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Study on Growth and Yield of Upland Terrace Rice as Affected by Different Levels of Nitrogen and Spacing in Kiphire District, Nagaland of NE India

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A B S T R A C T

An experiment was conducted at KVK, Kiphire experimental farm during *kharif* season of the year 2018 to assess the influence of different nitrogen levels and spacing on growth and yield of upland terrace rice. The experiment was laid out in RBD and conducted in factorial experiment with three replications. The experiment revealed that application of 90 kg N/ha recorded the highest grain yield (52.55 q/ha) and 20x10 cm spacing recorded the highest grain yield (45.65 q/ha). The treatment interaction effect also resulted in similar trend where application of 90 kg N/ha and 20x10 cm interaction resulted the highest grain yield (52.00 q/ha). The economic analysis revealed that the combination with the application of 90 kg N/ha and 20x10 cm spacing resulted in the highest economic return which recorded a B: C ratio of 3.68.

Introduction

Rice is the staple food for the people of Kiphire, Nagaland and grown mostly in hilly slopes as direct seeded upland rice under rainfed condition. The major crops grown are paddy, maize, potato, kholar and soyabean. The gross cropped area accounts for 48.55 ('000 ha) which is mostly under *Jhum*. The production and productivity of rice was recorded at 14.23 ('000 t) and 17.14 q/ha which is very low for meeting the need of the population. With the increase in population, limited land resources and insufficient rice crop production in Nagaland, it is likely to pose a serious problem of food shortage n the days to come. The main factor leading to low crop production in Kiphire may be due to farmers' adoption of traditional cultivation practices (*Jhum*). There is almost zero

utilization of farm inputs including chemical fertilizers and pesticides and the seed are sown at random without any definite row arrangement. All these unscientific practices ultimately lead to reduce crop yield. Among several agronomic approaches for rice, spacing and fertilizer nitrogen application remains the most important factor affecting the growth and yield of rice. Thus, the present investigation was carried out to standardize the optimum nitrogen levels and spacing for upland rice condition in Kiphire, District, Nagaland.

Materials and Methods

The experiment was carried out in the experimental farm of KVK, Kiphire, ICAR for NEH Region, Nagaland Centre during the *kharif* season during the year 2018. The experimental farm is located at an altitude of 896.42 MSL with humid and hot during summer and cold during winter with winter temperature touching a low of 2.7^0C and a high of 37.0^0C during summer. Monsoon period extends from June to September and sometimes up to October. The average rain fall for the last three years is 876mm. Undulating topography with sandy loam to fine rich humus soil constitutes the main soil condition.

The experiment was laid out in "Randomised Block Design" and conducted in "Factorial Experiment" (2 levels of factors) with three replications. The dose of nitrogen was 30 kg N/ha (N_1), 60 kg N/ha (N_2) and 90 kg N/ha (N_3) with 0 kg N/ha (N_0) as check and was applied through urea. The spacing was at 10x10 cm (S_1), 20x10 cm (S_2) and 30x10 cm (S_3). A uniform recommended dose of P_2O_5 and K_2O was applied as basal. Half dose of nitrogen through urea was applied as basal and the remaining was applied in two equal split dose, one at active tillering and the other at panicle initiation stage.

Results and Discussions

Growth attributes

Plant height (cm)

The higher of plant was significantly increased by application of different levels of nitrogen at 30, 60, 90, 120 DAS and at harvest where the maximum plant height (cm) was recorded at 120 DAS with the application of 90 kg N/ha which was however, found to be *at par* with the application of 60 kg N/ha (Table 1a). A similar finding was also reported by Geethadevi *et al.,* (2000).

The maximum plant height was recorded at harvest which was from 30x10 cm and was found to be *at par* with 20x10 cm. Ninad *et al.,* (2017) also reported similar finding.

The treatment interactions reveals that the maximum plant height was recorded from the combination of 90 kg N/ha with 30x10 cm spacing at all the growth stages which was however, found to be *at par* with 60 kg N/ha and 20x10 cm spacing (Table 1b). This may be due to well-developed roots and less competition for nutrients and moisture among the plants.

Number of effective tillers/hill

The number of effective tillers per hill was significantly increased with increasing the levels of nitrogen.

The data revealed that the maximum number of effective tillers per hill was recorded from the application of 90 kg N/ha (Table 2a).

Similar observation was also reported by Lawal and Lawal (2002) and Shrirame *et al.,* (2000). No significant effect due to spacing was observed on the number of effective tillers/hill.

Yield attributes

Panicle length (cm)

The result revealed that with the application of 90 kg N/ha resulted in the highest panicle length as compared with the rest of the treatments (Table 2a). This finding finds conformity with the finding of Bindra *et al.,* (2000) who reported that application of 90 kg N/ha recorded the highest panicle length (30.7 cm). The highest panicle length was recorded from a spacing of 20x10cm (24.92 cm) which was *at par* with 30x10cm spacing (24.11 cm) (Table 1a). The treatment interaction revealed that the maximum panicle length was recorded at 27.33 cm with the application of 90 kg N/ha and 30x10 cm spacing which was however, found to be *at par* with the application of 60 kg N/ha with 30x10 cm and 90 kg N/ha with the rest of the spacing (Table 2b).

Number of grains per panicle

The treatment effect on the number of grains per panicle revealed that application of 90 kg N/ha recorded the highest number of grains per panicle (167.27) (Table 2a). The maximum number of grains/panicle was recorded with 20x10 cm which was found to be *at par* with 30x10 cm (Table 2a). Similar finding was also reported by Bhowmik *et al.,* (2012).

The treatment interaction effect reveals that application of 90 kg N/ha and 20x10 cm spacing significantly recorded the highest number of grains per panicle (Table 2b).

Test weight (g)

The effect of nitrogen levels was found to significantly affect the test weight which resulted in highest test weight being recorded from the application of 90 kg N/ha (31.67g) (Table 2a).

Similar finding was also reported by Bindra *et al.,* (2000) who reported that application of 90 kg N/ha resulted in the highest test weight of rice. No significant treatment effect was recorded from the spacing on the test weight.

Table.1 (a) Effect of nitrogen levels and spacing on plant height (cm)

Treatments	Days after sowing				
Nitrogen (kg/ha)	**30**	**60**	**90**	**120**	**At harvest**
Control	28.41	92.66	117.84	142.15	142.60
30	28.49	96.64	121.66	145.42	145.91
60	29.00	97.50	126.91	149.67	149.92
90	29.83	102.24	127.08	151.42	151.86
SEm (±)	0.04	1.31	0.92	1.05	0.89
CD (P=0.05)	1.24	3.86	2.71	3.08	2.61
Spacing (cm)					
10x10	28.11	96.30	122.01	146.03	146.53
20x10	29.05	97.72	122.61	147.76	147.98
30x10	29.63	97.75	125.50	147.70	148.20
SEm (±)	0.40	1.14	0.80	0.91	0.77
CD (P=0.05)	1.17	3.35	2.34	NS	NS

Table.1 (b) Interaction effect of nitrogen levels and spacing on plant height (cm)

Treatments	Days after sowing				
	30	60	90	120	At harvest
$N_0S_{(10x10)}$	27.70	89.80	116.86	142.00	142.66
$N_0S_{(20x10)}$	27.75	92.86	117.80	143.73	142.13
$N_0S_{(30x10)}$	28.00	93.73	118.86	144.13	144.00
$N_{30}S_{(10x10)}$	28.38	94.93	119.66	144.73	145.73
$N_{30}S_{(20x10)}$	28.40	95.33	120.40	144.53	147.06
$N_{30}S_{(30x10)}$	28.66	96.60	124.53	146.46	144.93
$N_{60}S_{(10x10)}$	28.79	97.53	124.93	147.00	146.86
$N_{60}S_{(20x10)}$	28.94	98.63	125.33	147.63	150.06
$N_{60}S_{(30x10)}$	29.33	100.96	126.13	149.80	147.83
$N_{90}S_{(10x10)}$	30.00	101.00	127.80	151.60	151.86
$N_{90}S_{(20x10)}$	30.66	102.95	128.93	152.26	152.66
$N_{90}S_{(30x10)}$	32.83	103.78	129.26	155.53	156.06
SEm (±)	0.80	2.28	1.60	1.80	1.54
CD (P=0.05)	2.15	6.70	NS	5.34	4.53

Table.2 (a) Effect of nitrogen levels and spacing on number of effective tillers/hill, panicle length (cm) and number of grains/panicle

Treatments	No. of effective tillers	Panicle length (cm)	No. of grains/panicle
Nitrogen (kg/ha)			
Control	6.55	22.32	118.54
30	5.57	23.58	134.47
60	7.60	24.76	154.28
90	7.80	26.41	167.27
SEm (±)	0.35	0.37	2.30
CD (P=0.05)	1.05	1.10	6.76
Spacing (cm)			
10x10	7.06	23.77	137.49
20x10	7.05	24.92	148.47
30x10	7.30	24.11	144.96
SEm (±)	0.31	0.32	1.99
CD (P=0.05)	NS	0.90	5.85

Table.2 (b) Interaction effect of nitrogen levels and spacing on number of effective tillers/hill, panicle length (cm) and number of grains/panicle

Treatments	No. of effective tillers	Panicle length (cm)	No. of grains/panicle
$N_0S_{(10x10)}$	6.13	21.83	114.09
$N_0S_{(20x10)}$	7.26	22.07	120.52
$N_0S_{(30x10)}$	6.26	23.08	121.00
$N_{30}S_{(10x10)}$	6.60	24.90	130.05
$N_{30}S_{(20x10)}$	6.66	23.08	138.36
$N_{30}S_{(30x10)}$	6.46	22.76	135.00
$N_{60}S_{(10x10)}$	7.46	22.72	143.51
$N_{60}S_{(20x10)}$	7.46	24.24	158.33
$N_{60}S_{(30x10)}$	8.60	26.38	161.00
$N_{90}S_{(10x10)}$	8.06	25.63	162.29
$N_{90}S_{(20x10)}$	7.53	27.23	176.66
$N_{90}S_{(30x10)}$	7.86	27.33	162.86
SEm (±)	0.62	0.65	3.99
CD (P=0.05)	NS	1.91	11.71

Table.3 (a) Effect of nitrogen levels and spacing on test weight (g), grain yield (q/ha) and straw yield (q/ha)

Treatments	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)
Nitrogen (kg/ha)			
Control	27.37	30.67	24.96
30	28.10	44.59	29.46
60	29.63	48.53	36.06
90	31.07	52.55	42.61
SEm (±)	0.61	0.51	1.73
CD (P=0.05)	1.81	1.51	5.08
Spacing (cm)			
10x10	28.36	40.53	29.60
20x10	28.69	45.65	32.86
30x10	30.08	45.57	37.36
SEm (±)	0.53	0.44	1.50
CD (P=0.05)	NS	1.30	4.40

Table.3 (b) Interaction effect of nitrogen levels and spacing on test weight (g), grain yield (q/ha) and straw yield (q/ha)

Treatments	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)
$N_0S_{(10x10)}$	26.56	20.79	22.06
$N_0S_{(20x10)}$	27.03	26.85	25.59
$N_0S_{(30x10)}$	28.53	28.37	27.25
$N_{30}S_{(10x10)}$	28.66	35.37	28.81
$N_{30}S_{(20x10)}$	26.58	36.74	27.77
$N_{30}S_{(30x10)}$	29.06	38.67	31.81
$N_{60}S_{(10x10)}$	27.46	38.67	32.72
$N_{60}S_{(20x10)}$	29.70	41.03	32.54
$N_{60}S_{(30x10)}$	31.73	40.90	42.93
$N_{90}S_{(10x10)}$	30.76	48.28	34.82
$N_{90}S_{(20x10)}$	31.46	52.00	45.54
$N_{90}S_{(30x10)}$	31.00	49.37	47.47
SEm (±)	1.06	0.89	3.00
CD (P=0.05)	NS	2.61	NS

Table.4 Economics of rice cultivation as affected by different treatment combinations

Treatments	Cost of cultivation	Gross return (Rs.)	Net return (Rs.)	B: C ratio
$N_0S_{(10x10)}$	14000	37422	23422	1.67
$N_0S_{(20x10)}$	14000	48330	34330	2.45
$N_0S_{(30x10)}$	14000	51066	37066	2.65
$N_{30}S_{(10x10)}$	16000	63666	47666	2.98
$N_{30}S_{(20x10)}$	16000	66132	50132	3.13
$N_{30}S_{(30x10)}$	16000	69606	53606	3.35
$N_{60}S_{(10x10)}$	18000	69606	51606	2.87
$N_{60}S_{(20x10)}$	18000	73854	55854	3.10
$N_{60}S_{(30x10)}$	18000	73620	55620	3.09
$N_{90}S_{(10x10)}$	20000	86904	66904	3.35
$N_{90}S_{(20x10)}$	20000	93600	73600	3.68
$N_{90}S_{(30x10)}$	20000	88866	68866	3.44

Grain yield (q/ha)

It was observed that the grain yield increased with the increase of nitrogen levels thus recording the highest grain yield from the application of 90 kg N/ha which was recorded at 52.55 q/ha (Table 3a). This might be due to better uptake of nitrogen leading to greater dry matter production and its translocation to sink. Similar finding was also reported by Bindra *et al.*, (2000) who found that application of 90 kg N/ha resulted in the highest grain yield. The maximum grain yield (45.65 q/ha) was recorded from 20x10 cm

which was observed to be *at par* with 30x10 cm (Table 3a). This might be due to higher ear bearing tillers per unit area as compared to 30x10 cm. This finding finds similarity with the finding reported by Geethadevi *et al.*, (2000) and Ninad *et al.,* 2017, who reported that the highest grain yield was recorded from 20x10 cm spacing. The interaction effect reveals that application of 90 kg N/ha with 20x10 cm spacing recorded the significantly the highest grain yield (52 q/ha) as compared with the rest of the treatment combination (Table 3b).

Straw yield (q/ha)

With the increase in levels of nitrogen, the straw yield also tends to increase with the highest being recorded from the application of 90 kg N/ha (Table 3a) as compared with the rest of the treatments which finds conformity with the findings reported by Rajendran and Veeraputhiran (1999). The maximum straw yield was recorded from 30x10 cm spacing which may be due to better utilization of resources.

Economic analysis

The economics for the different treatment were worked out in order to enable us to decide the suitable treatment combinations for profitable rice cultivation.

Among the different treatment combinations, the maximum net return was recorded from the application of 90 kg N/ha and 20x10 cm spacing (Rs.73600) recording the highest B: C ratio at 3.68 (Table 4).

On the basis of the above findings, it can be concluded that application of 90 kg N/ha with a spacing of 20x10 cm which resulted in highest grain yield and economic return may be considered for adoption by the farmers of Kiphire, District.

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