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Effect of Spacing and Number of Seedling Hill^{-1} on Grain Yield and other Agronomic Traits of Hybrid Rice (U.S. 312) on Late Transplantation

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Abstract

The experiment was carried out at the Agronomy Field of Institute of Agriculture and Animal Science (IAAS), Lamjung during kharif season of 2017 to find out the effect of spacing and number of seedlings hill^{-1} on the performance of old aged seedling of Hybrid rice (U.S. 312). The land was moderately fertile with clay loam soil type with pH 5.7. Two factors were used a) Spacing of transplanting b) Seedling number hill^{-1}. Spacing of transplanting used was 15cm x 15cm (S1), 15 cm x 20 cm (S2), 20cm x 20cm (S3) and seedling number per hill were single seedling per hill, double seedling hill^{-1} and triple seedling hill-1. The experiment was laid in two factorial randomized complete block design (RCBD) with three replications. Effect of Spacing and seedlings number hill^{-1} was significant for most of the parameters except plant height, panicle length, straw yield and harvest index. Results revealed that maximum grain yield (3.40 t/ha) with mean harvest index 0.31 was found in 20cm x 20cm spacing. Similar results were obtained in case of effective tillers (8.55), filled grain/ panicle (89.42), Spikelet fertility (81.29%) and panicle length (26.04), where 20cm x 20cm spacing recorded the higher value compared to others. In case of Seedling number hill^{-1}, Grain yield was found similar in all seedling number hill^{-1} but other parameters like effective tillers (9.12), filled grain/ panicle (87.57), Spikelet fertility (79.01%) and panicle length (26.65) were found statistically superior in triple seedling hill^{-1}. The interaction between spacing and seedling numbers/ hill was found non-significant for all the parameters used in the research. 20cm x 20cm spacing with triple seedlings/hill was found superior in majority of parameters used. However, the results need to be confirmed for different aged seedlings used by farmers in Nepal.

Keywords: Hybrid rice; Seedling number hill^{-1}; Spacing

Introduction

Rice is a staple food crop belonging to Family Graminae & genus *Oryzae linn* (Grist, 1986). It is grown in 114 countries across the world in around 150 million ha (11% of the world's cultivated land), producing 575 million ton with an average productivity of 3.83mt/ha [1]. In Nepal, it is cultivated in 1.36-hectare area with production of 4.29 million metric ton and productivity is 3.154 ton/ha in year 2015/16 [2] which is significantly higher compared to last few decades. The same report of MOAD shows that 69.92% of total cultivated land of Nepal is irrigated and remaining 30.08% of land is rainfed in case of rice cultivation. About 49% rice cultivation of mountain and and 40% rice cultivation of hilly region of Nepal is rainfed respectively. Rainfed Farming system of Nepal is dependent on monsoon rain from Bay of Bengal. Due to irregular and scattered monsoon and disturbance in delivery of irrigation water by mountainous terrain, it is difficult to forecast upcoming drought in rice field in Nepalese context which force farmers to plant old aged seedling of hybrid rice.

Age of seedling at transplanting is an important factor for uniform stand of rice [3] as it primarily contributes to the number of tillers produced per hill. Higher the tillering higher will be the yield of rice. When seedlings stay for a longer period of time in the nursery beds, primary tiller buds on the lower nodes of the main culm become degenerated leading to reduced tiller production [4]. 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 [5]. 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 [4].

Plant spacing and Number of seedling hill^{-1} is another important factor which can play an important role in the boosting yield of rice. Many studies reveal that closer spacing may cause mutual shading, lodging, insect pest infestation due to more intra-specific competition [6,7]. Optimum plant density ensures the plant to grow properly by utilizing more solar radiation and soil nutrients [8]. Also, Number of seedling hill^{-1} influences the

tiller formation, solar radiation interception, nutrient uptake, rate of photosynthesis and other physiological phenomena which ultimately affect the growth and development of rice plant [9]. The lesser number of seedlings hill^{-1} may cause insufficient tiller number, thus keeping space and nutrients underutilized and total number of panicles unit^{-1} area may be reduced resulting in poor gain yield.

Besides this, spatial arrangement of seedling per hill helps to cut down excess seed requirement and helps farmer to plan farming activities effectively. It is, therefore, necessary to determine the suitable number of seedlings hill^{-1} for obtaining higher yield from a hybrid rice variety so, the present study was done to evaluate performance of old aged seedling of hybrid rice under different spacing and seedling number per hill.

Materials and method

Table 1: Effect of spacing and number of seedling/ hill on plant height, panicle length and flag leaf area of rice during kharif season, 2017.

Treatment	Plant height (cm)	Panicle length (cm)	Flag leaf Area(cm^2)
Factor A: Spacing			
15 x 15cm	98.07	24.96b	40.85
15 x 20cm	101.36	26.12a	45.87
20 x 20cm	98.9	26.04a	42.17
F test (at 5%)	NS	*	NS
LSD	5.89	0.86	6.12
Factor B: Seedling/ hill			
Single seedling/ hill	97.93	25.21b	41.69
Double seedling/ hill	99.75	25.26b	44.97
Triple seedling/ hill	100.64	26.65a	42.23
F test (at 5%)	NS	**	NS
LSD	5.89	0.86	6.12
CV%	5.98	3.38	14.4
Grand Mean	99.44	25.71	42.96

In a column figures with same letter or without letter do not differ significantly, whereas figures with dissimilar letters differ significantly (as per DMRT).

(Table 1) The experiment was carried out in agronomy field of Lamjung campus during kharif season of 2017. The land was moderately fertile with clay loam soil type with 5.7pH. 40 days old seedlings of Hybrid rice U.S. 312 was used in experiment. Two factorial experiments were conducted one being Spacing of transplanting and other Seedling number per hill. Spacing of transplanting used was 15cm x 15cm (S1), 15 cm x 20cm (S2), 20cm x 20cm (S3) and seedling number per hill were single seedling per hill, double seedling per hill and triple seedling per hill. The experiment was laid in two factorial randomized complete block design (RCBD) with three replications. The unit plot size was 6m^2 with different plant density per plot i.e. 150, 195 and 260 hills for 15cm x 15cm (S1), 15cm x 20cm (S2), and 20cm x 20cm (S3) spacing plot. Seedling were transplanted accordingly, and gap filling was done after a weeks. Three weeding was done at 30DAT, 45 DAT and 60 DAT after transplanting. All other operations were carried out properly and DATA was taken at 30 DAT, 60 DAT, 90 DAT and at the time of harvesting. Grain yield was adjusted to 14% moisture content and converted to t/hec. The DATA was analyzed using R-studio and MS-Excel.

Results

Growth Character

Plant height shows non-significant relation to spacing, number of seedling/hill and their interaction. However, tallest plant height was that of 15 x 20 cm (101.36 cm) whereas 15 x 15 cm has lowest plant height (98.07cm). In case of number of seedling transplanted, planting 3 seedling /hill gives maximum height followed by double seedling /hill and single seedling/ hill. Similar results were observed in case of Flag leaf area where non-significant relation to spacing, number of seedling/hill and their interaction was observed. But, the highest panicle length was measured in case of 15 x 20cm spacing (26.12cm) which is statistically similar with 20 x 20cm (26.04cm). 15 x 15cm spacing has lowest panicle length (24.96cm) and found statistically inferior than other spacing. In case of seedling number, Panicle length was found longest in triple seedling/ hill (26.65cm). Single seedling/ hill have shortest panicle length (25.21cm) which is found statistically similar with double seedling/ hill (25.26cm). Similar results was observed by [10-14].

Yield and Yield attributing characters

In Table 2 all the parameters taken shows non-significant relationship to interaction of spacing and seedling number. Spacing and Seedling number had significant effect on total tillers, effective tillers, filled grain and Fertility percentage. Total tillers and effective tillers were observed significantly higher at 20 x 20cm spacing and lower at 15 x 15cm spacing. Also, they were observed significantly higher in triple seedling/ hill whereas lower value was observed in single seedling/ hill. Similar results was obtained by Rashid and [15-18] where there was an

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increased in total tillers with increasing spacing. The number of filled grains was observed highest in 20 x 20cm spacing with mean value 89.4. In case of seedling/ hill, highest filled grains per panicle was observed in triple seedling/ hill (87.57) which is statistically superior than single seedling/ hill (77.11). This result showed that the spikelet fertility% was highest in 20 x 20cm spacing (81.29) which is statistically superior than others two spacing. In case of seedling/ hill, higher fertility% was observed in triple seedling/ hill (79.01%) which is statistically superior to single seedling/ hill (72.70%).

Table 2: Effect of Spacing and Seedling number on Yield and Yield attributing characters of rice during kharif season, 2017.

Treatment	Total tillers	Effective tillers	Total filled grains	Spikelets Fertility %	Biological Yield (t/ha)	Grain Yield (t/ha)	Straw Yield (t/ha)	Harvest IndexI
Factor A: Spacing								
15 x 15cm	7.11b	6.19b	77.75b	71.59b	13.46ab	2.90b	10.55	0.318
15 x 20cm	8.62a	7.80a	80.44b	74.99b	12.36b	3.008ab	9.35	0.33
20 x 20cm	9.37a	8.55a	89.42a	81.29 a	14.10a	3.40a	10.7	0.315
F test (at 5%)	**	**	**	***	*	*	**NS**	**NS**
LSD	1.34	1.3	6.89	3.51	1.3	0.4	1	0.041
Factor B: Seedling/ hill								
Single seedling/ hill	7.20b	6.53b	77.11b	79.01a	12.79	2.96 a	9.83	0.311
Double seedling/ hill	8.78a	7.72ab	82.93ab	76.15ab	13.49	3.11a	10.38	0.338
Triple seedling/ hill	9.12a	8.28a	87.57a	79.01a	13.63	3.23a	10.39	0.317
F test (at 5%)	*	*	*	**	**NS**	**NS**	**NS**	**NS**
LSD	1.34	1.3	6.89	3.51	1.3	0.4	1.39	0.041
CV%	16.25	17.57	8.43	4.67	9.86	13.2	13.81	13.04
Grand Mean	8.37	7.51	82.54	7 5.95	13.31	3.1	10.2	0.32

In a column figures with same letter or without letter do not differ significantly, whereas figures with dissimilar letters differ significantly (as per DMRT).

Biological yield showed significant difference with in spacing and is non-significant to number of seedling/ hill. Biological yield was observed 14.10ton/ha in 20 x 20cm spacing which was statistically superior to 15 x 15cm spacing (13.46). Similar was the case for grain yield where the grain yield was found statistically different among various spacing and was independent to number of seedling/ hill. It was observed higher at 20 x 20cm spacing (3.40t/ha). This is in conformity with earlier observations of [19]. where rice transplanted at 30cm x 30cm spacing yielded significantly higher grains than those transplanted at 10cm x 10cm spacing and 20cm x 20cm spacing respectively. Straw yield and harvest index was found statistically similar for different spacing and seedling number.

Discussion

Different spacing and seedling number had great role in growth and yield characters of rice. Most of the parameters were found superior (whether statistically or arithmetic mean) in case of 20x20cm spacing. As the ground area per hills was greater in 20x20cm compared to 15x15cm and 15x20cm spacing, Plants will have more nutrient use efficiency, light penetration, moisture and space for better crop establishment. There will be less competition between plants as they are spaced apart. More spacing favors larger leaf area too, which increases net photosynthetic assimilates and helps for vigorous growth of plant. Similarly, in case of seedling number per hills, Triple seedlings per hill were found superior in most of the parameters used for research. This might be due to the easier establishment of seedlings after transplanting because they suffer less root damage during uprooting, with minimum transplanting shock and mortality rate. As the more number of seedlings is used at the time of transplanting, the trauma of root damage will be less and Seedling mortality will also be less as three seedlings jointly contribute to recover seedling from transplanting shock.

When we observe the grain yield in case of late transplanted rice, the overall mean yield was found very low (3.1 t/hec). This value of yield obtained in the research seems very low as compared yield of rice at normal transplantation or productivity of U.S 312 at research trail. In our research, we have used 40 days old seedling of rice and transplanted by topping upper one third part of seedling in order to prevent lodging problem. This has created stress in plant which has lengthened the phyllocron interval and ultimately reduced tillering capacity of rice. Besides this, as seedling stays for greater times in nursery bed, its primary bud degenerates delaying time of primary tillers initiation and reduces the grain yield which was further reinforced in different spacing and seedling number.

Conclusion

As age of seedling at the time of transplanting plays great role in determing yield of rice, it is better not to transplant old aged seedling of hybrid rice (U.S. 312) by the farmers. In extreme case, it is suggested to plant old aged seedling at spacing 20x20cm spacing and triple seedling per hills.

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