Original Research Article

INFLUENCE OF SPACING, AGE OF SEEDLING AND BIO NPK CONSORTIUM ON GROWTH, YIELD ATTRIBUTES AND YIELD OF TRANSPLANTED RICE

ABSTRACT:

A field experiment was carried out during *kharif* season of the year 2021 at Paddy Research Station, Anand Agricultural University, Dabhoi, Gujarat to investigate the influence of spacing, age of seedling and Bio NPK consortium on growth, yield attributes and yield of transplanted *kharif* rice. The texture of experimental soil was sandy clay it was low in available N (219.68 kg/ha), medium in available P_2O_5 (28.43 kg/ha), available K_2O (183.00 kg/ha) and organic carbon (0.42%) with pH (7.49) and EC (0.39 dS/m). Twelve treatment combinations comprising of two spacing *viz*., S_1 (20 × 15 cm) and S_2 (25 × 25 cm), three age of seedlings *viz*., A_1 (15 days old seedling), A_2 (25 days old seedling) and A_3 (35 days old seedling) and two Bio NPK consortium *viz*., B_1 (with Bio NPK consortium) and B_2 (without Bio NPK consortium), tested in split plot design which was replicated thrice. The result showed that rice crop transplanted at S_2 (25 × 25 cm spacing) recorded significantly higher, number of tillers/m^2 (335/m^2), number of panicle/m^2 (272.72/m^2), panicle length (27.83 cm), panicle weight (7.01 g), number of grains(207.89/panicle, grain yield (5477 kg/ha) and straw yield (8957 kg/ha). However, transplanting of 15 days old seedling (A_1) gave significantly higher number of tillers/m^2 (335.08/m^2), number of panicle/m^2 (267.92 /m^2), panicle length (26.67 cm), panicle weight (6.54 g), number of grains (201/panicle, grain yield (5200 kg/ha) and straw yield (8928 kg/ha) and remained at par with transplanting of 25 days old seedling. Seedling treated with Bio NPK consortium was not effective.

Keywords: Rice, spacing, age of seedling, Bio NPK consortium and Bio fertilizer

INTRODUCTION:

Rice (*Oryza sativa* L.) is the staple food for more than 65% of the people and it provides employment and livelihood security to 70% of Indian population. India grows rice in highly diverse conditions starting from below sea levels to hill as high as > 2000 meters. Major share of rice is cultivated during *kharif* season. A small share of rice is grown in *rabi*/summer season with

assured irrigation. Indian rice production largely depends on monsoon rains and only 59% rice area has assured irrigation. Rice is the major source of food for nearly half of the world's population. The slogan "Rice is life" comes from the understanding that rice-based cropping system are essential to everyone directly or indirectly for food security, livelihood improvement, cultural heritage and sustainable development for global peace, according to FAO, the global rice requirement in 2025 will be of the order of 800 million tones. At the moment, the production is less than 600 million tonnes. And hence the additional 200 million tonnes of rice have to be produced by increasing productivity per unit area.

Spacing plays a significant role in rice production. Spacing is generally depends upon the expected growth of a particular crop in a given set of agro climate, which determines the plant density. The optimum plant spacing provides better conditions for plant growth, which results in timely commencement of reproductive phase and formation of sink. The establishment of an optimum plant population per unit area is the contributory factor which determines the yield (Sultan *et al*., 2018).

Seedling age also plays a key role in deciding the productivity of rice. Transplanting is done at an early stage of seedling, which increase the tillering ability of the plant. Due to uncertainty of monsoon rains, the transplanting of rice gets prolonged. Under such situation, comparative evolution of young aged seedlings needs to be done to make the crop more accommodative in the system and to obtain good yields.

The bio fertilizers contain nitrogen (N) fixing organisms which are more importance in agriculture. Application of nitrogenous bio fertilizers resulted in good root development, improves vegetative growth by enhancing N availability to crop and also acts as antagonists to suppress the incidence of soil borne plant pathogens and add 25-30 kg N/ha. The phosphate solubilizing bio fertilizer converts the insoluble soil phosphorus into soluble forms by secreting several organic acids and under optimum conditions they can solubilize / mobilize about 30-50 kg P_2O_5/ha (Mahdi *et al*. 2010). Potassium (K) is a macronutrient in plants and also a major constituent of several soil minerals. It plays an important role in plant tolerance to various stress conditions such as cold, hot temperature, drought, pest and disease problems. Besides, it acts as catalyst for many of the enzymatic processes in plants that are necessary for plant growth. It has been reported that most of the K forms are insoluble in nature and has to be converted into soluble forms during plant growth by microbial consortia (Han and Lee, 2006).

MATERIALS AND METHODS:

A field experiment was conducted during the *kharif* season of the year 2021 at Paddy Research Station, Anand Agricultural University, Dabhoi (Gujarat, India). The texture of soil was low in available N (219.68 kg/ha), medium in available P_2O_5 (28.43 kg/ha), available K_2O (183.00 kg/ha) and organic carbon (0.42%) with pH (7.49) and EC (0.39 dS/m). Twelve treatment combinations comprising two spacing *viz.* S_1 (20 × 15 cm) and S_2 (25 × 25 cm), three age of seedling *viz*., A_1 (15 days old seedling), A_2 (25 days old seedling) and A_3 (35 days old seedling) and two Bio NPK consortium *viz*., B_1 (with Bio NPK consortium) and B_2 (without Bio NPK consortium), tested in split plot design in which spacing main plot treatment and age of seedling and Bio NPK consortium in sub plot treatment was replicated thrice.

The seedlings were raised in the nursery. The beds having 10-meter length and 1-meter width were prepared and given 20 kg FYM, 500 g single super phosphate and 250 g ammonium sulphate and mixed with the soil and beds were leveled perfectly. The seed were sown in the 10 cm apart in line and covered with powder form of FYM. The seeding in the nursery was done on 9th June 2021 for 35 days old seedling, the seeding in the nursery was done on 19th June 2021 for 25 days old seedling and the seeding in the nursery was done on 29th June 2021 for 15 days old seedling. To obtain vigorous healthy seedlings, ammonium sulphate was applied as top dressing @ 250 g/10 m^2. Proper care of nursery beds was taken by frequent watering and weeding in the nursery and plant. After 15, 25, and 35 days old seedlings uprooted and seedling treated with Bio NPK consortium @ 5 mL/L. of water for 15- 20 minutes after transplanted as per treatment. Proper care of was taken by watering, weeding and plant protection measures. Recommended dose of fertilizer 100: 25: 00 kg NPK/ha was applied, in which full dose of P and 40% of N applied at transplanting in the form of Ammonium sulphate, while remaining N applied at imitation stage in equal proportion to respective treatment single seedling along with soil as transplanted per hill. Irrigation, plant protection and weeding are done as per requirement. The crop was harvested at physiological maturity stage.

RESULT AND DISSCUSION:

Growth attributes

Effect of spacing

Results shown under Table 1 revealed that the plant population recorded at 20 DATP and at harvest was found significant and the highest plant population recorded in the treatment

S_1 (20 × 15 cm) at 20 DATP and at harvest. This might be due to the closer spacing which increased plant population per unit area, the similar views were also expressed by Baloch (2002). The plant height found non-significant at 60, 90 DATP and at harvest.

Table 1: Effect of different treatments on growth parameters of rice crop

Treatments	Plant population/net		Plant height (cm)			
	At 20 DATP	At harvest	At 30 DATP	At 60 DATP	At 90 DATP	At harvest
A. Main Plot (Spacing) (S)						
S_1 : 20 × 15 cm	394.33	393.00	67.72	98.39	111.38	121.69
S_2 : 25 × 25 cm	158.50	157.61	64.80	88.72	101.52	108.20
S. Em. ±	5.15	4.92	1.45	1.59	1.42	1.99
C. D. at 5%	31.31	29.95	NS	NS	NS	NS
C. V.%	7.90	7.59	9.29	7.19	5.65	7.35
B. Sub Plot (Age of seedling and Bio NPK consortium combination)						
A : Age of seedling (A)						
A_1 : 15 Days	276.42	275.42	64.12	95.67	108.66	118.93
A_2 : 25 Days	276.50	275.33	67.28	94.83	107.65	116.89
A_3 : 35 Days	276.33	275.17	67.28	90.17	103.03	109.03
S. Em. ±	4.04	4.46	1.37	1.44	1.59	2.23
C. D. at 5%	NS	NS	NS	4.25	4.70	6.58
B : Bio NPK consortium (B)						
B_1 : With Bio NPK	276.72	275.56	66.33	94.22	107.16	116.32
B_2 : Without Bio NPK	276.11	275.06	66.18	92.89	105.74	113.57
S. Em. ±	3.30	3.64	1.12	1.18	1.30	1.82
C. D. at 5%	NS	NS	NS	NS	NS	NS
Interactions	NS	NS	NS	NS	NS	NS
C. V.%	5.06	5.61	7.18	5.33	5.18	6.73

Effect of age of seedling

The data on plant population recorded at 20 DATP and at harvest as well as plant height recorded 30 DATP were found non significant due to different age of seedling. While plant height recorded at 60, 90 DATP and at harvest found significant and treatment A_1 (15 days old seedling) recorded significantly higher plant height of 95.67 cm, 108.66 cm and 118.93 cm respectively and it was remain at par with treatment A_2 (25 days old seedling).

Effect of Bio NPK consortium

No any significant differences observed in plant population at 20 DATP and at harvest as well as plant height recorded at 30, 60, 90 DATP and at harvest due to application of Bio NPK consortium.

Interaction effect

Interaction effect among spacing, age of seedling and Bio NPK consortium were found non-significant with respect to plant population at 20 DATP and at harvest and plant height recorded at 30, 60, 90 DATP and at harvest.

Yield attributes and yields of rice crop

Effect of spacing

Yield attributes and yield *viz.* number of tillers, number of panicles, panicle length, panicle weight, number of grains/panicles, days to maturity recorded significantly higher value under wider spacing S_2 (25 × 25 cm) than closer spacing S_1 (20 × 15 cm). Transplanting at 25 × 25 cm spacing recorded significantly higher grain yield (5477 kg/ha) and straw yield (8957) as compared to S_1 (20 × 15 cm). This might be due to the wider spacing that improved aeration in *rhizosphere* and enhanced microbial activity under field condition which might enabled the plants to utilize the inputs efficiently, thereby encouraging the plants development and production ability consequently leading to gain yield and also due to the optimum level of plant population coupled with better yield parameters might have resulted in higher grain yield. These results are in accordance with those reported by Krishna *et al*. (2008) and Veeramani (2010).

Effect of age of seedling

Yield attributes and yield of rice were found significant due to age of seedling and significantly higher value obtained under the treatment of 15 days old seedling transplanted, while maximum grain yield (5200 kg/ha) and straw yield (8928 kg/ha) were also produced under the same age of seedling treatment and remained at par with treatment A_2 (25 days old seedling) for almost all yield attributing parameters. This might be due to younger seedlings absorbed sufficient nutrients for vegetative growth and reproductive phase, which ultimately leads to increase in plant height and yield attributes there by increased straw yield. Another reason might be due to vigorous and healthy growth of plants which produced more productive tillers and stronger root system, which increased greater resource utilization. The similar result was also reported by Manjapa and Kelaginamani (2006).

Table 2: Effect of different treatments on yield attributes and yield of rice crop

Treatments	Tillers/m^2	Panicle/m^2	Panicle	Panicle	Grains	Days to	Yield kg/ha

			length (cm)	weight (g)	/panicle	Maturity	Grain	Straw
Main Plot (Spacing) (S)								
S_1 : 20 × 15 cm	303.94	239.94	24.14	5.60	182.89	130.78	4439	7750
S_2 : 25 × 25 cm	335.06	272.72	27.83	7.01	207.89	137.72	5477	8957
S. Em. ±	4.80	4.95	0.51	0.16	4.08	1.93	101.59	196.78
C. D. at 5%	29.19	30.13	3.09	0.99	24.85	NS	618.24	1197.46
C. V.%	6.37	8.19	8.29	10.92	8.87	6.50	8.69	9.99
B. Sub Plot (Age of seedling and Bio NPK consortium combination)								
A. Age of seedling (A)								
A_1 : 15 Days	332.08	267.92	26.67	6.54	201.00	129.83	5200	8928
A_2 : 25 Days	323.67	261.75	26.12	6.43	197.42	134.67	5080	8194
A_3 : 35 Days	302.75	239.33	25.18	5.94	187.75	138.25	4593	7939
S. Em. ±	4.45	3.47	0.51	0.14	3.37	1.76	97.89	207.09
C. D. at 5%	13.14	10.24	NS	0.41	9.95	5.20	288.77	610.93
B. Bio NPK consortium (B)								
B_1 : With Bio NPK	324.56	261.83	26.35	6.34	197.94	134.06	5063	8414
B_2 : Without Bio NPK	314.44	250.83	25.62	6.27	192.83	134.44	4852	8293
S. Em. ±	3.64	2.83	0.42	0.11	2.75	1.44	79.93	169.09
C. D. at 5%	NS	8.36	NS	NS	NS	NS	NS	NS
Interactions	NS	NS	NS	NS	NS	NS	NS	NS
C. V.%	4.83	4.69	6.86	7.57	5.98	4.55	6.84	8.59

Effect of Bio NPK Consortium

Yield attributing characters *viz*, number of tillers/m^2, length of panicle, panicle weight, number of grains/panicle, days to maturity and yield parameters *viz.*, grain and straw yield, found non- significant due to due to application of Bio NPK consortium. While, number of panicle/m^2 was found significant due to application of with respect to Bio NPK consortium and application of Bio NPK consortium recorded higher number of panicle/m^2 (261.83/m^2).

Interaction effect

Interaction effect among spacing, age of seedling and Bio NPK consortium found non-significant for yield attributes *viz.* number of tillers/m^2, length of panicle, panicle weight, number of grains/panicle, days to maturity and yield parameters *viz.*, grain and straw yield.

Conclusion

It can be concluded that for getting higher grain and straw yield of the rice, crop can be transplanted keeping the distance of 25 × 25 cm by using 15 to 25 days old seedling. Seedling treated with Bio NPK consortium was not effective.

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