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Effect of different age of seedlings and nitrogen levels on yield and economics of rice (*Oryza sativa* L.)

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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 panicle length (32.30cm), 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 120 kg/ha was found more productive and cost effective.

Keywords: Rice, age of seedlings, nitrogen levels, yield attributes, *kharif*

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. Paddy has relatively higher degree of thermo sensitivity during flowering and grain filling stages as compared to high yielding varieties. Too high or too temperature may cause damage un flowering and prevent pollen shedding leading to increased infertility and production of chaffy grains. 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.

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 observations were recorded on different yield parameters at harvest *viz.* panicle per m^2, no. of filled grains per panicle and grain yield(t/ha).

Result and Discussion

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.

Table 1: 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 weight(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
S.Em (±)	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

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 2: 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
S.Em (±)	0.10	0.18	1.09
CD (5%)	0.29	0.54	-

Table 3: Effect of Different Age of Seedlings and Nitrogen Levels on Economics of Rice

Treatments	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C Ratio
14 days age of seedling + Nitrogen 100 kg/ha	33432.80	74819.33	41386.53	1.24
14 days age of seedling + Nitrogen 110 kg/ha	33530.90	77632.67	44101.77	1.32
14 days age of seedling + Nitrogen 120 kg/ha	33628.60	84196.67	50568.07	1.50
21 days age of seedling+ Nitrogen 100 kg/ha	33432.80	81334.00	47901.20	1.43
21 days age of seedling + Nitrogen 110 kg/ha	33530.90	107344.67	73813.77	2.20
21 days age of seedling + Nitrogen 120 kg/ha	33628.60	111904.00	78275.40	2.33
28 days age of seedling + Nitrogen 100 kg/ha	33432.80	86610.67	53177.87	1.59
28 days age of seedling + Nitrogen 110 kg/ha	33530.90	92778.00	59247.10	1.77
28 days age of seedling + Nitrogen 120 kg/ha	33628.60	96235.33	62606.73	1.86

Economics

The cost of cultivation of paddy crop recorded minimum cost of cultivation is with application of 14 days age of seedling + Nitrogen 100 kg/ha (33432.80 INR/ha) and numerically higher (33628.60 INR/ha) value for the treatment of application of 28 days age of seedling + Nitrogen 120 kg/ha. Numerically higher gross return (111904.00 INR/ha) was obtained with application of 21 days age of seedling + Nitrogen 120 kg/ha and minimum which application of 14 days age of seedling + Nitrogen 100 kg/ha (74819.33 INR/ha). Numerically higher net return (78275.40 INR/ha) was obtained with application of 21 days age of seedling + Nitrogen 120 kg/ha, which was significantly superior over rest of the treatments and minimum within 14 days age of seedling + Nitrogen 100 kg/ha (41386.53 INR/ha). Higher benefit cost ratio (2.33) was obtained with application of 21 days age of seedling + Nitrogen 120 kg/ha, which was significantly superior over rest of the treatments.

Conclusion

On the basis of one season experimentation application 21 days age of seedling + Nitrogen 120 kg/ha was found more productive.

The conclusions drawn are based on one season data only which requires further confirmation for recommendation.

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