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Effect of Different Date of Sowing and Nitrogen Level on Production of Direct Seeded Rice

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Abstract: A field experiment to evaluate the growth, yield and yield attributing components of direct seeded rice was conducted under different date of sowing and nitrogen level at Dang, Nepal during rainy season from June to September, 2017. The experiment was laid out in to Randomized Complete Block Design with three replication consisting three date of sowing (5th June, 20th June and 5th July) and four level Nitrogen (0 kg N ha^{-1}, 80 kg N ha^{-1}, 100 kg N ha^{-1} and 120 kg N ha^{-1}). The results revealed that the 20th June sowing date recorded the highest plant height (112.2 cm) at the time of harvesting, effective tiller m^{-2} (225.0), longest panicle length (27.4 cm), grain yield (3.3 t ha^{-1}) and straw yield (5.0 t ha^{-1}). The sowing date 5th June recorded the highest sterile grain panicle^{-1}. Whereas filled grain panicle^{-1}, thousand grain weight were non-significant with different date of sowing. Regarding the nitrogen level, 120 kg N ha^{-1} recorded the highest plant height (112.4 cm) at the time of harvesting, effective tillers m^{-2} (254.9), filled grain panicle^{-1} (121.5), grain yield (3.2 t ha^{-1}) and straw yield (5.3 t ha^{-1}). Whereas the thousand grain weight and harvest index were not affected by the different level of Nitrogen. The interaction between the sowing date and nitrogen level showed the significant effect on grain yield and harvest index whereas other parameters showed non-significant relation. The 20th June with 120 kg N ha^{-1} recorded the highest grain yield (4.5 t ha^{-1}) and harvest index (41.5%).

Keywords: DSR, Sowing Date, N Level

1. Introduction

Rice (*Oryza sativa L.*) is an important staple food crop of about 60% of world population and account for 20% calorie consumed worldwide [1]. It is also an important food crops in Nepalese agriculture, it is grown in about 1.5 million ha of land with the production of 5.2 million tons with 3.36 t ha^{-1} productivity [2]. The average annual rice consumption per person in Nepal is 92.8 kg coarse rice and 38.5 kg fine rice.

Direct seed rice (DSR) is labor and water efficient [3], climate smart [4] technology for the rice production. It is economical as compared to transplanted rice and also matures early than transplanted rice. The sowing date plays vital role for the growth and improvement of yield and yield attributing character and weed population on the rice field [5]. The appropriate sowing time of the rice crop ensures the appropriate level of temperature and solar radiation during vegetative growth phase and grain filling period hence good grain quality is achieved [6]. The early and delay in sowing results poor emergence results less number of effective tiller m^{-2}, less number of grain per panicle as a result less grain yield [7]. Thus optimum date of sowing is necessary to achieve good plant stand and yield.

Nitrogen is one of the most important and yield-limiting nutrient in rice production. It play vital role in plant growth, biomass production and photosynthesis. Increasing in number of effective tiller per unit area is the main factor of yield increment as a result of nitrogen application [8]. The efficient fertilizer management can increase crop yield and reduce production cost. Excess amount of nitrogen fertilizer results in lodging of plant, prolonging growing period, delaying maturity and reducing yield [9]. Non-judicious application of nitrogen fertilizer not only increases production cost but also reduces the quality of the product.

So, it is necessary to use the proper amount of nitrogen fertilizer for efficient management and better yield of rice. Nutrient management practices play important role in the rice production. Fertilizer application doses, method and timing heavily affect the fertilizer utility by crop as well as the production [10].

2. Materials and Methodology

This experiment was conducted at Agronomy farm of Prithu Technical College, Lamahi Dang district during June to September 2017 to study the effect of date of sowing and different nitrogen level on production of direct seeded rice. Geographically, it is located at 27°99' N latitude and 82°30' E longitude. The average maximum and minimum temperature during cropping season were 31.32°C and 23.32°C respectively and the total rainfall was 2150.2 mm during rice growing period (June to September 2017). The experimental site was silty loam with pH 6.6, soil organic matter 1.46%, available N, P, K were 0.1%, 45 kg ha^{-1}, and 190.8 kg ha^{-1} respectively.

The experiment was laid out in randomized complete block design (RCBD) with three different date of sowing (June 5th, June 20th and July 5th) and four different level of nitrogen dose (0 kg N ha^{-1}, 80 kg N ha^{-1}, 100 kg N ha^{-1} and 120 kg N ha^{-1}) was replicated thrice. Each replication consists of 12 plots and the unit plot was 9 m^2 (3 m × 3 m). The individual plots and replications were separated by 0.5 m. The other fertilizer P and K were applied at the rate of 60:40 kg ha^{-1}. The N, P and K were applied from urea (46%N), DAP (18% N and 46% P_2O_5) and MOP (60% K_2O). Half dose of Nitrogen and full dose of P and K were applied at the time of sowing as basal dose and remaining N was applied in two split dose at 45 DAS and 60 DAS. Seed was sown manually in line maintaining 20 cm R-R and continuous in plan to plant. Gap filling and thinning was done in 7 DAS and 15 DAS to maintain the optimum plant population. Manual weeding was done to manage the weed in field, 1st weeding was done 25 DAS and 2nd weeding at 45 DAS.

Before harvesting plant height was recorded. For plant height, ten hills were selected from the 5th and 10th row of each plot and tagged it for taking plant height. Plant height was determined by measuring the distance from the soil surface to the tip of the panicle. The mean height of ten plants is expressed as plant height of each plot. Similarly, different yield and yield attributing characters like number of effective tillers m-2, panicle length, number of grains per panicle, thousand grain weight (g), grain yield and straw yield were recorded from unit plot. The grains and straws are sun dried and converted to t ha^{-1} with 14% moisture content of grains. The biological yield and harvest index were calculated by using the following formula.

Biological yield = Grain yield + Straw yield

Harvest index = (Grain yield / Biological yield) x 100

Collected data were analyzed statistically using R-program with Agricola. Least significant difference (LSD) and Duncan multiple Range Test (DMRT), as mean separation technique was applied to identify the most efficient treatment [11].

3. Result and Discussion

3.1. Effect of Different Date of Sowing on the Plant Height, Yield and Yield Attributing Characters of Direct Seeded Rice

The plant height at the time of harvesting significantly affected by the date of sowing. The direct seeded rice (DSR) sown on 20th June recorded the maximum plant height (112.2 cm) and the lowest plant height was recorded in the crop sown on 5th July (96.9 cm) (Table 1). This finding is also conformity with Khakwani et al (2006) [12], who also reported that the different sowing date significantly affected the plant height. The sowing date also influence the different yield attributing characters like effective tillers m^{-2}, panicle length sterile grain per panicle, straw yield, grain yield and harvest index (Table 1). The highest effective tillers per m^2 was recorded on DSR sown on 20th June (225) which was statistically par with the DSR sown on 5th June (213.1), whereas DSR sown on 5th July (205.3) recorded the lowest number of effective tillers m^{-2}. This result is also in alignment with the findings of Pandey et al (2001) [13] and Bashir et al (2010) [14] who also found the highest number of effective tiller m^{-2} of direct seeded rice sown on 20th June and decreasing trend of effective tiller m^{-2} after on 20th June. Similarly, highest panicle length was recorded in the DSR sown on 20th June, whereas DSR sown on 5th June (23.6 cm) and 5th July (23.4 cm) recorded the statistically similar length of panicle. This finding is also in alignment with the finding of Dawadi and Chaudhary (2013) [15], who also found the highest panicle length of direct seeded rice sown on 2nd and 3rd week of June. Maximum grain yield (3.3 t ha^{-1}) and straw yield (5.0 t ha^{-1}) were found in the direct seeded rice sown on 20th June followed by the 5th June and 5th July. This finding are also in alignment with the findings of Akbar et al (2010) [16] and Dahiya et al (2017) [17], who also found the highest grain yield of direct seeded rice sown on 2nd and 3rd week of June. Similarly, highest number of sterile grain was found in the rice sown on 5th June (24.1) which was statistically similar with the rice sown on 5th July (24.1), whereas rice sown on 20th June (18.3) recorded the lowest number of sterile grain per panicle. Direct seeded rice sown on 20th June recorded the highest harvest index (39.3%) whereas rice sown on 5th June recorded the lowest harvest index (35.7%). The different date of sowing on direct seeded rice did not influence the filled grain per panicle and thousand grain weight. This result also in alignment with the finding of Wani et al (2016) [18], who also reported the no significant effect on the thousand grain weight with respect to the different date of sowing.

3.2. Effect of Different Nitrogen Level on the Plant Height, Yield and Yield Attributing Characters of DSR

Nitrogen level significantly affect the plant height at the

time of harvesting, there is increasing trend of plant height with increase in nitrogen level (Table 1). Maximum height was obtained from the 120 kg ha^{-1} N level (112.4 cm) whereas controlled condition recorded the lowest plant height (93.8 cm). This finding is also in conformity with the finding of Tayefe et al (2014) [19], who also found the increasing trend of plant height with increasing the level of nitrogen. The different level of nitrogen also influence the different yield attributing components like effective tillers m-2, panicle length, field grain per panicle, sterile grain per panicle, grain yield and straw yield (Table 1). The highest effective tillers per m^2 was recorded on 120 kg N ha^{-1} (254.9) followed by 100 kg N ha^{-1} whereas controlled condition recorded the lowest number of effective tillers per m-2. This result is also in alignment with the findings of Buri et al., (2015) [20], who also found the highest increasing trend of number of effective tiller m-2 with increasing the N level up to 150 kg N ha^{-1}. Similarly, highest panicle length was recorded from the 100 kg N ha^{-1} (26.6 cm) which was statistically similar with the panicle length (26.3 cm) produced by 120 kg N ha^{-1}, whereas controlled condition recorded the shortest panicle (21.9 cm). 120 kg N ha^{-1} recorded the highest number of filled grain (121.5) and lowest number of sterile grain per panicle (17.5), which was statistically similar with the 100 kg N ha^{-1}, whereas controlled condition recorded the lowest number of filled grain per panicle (89.4) and highest number of sterile grain per panicle (27.5). This result is also in line with the findings of Abou-Khalifa (2012) [21], who also found the highest number of grains per panicle with highest level nitrogen. Highest grain yield (3.2 t ha^{-1}) and straw yield (5.3 t ha^{-1}) were found in 120 kg N ha^{-1} whereas the controlled condition recorded the lowest grain and straw yield. This result is also in alignment with the findings of Ahmed et al (1998) [22], Naser et al. (2011) [23], Khorshidi et al (2011) [24], who also found the highest grain and straw yield with increasing N level up to 120 kg N ha^{-1}. The different level of N did not influence the thousand grain weight and harvest index. This finding is also in line with the findings of Yadanar et al (2018) [25], who also reported that there is no influence on thousand grain weight with different level of nitrogen.

Table 1. *Effect of Date of Sowing and Nitrogen level on Plant height, yield and yield attributing components of DSR.*

Treatments	Plant height (cm)	Effective Tillers (m^2)	Panicle length (cm)	Filled Grains panicle^{-1}	Sterile grain panicle^{-1}	1000 grain Weight (g)	Grain Yield (t ha^{-1})	Straw Yield (t ha^{-1})	Harvest Index %
Sowing Date (A)									
June 5th	101.3^{b}	213.1^{ab}	23.6^{b}	110.8	24.13a	25.8	2.4^{b}	4.4^{b}	35.7^{c}
June 20th	112.2^{a}	225.0^{a}	27.4^{a}	108.5	18.25b	26.2	3.3^{a}	5.0^{a}	39.3^{a}
July 5th	96.9^{c}	205.3^{b}	23.4^{b}	106.1	24.14a	25.4	1.7^{c}	2.9^{c}	36.5^{b}
LSD	3.6	14	1.42	NS	3.81	NS	0.3	0.2	1.7
Fertilizer Dose (B)									
0:60:40	93.8d	181.4d	21.9^{c}	89.4^{c}	27.5^{a}	24.9	1.6^{c}	2.8^{d}	36.4
80:60:40	101.4c	202.4c	24.4^{b}	107.5^{b}	23.5^{ab}	25.9	2.4^{b}	3.9^{c}	37.8
100:60:40	106.5b	219.0b	26.6^{a}	115.3^{ab}	20.2^{bc}	26.1	2.6^{b}	4.4^{b}	37.2
120:60:40	112.4a	254.9a	26.3^{a}	121.5^{a}	17.5^{c}	26.3	3.2^{a}	5.3^{a}	37.2
LSD	4.2	16.2	1.6	8.5	4.4	NS	0.3	0.3	NS
CV%	4.2	7.7	6.8	7.6	20.3	5.8	14.2	6.8	5.5
Grand mean	103.5	214.4	24.8	108.4	22.2	25.8	2.5	4.1	37.2

Treatments means followed by the same letter (s) within column are non-significantly different among each other at 5% level of significance. '' and '**' indicate statistically different means at 5% and 1% significant level respectively. LSD= Least significant difference and CV= Coefficient of variation*

3.3. Interaction of Effect of Different Date of Sowing and Nitrogen Level on Plant Height, Yield and Yield Attributing Components of DSR

The interaction of different date of sowing and nitrogen level statistically affect the grain yield and harvest index, however it did not affect the plant height, effective tillers m^{-2}, panicle length, filled grain per panicle, sterile grain per panicle, thousand grain weight and straw yield (Table 2). The treatment combination sowing date 20th June with 120 N kg ha^{-1} recorded the maximum grain yield (4.5 t ha^{-1}) and harvest index (41.5%), whereas treatment combination 5th July with controlled N level recorded the lowest grain yield (1.0 t ha^{-1}). regarding the harvest index treatment combination 5th June with 100 kg N recorded the lowest harvest index (33.8%).

Table 2. *Interaction effect of different Date of sowing and Nitrogen level on plant height, yield, yield attributing components of DSR.*

Sowing date	Nitrogen level	PH	ET	PL	FGPP	UFGPP	TGW	GY	SY	HI
June 5th	0:60:40	91.3	175.7	21.8	89.7	20.4	26	1.9^{fg}	3.1	38.0^{bc}
June 5th	80:60:40	97.9	196.7	22.9	113.4	18.6	26.2	2.3^{de}	4.2	35.8^{cd}
June 5th	100:60:40	105.0	220.3	24.4	116.9	15.8	26.1	2.4^{d}	4.7	33.8^{d}
June 5th	120:60:40	111.2	259.7	24.4	123	18.1	16.6	3.0^{c}	5.6	35.1^{cd}
June 20th	0:60:40	100.2	183.3	24.8	89.2	30.5	24.3	2.0^{efg}	3.5	36.1^{cd}
June 20th	80:60:40	110.5	212.7	27.4	105	25	25.4	3.1^{bc}	4.8	40.0^{ab}
June 20th	100:60:40	115.4	233.7	28.2	114.3	23.9	25.7	3.6^{b}	5.4	39.6^{ab}
June 20th	120:60:40	122.8	270.3	29.4	125.3	17.2	26.1	4.5^{a}	6.3	41.5^{a}

Sowing date	Nitrogen level	PH	ET	PL	FGPP	UFGPP	TGW	GY	SY	HI
July 5th	0:60:40	89.8	185.3	19.3	89.3	31.5	24.4	1.0^{h}	1.9	35.2^{cd}
July 5th	80:60:40	95.8	198	22.9	104	27	26.1	1.6^{g}	2.6	37.6^{bc}
July 5th	100:60:40	99.0	203	27.1	114.7	20.9	26.5	1.9^{fg}	3.1	38.2^{abc}
July 5th	120:60:40	103.2	234.7	25	116.3	17.2	26.1	2.1^{def}	3.9	35.1^{cd}
CV		4.8	7.7	6.8	8	20.3	7	10.3	6.8	5.5
LSD		NS	NS	NS	NS	NS	NS	0.4**	NS	3.4*
Mean		103.5	214.4	24.8	108.4	22.2	25.8	2.5	4.1	37.2

Treatments means followed by the same letter (s) within column are non-significantly different among each other at 5% level of significance. '' and '**' indicate statistically different means at 5% and 1% significant level respectively. LSD= Least significant difference and CV= Coefficient of variation PH= plant height, ET= effective tiller m-2, PL= panicle length, FGPP= filled grain panicle-1, UFGPP = Unfilled grain panicle-1, TGW= Thousand grain weight, GY= Grain yield, SY= Straw yield, HI= Harvest index*

4. Conclusion

The different sowing date and nitrogen level in direct seeded rice significantly affect the growth, yield and yield components of rice. The sowing date 20th and 120 kg N ha^{-1} June produced the highest plant height, effective tiller per m^{-2}, panicle length, grain yield, straw yield and harvest index. Similarly, the combination of 20th June with 120 kg N ha^{-1} produced the maximum yield. Thus, sowing date 20th June with 120 kg N ha^{-1} is recommended for the direct seeded rice cultivators however, it requires more investigation.

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