) was significantly recorded in the the treatment with 21 days age of seedling + Nitrogen 120 kg/ha and the treatment with 21 days age of seedling + Nitrogen 110 kg/ha (31.80cm) which was statistically at par with the treatment with application of 21 days age of seedling + Nitrogen 120 kg/ha. Longer panicle length due to nitrogen because nitrogen takes part in panicle formation as well as panicle elongation and for this reason, panicle length increased with the increase of N-fertilization. (Pramanik and Bera, 2013). The number of panicle/hill (10.70) was recorded significantly highest in the treatment with 21 days age of seedling + Nitrogen 120 kg/ha and the treatment with 21 days age of seedling + Nitrogen 110 kg/ha (10.20) which where statistically at par with the treatment with application of 21 days age of seedling + Nitrogen 120 kg/ha. The number of filled grains per panicle (165.00) was recorded significantly highest in the treatment with 21 days age of seedling + Nitrogen 120 kg/ha and the treatment with 21 days age of seedling + Nitrogen 110 kg/ha (159.00) which where statistically at par with the treatment with 21 days age of seedling + Nitrogen 120 kg/ha. Similar findings were reported in Pramanik and Bera, 2013. The number of un filled grains per panicle (20.00) was recorded significantly highest in the treatment with 14 days age of seedling + Nitrogen 100 kg/ha and the treatment with 14 days age of seedling + Nitrogen 110 kg/ha (18.3) which where statistically at par with the treatment with 14 days age of seedling + Nitrogen 100 kg/ha. Treatment with 21 days age of seedling + Nitrogen 120 kg/ha was recorded significantly highest test weight (26.40 g) and the treatment with 21 days age of seedling + Nitrogen 110 kg/ha (25.72 g) which were statistically at par with treatment with application of 21 days age of seedling + Nitrogen @ 120 kg/ha. This might be due to the proper crop growth and development and assimilate synthesis in the grains. Similar types of results were obtained by Husain *et al.* (2004). Similarly, Hasegawa *et al*. (1994) also indicated that increased number of spikelets and vigorous growth of rice due to high rates of N fertilizer application induce competition for carbohydrate available for grain filling and spikelet formation.

3.3 YIELD

The grain yield of rice was significantly influenced by rate of N application and different age of seedling (Table 2). The treatment with 21 days age of seedling + Nitrogen 120 kg/ha had recorded significantly higher grain yield (4.16 t/ha). However, the treatment with 21 days age of seedling + Nitrogen 110 kg/ha (3.95 t/ha) which was statistically at par with the treatment 21 days age of seedling + Nitrogen 120 kg/ha. The higher grain yield production in the younger seedlings might be attributed to the vigorous and healthy growth, development of more productive tillers and leaves ensuring greater resource utilization as compared to old age seedlings (Pramanik and Bera, 2013). The younger seedlings also aid to better phyllochron development and better tillering and thus, increase the final grain yield (Datta, 1980). The treatment with 21 days age of seedling + Nitrogen 120 kg/ha had recorded significantly higher straw yield (6.24 t/ha). However, the treatment with 21 days age of seedling + Nitrogen 110 kg/ha (6.13 t/ha) which was statistically at par with the treatment 21 days age of seedling + Nitrogen 120 kg/ha. The increased straw yield was due to more number of tillers and dry matter production (Vijayalaxmi *et al.,* 2016). The maximum harvest index was observed in the treatment with 21 days age of seedling + Nitrogen 120 kg/ha (40.01 %) and minimum in treatment with 14 days age of seedling + Nitrogen 100 kg/ha (34.98 %). The highest harvest index might be due to the proper crop growth and development and assimilate synthesis in the grains (Pramanik and Bera, 2013).

Table 1. Effect of different age of seedlings and nitrogen levels on growth and yield of Rice

Treatments	**Plant height (cm) At Harvest**	**Number of tillers At Harvest**	**Plant dry weight (g/hill) At Harvest**
14 days age of seedling + Nitrogen 100 kg/ha	86.20	12.47	41.04
14 days age of seedling + Nitrogen 110 kg/ha	87.20	12.80	41.33
14 days age of seedling + Nitrogen 120 kg/ha	87.60	12.93	43.97
21 days age of seedling+ Nitrogen 100 kg/ha	89.20	13.13	44.53
21 days age of seedling + Nitrogen 110 kg/ha	98.00	14.27	50.50
21 days age of seedling + Nitrogen 120 kg/ha	100.40	14.80	53.06
28 days age of seedling + Nitrogen 100 kg/ha	90.10	13.27	44.80
28 days age of seedling + Nitrogen 110 kg/ha	89.90	13.60	47.03
28 days age of seedling + Nitrogen 120 kg/ha	90.20	13.93	48.73
F TEST	S	S	S
SEm(±)	2.99	0.18	0.91
CD (p=0.05)	8.97	0.55	2.73

Table 2. Yield Attributes of Rice Influenced By Different Age Of Seedling And Nitrogen Levels

Treatments	**Panicle length (cm)**	**Panicle per meter square**	**No of panicle per hill**	**No of filled grains per panicle**	**No of un filled grains per panicle**	**Test weigh t (g)**
14 days age of seedling + Nitrogen 100 kg/ha	29.00	272.0	9.00	103.30	20.0	22.03
14 days age of seedling + Nitrogen 110 kg/ha	29.40	280.0	9.20	111.30	18.3	23.09
14 days age of seedling + Nitrogen 120 kg/ha	29.50	286.0	9.30	120.30	16.7	23.30
21 days age of seedling+ Nitrogen 100 kg/ha	30.10	286.0	9.60	129.00	15.3	23.31
21 days age of seedling + Nitrogen 110 kg/ha	31.80	310.0	10.20	159.00	13.0	25.72
21 days age of seedling + Nitrogen 120 kg/ha	32.30	320.0	10.70	165.00	10.3	26.40
28 days age of seedling + Nitrogen 100 kg/ha	30.30	292.0	9.70	136.30	15.0	23.93
28 days age of seedling + Nitrogen 110 kg/ha	30.90	292.0	9.70	134.70	14.7	24.52
28 days age of seedling + Nitrogen 120 kg/ha	31.40	292.0	9.80	148.30	13.3	24.80
F Test	S	S	S	S	S	S
SEm (±)	0.22	3.55	0.17	4.95	0.65	0.43
CD (5%)	0.66	10.64	0.50	14.83	1.94	1.28

Table 3. Effect Of Different Age Of Seedling And Nitrogen Levels On Yield Of Rice

Treatments	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index %
14 days age of seedling + Nitrogen 100 kg/ha	2.61	4.85	34.98
14 days age of seedling + Nitrogen 110 kg/ha	2.72	4.96	35.42
14 days age of seedling + Nitrogen 120 kg/ha	3.03	5.07	37.44
21 days age of seedling+ Nitrogen 100 kg/ha	2.86	5.17	35.54
21 days age of seedling + Nitrogen 110 kg/ha	3.95	6.13	39.21
21 days age of seedling + Nitrogen 120 kg/ha	4.16	6.24	40.01
28 days age of seedling + Nitrogen 100 kg/ha	3.09	5.32	37.04
28 days age of seedling + Nitrogen 110 kg/ha	3.37	5.48	38.07
28 days age of seedling + Nitrogen 120 kg/ha	3.50	5.68	38.11
F- test	S	S	NS
SEm (±)	0.10	0.18	1.09
CD (5%)	0.29	0.54	-

4. CONCLUSION

On the basis of one season, it was concluded that 21 days age of seedling along with Nitrogen 120 kg/ha was found more productive. The finding was based on the research done in one season it may be repeated further for confirmation and recommendation.

5. FUTURE SCOPE

As there was less research happened in the field, further research should be done to obtain proper results and help farmers obtaining better yields. Since the findings are based on the research done in one season, further trails are needed to confirm the results of this experiment.

ACKNOWLEDGEMENT

The work was supported by my advisor Dr. Rajesh Singh and all faculty members, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, (U.P.) India for providing field and assistance in conducting the research trail.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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