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Yield and Yield Parameter of Rice as Influenced by Age of Seedling and Spacing

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Abstract: ***A field experiment was conducted at National Rice Research Program, Hardinath, Dhanusha to evaluate the effect of age of seedling and spacing on yield and yield components of rice during rainy seasons of 2015 and 2016. The experiment was arranged in a split plot design with four replications. Age of seedlings at four levels (21, 28, 35 and 42 days old) and planting space at three levels (15 cm x 15 cm, 20 cm x 20 cm and 25 cm x 25 cm) were evaluated as main plot and sub plot factors, respectively. Observations on yield and yield contributing parameters were recorded. Results showed that the effect of seedling age was significant for days to heading, grain yield and most of the yield contributing parameters. The effect of plant spacing was also significant for number of effective tillers/m^2 and grain yield. The interaction effect of seedling age and planting space was found significant for most of yield and yield attributing traits. The highest grain yield (5.26 t/ha) was recorded in 21 days old seedlings with 20 cm x 20 cm spacing.***

Keywords: Seedling age, spacing, yield, yield parameters

1. Introduction

Rice is the principle food crop of Nepal and it has great contribution (~22%) in national agricultural growth domestic product [1]. In Nepal, the rice covers about 13,62,908 and 1, 10,000 ha area in normal and sprig season, respectively. At present, the spring rice cultivation sizes up as only 10-12 percent of the total rice production in a year. The average productivity of rice in Nepal is 3.35 t/ha [2] which is very low as compared to our neighboring countries. There is less possibility of bringing more lands under production. Therefore, we have to increase the productivity per hectare per year by knowledge- and science-based farming.

Currently, total irrigated area is 51% of total cultivated land and it's in increasing trend [1]. Recently, Nepal Agricultural Research Council has released an early maturing short duration rice variety, Chaite-5. However, the farmers have not been achieving the potential yield of the variety [3]. The reason for low yield is mainly associated with crop management technologies. Among cultural technologies, use of best planting space, planting of healthy and optimum age seedlings are considered as the important ones. Farmers of Nepal especially Terai (plain area) are suffering with climatic stresses of erratic nature of the monsoon rainfall patter and climatic stress events and they are compelled to do late planting of rice due to drought or flood [4, 5, 6, 7]. Delaying transplantation can detrimentally impact rice growth and grain yield formation, mainly due to poor tiller occurrence, shortened vegetative duration, and decreased dry matter accumulation [8].

It has been established that planting density plays an important role in improving population structure, promoting the efficient use of sunlight and regulating rice tiller occurrence and grain yield formation [9, 10, 11, 12, 13]. If the age of seedlings is more than optimum, the seedlings produce less number of effective tillers due to reduce vegetative period and thereby results in poor yield. There is little information available with regards to optimal seedling age and planting density for recently released rice variety, Chaite-5.

Thus, the present research could provide a reference for guiding the management of rice cultivation for maximization of yield. The objective of this research was to find out the optimum seedling age and planting density for realizing high grain yield of rice.

2. Materials and Methods

Experimental site

Field experiments were carried out at the research block of National Rice Research Program, Dhanusha, Nepal in 2015 and 2016 rainy seasons. The experimental site is located at the latitude of 26^{o}49' E and longitude of 86^{o}01' N with an altitude of 93 m from mean sea level. Agro-ecologically, the area falls under sub-tropical region. The climate is warm and moist having hot and humid summer and mild winter.

Experimental design and treatments

The experiment was laid out in a split design with three replications. The recently released rice variety, Chaite-5, was used in the experiment. The plot size was 12 m^2. Seedling age at four levels (21, 28, 35 and 42 days old) as main plot factor and plant spacing at three levels (15 cm x 15 cm, 20 cm x 20 cm and 25 cm x 25 cm) as sub plot factor was included as treatments for the experimentation.

Recommended crop management practices were followed to raise a healthy crop. Fertilizers were applied @ 100:30:30 N:P_2O_5:K_2O kg/ha. Half dose of the N, full dose of P_2O_5 and K_2O was applied as a basal application. Remaining N was splitted into two equal parts and applied as a top dress. Observations on plant height, days to heading, no. of effective tillers/m2, number of filled grains/panicle, sterility

percentage, 1000-grains weight and grain yield were recorded for assessing treatment effects.

Statistical Analysis

Data were subjected to analysis of variance using CropStat V.07 [14]. Means were separated using Least Significant Difference (LSD) test at $P \leq 0.05$.

3. Results and Discussion

Effect of seedling age

Mean data for growth, yield and yield contributing parameters as influenced by seedling age are presented in Table 1. The effect of seedling age was found significant for days to heading, grain yield and most of the yield contributing parameters except panicle length and 1000-grains weight (Table 1). The earliest heading was recorded with 42 days old seedlings while the highest values of plant height (108.3 cm), number of effective tillers/m^2 (320) and grain yield (5.32 t/ha) were obtained in seedling age at 21 days. However, it was at par with 28 days old seedlings (Table 1). Our results are in agreement with the findings of previous research findings [15, 16, 17, 18]. The physiological limitation of aged seedlings produced limited effective tillers/hill [19].

Effect of planting space

The effect of plant spacing was significant only for number of effective tillers/m^2 and grain yield (Table 1). The highest number of effective tillers/m^2 (316) and grain yield (4.52 t/ha) were obtained in 20 cm x 20 cm planting space. Decline in tiller number with closer spacing and grain yield with closer spacing was reported by various researchers [20, 21, 22)

Table 1: Mean data for various agronomic traits of rice (Var: Chaite-5) as influenced by seedling age and spacing

Treatment		DH	Pht	ET	PL	FGP	TGW	GY
Seedling age	21 days	93^{a*}	108.3^{a}	320^{a}	26.2^{a}	345^{a}	18.4^{a}	5.32^{a}
	28 days	90^{a}	106.1^{a}	314^{a}	24.5^{a}	342^{a}	17.9^{a}	4.98^{a}
	35 days	85^{b}	102.6^{b}	285^{b}	23.1^{a}	287^{b}	16.9^{a}	4.14^{b}
	42 days	80^{c}	102.2^{b}	262^{c}	21.6^{a}	267^{c}	17.4^{a}	3.24^{c}
Plant spacing	15 cm x 15 cm	92^{a}	105.3^{a}	301^{b}	23.5^{a}	338^{a}	18.6^{a}	4.27^{a}
	20 cm x 20 cm	94^{a}	107.6^{a}	316^{a}	24.7^{a}	349^{a}	19.1^{a}	4.52^{a}
	25 cm x 25 cm	92^{a}	109.4^{a}	293^{c}	25.8^{a}	325^{b}	18.3^{a}	3.95^{b}

Note: DH = days to heading, pht = plant height (cm), ET = number of effective tillers/m2, PL = panicle length (cm), FGP = number of filled grains/panicle, TGW = thousand grains weight (g) and GY = grain yield (t/ha).
*Means followed by the same letter within a column for each factors are not significantly different at $p \leq 0.05$ by DMRT.

Interaction Effect of seedling age and planting space

The interaction effect of seedling age and planting space was found significant for most of yield and yield attributing traits. The highest grain yield (5.26 t/ha) was recorded in 21 days old seedlings with 20 cm x 20 cm spacing. The least grain yield (3.15 t/ha) was found in 42 days old seedlings with 25 cm x 25 cm planting space (Table 2).

Table 2: Mean data for various agronomic traits of rice (Var: Chaite-5) as influenced by interaction effects of seedling age and spacing

Seedling age	Spacing	DH	Pht	ET	PL	FGP	TGW	GY
21 days	15 cm x 15 cm	91^{a}	107.5^{a}	321^{b}	27.1^{a}	321^{a}	19.2^{a}	4.42^{b}
	20 cm x 20 cm	92^{a}	108.3^{a}	352^{a}	26.3^{a}	318^{a}	18.2^{a}	5.26^{a}
	25 cm x 25 cm	91^{a}	108.7^{a}	344^{b}	24.8^{b}	313^{a}	17.9^{a}	4.28^{b}
28 days	15 cm x 15 cm	91^{a}	107.8^{a}	338^{b}	25.7^{a}	316^{a}	18.4^{a}	4.72^{b}
	20 cm x 20 cm	89^{a}	106.3^{a}	342^{b}	24.5^{a}	315^{a}	17.5^{a}	4.87^{a}
	25 cm x 25 cm	88^{b}	107.5^{a}	339^{b}	24.3^{a}	309^{b}	18.3^{a}	4.37^{b}
35 days	15 cm x 15 cm	90^{b}	104.4^{b}	256^{d}	23.5^{a}	318^{a}	17.9^{a}	4.22^{c}
	20 cm x 20 cm	84^{c}	105.2^{b}	294^{c}	22.19^{b}	316^{a}	17.4^{a}	4.18^{c}
	25 cm x 25 cm	83^{c}	105.7^{b}	276^{c}	24.31^{b}	310^{b}	16.5^{a}	4.14^{c}
42 days	15 cm x 15 cm	81^{d}	103.2^{c}	263^{d}	23.6^{b}	318^{a}	17.7^{a}	3.26^{d}
	20 cm x 20 cm	80^{d}	103.6^{c}	291^{c}	23.12^{b}	322^{a}	17.6^{a}	3.21^{d}
	25 cm x 25 cm	80	105.3^{c}	288^{c}	21.3^{b}	313^{a}	16.5^{a}	3.15^{d}

Note: DH = days to heading, pht = plant height (cm), ET = number of effective tillers/m2, PL = panicle length (cm), FGP = number of filled grains/panicle, TGW = thousand grains weight (g) and GY = grain yield (t/ha).
*Means followed by the same letter within a column are not significantly different at $p \leq 0.05$ by DMRT.

4. Conclusion

The results of the current study reflected that an increase in tiller number through enhanced cultivation density regardless of seedling age. The results also revealed that an enhancement in cultivation density exerts a positive role in minimizing the reduction of rice tiller number incurred by delaying transplantation.

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