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Effect of nursery fertilization on seedling growth and yield of rice (*Oryza sativa*)

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ABSTRACT

A field experiment was conducted at the main campus of Sher-e-Kashmir University of Agricultural Sciences and Technology, Shalimar, Kashmir, during 2000 and 2001, to study the effect of fertility levels in rice (*Oryza sativa* L.) nursery and ultimate effect on yield of rice crop. The seedling length, dry weight and seedling growth increased significantly by increasing fertility up to the highest level 200 N + 100 P_2O_5 + 50 K_2O kg/ha. Yield and yield-attributing characters, i.e. grains/ panicle, panicles/ m^2, and straw yield also recorded highest value at treatment 200 N + 100 P_2O_5 + 50 K_2O kg/ha in the nursery. Nitrogen content and uptake in nursery increased by increasing fertility levels but N recovery was very low in nursery. Higher fertilizer application in rice nursery increased benefit : cost ratio and grain yield of rice.

Key words: Rice nursery, Seedling growth, Yield attributes, Yield.

Nursery management is an integral part of transplanted rice (*Oryza sativa* L.). Among different components of nursery management, adequate nutrition to nursery is an important factor to get healthy rice seedlings. Proper fertilizer recommendations for rice nursery in temperate valley of Kashmir are not available. However, higher use of fertilizer in rice nursery is a common practice among farmers. The present fertilizer schedule for rice nursery is based upon adhoc recommendations. Further rice nursery in Kashmir valley is raised between 15 April and 15 May and nursery duration is of 35 days. Rice nursery is subjected to hostile climatic conditions as minimum temperature from 16 April to 13 May is recorded between 6.4 to 9.8 °C and maximum temperature varies between 20.2 and 22.3 °C, accompanied with chilly winds and erratic rainfall due to western disturbances. Therefore, present experiment was conducted to study the effect of fertilization of nursery seedling and consequent effect on yield and yield attributes of rice.

MATERIALS AND METHODS

A field experiment was carried out during the rainy (*kharif*) season of 2000 and 2001 at Shalimar Campus, Sher-e-Kashmir University of Agricultural Sciences and Technology. The experiment in the nursery as well as in the main field was laid out in radomized block design with 4 replications. The soil was silty clay loam (pH 6.5, available N 295 kg/ha, P 15.7 kg/ha and K_2O 250 kg/ha) in texture. Nursery was sown on 31 April during both the years. Sprouted seeds of genotype 'SKAU 5' were broadcast @ 100 kg seed/ha. Nursery seed-beds received fertilizer in the form of urea, single superphosphate and muriate of potash as per treatment, control, 50 N + 25 P_2O_5 + 12.5 K_2O kg/ha, 100 N + 50 P_2O_5 + 25 K_2O kg/ha, 150 N + 75 P_2O_5 + 37.5 K_2O kg/ha and 200 N + 100 P_2O_5 + 50 K_2O kg/ha. Half of nitrogen as per treament was applied as top dose 10 days before uprooting of nursery. The main experimental field was given uniform dose of 100, 45 and 30 kg N, P_2O_5 and K_2O/ ha, in the form of urea, diammonium phosphate and muriate of potash. Thirty-five days old seedlings were transplanted in the main field at 15 cm × 15 cm spacing on 5 June during both the years and harvested on 9 and 5 October during 2000 and 2001 respectively. At the time of uprooting seedling for transplanting, simultaneously samples of 50 seedlings each from all plots were drawn randomly. Seedling length was recorded excluding roots.

RESULTS AND DISCUSSION

Increasing fertility level in rice nursery significantly increased the seedling length and dry weight of seedling up to highest level of fertility dose, through difference between 100 N + 50 P_2O_5 + 25 K_2O kg/ha and 150 N + 75 P_2O_5+37.5 K_2O kg/ha was not significant. Singh (1999) also reported increase in seedling length by increasing fertility. Seedling length was 20.7–32.7 cm and 20.5–31.0

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cm during 2000 and 2001 respectively. However, difference between the control and 50 N + 25 P_2O_5 + 12.5 K_2O kg/ha was not significant during 2000, whereas fertility level 100 N + 50 P_2O_5 + 25 K_2O kg/ha was at par with 150 N + 75 P_2O_5 + 37.5 K_2O kg/ha during both the years for seedling dry weight (Table 1). Singh (1999) recorded increased seedling weight by application of urea @ 120 kg N/ha. Highest seedling growth of 3.79 and 4.25 mg/cm was recorded with highest fertility level 200 N + 100 P_2O_5 + 50 K_2O kg/ha during both the years. Singh (1999) also reported similar findings. Accumulation of more biomass and increased seedling length due to higher fertility levels reflects higher photosynthate accumulation in the rice plant.

Nitrogen content

Increasing fertiltiy levels from the control to highest level (200 N + 100 P_2O_5 + 50 K_2O kg/ha) signficantly increased nitrogen content of seedling during both the years. However, during 2000, treatment 200 N + 100 P_2O_5 + 50 K_2O kg/ha was found at par with 150 N + 75 P_2O_5 + 37.5 K_2O kg/ha (Table 1).

Yield and yield attributes

Increasing fertility levels in nursery increased the yield attributes like grains/panicle and panicles/m^2 upto the highest level of 200 N + 100 P_2O_5 + 50 K_2O kg/ha. The difference between 100 N + 50 P_2O_5 + 25 K_2O kg/ha and 50 N + 25 P_2O_5 + 12.5 K_2O kg/ha was not significant; though treatment 50 N + 25 P_2O_5 + 12.5 K_2O kg/ha was at par with the control during 2000 for grains/panicle. Maximum panicles/m^2 were recorded with 200 N + 100 P_2O_5 + 50 K_2O kg/ha, though the difference between the control and 50 N + 25 P_2O_5 + 12.5 K_2O kg/ha was not significant during both the years. Singh (1999) reported increased yield attributes of rice crop with application of fertilizers in nursery. Similar findings were reported by Maskina *et al.* (1985).

Increasing fertility levels in rice nursery consequently increased the grain yield significantly with 200 N + 100 P_2O_5 + 50 K_2O kg/ha and the lowest grain yield with the control (Table 2). However, during both the years increase in each fertility level from 50 N + 25 P_2O_5 + 12.5 K_2O kg/ha during 2000 and in pooled data. The magnitude of increase in grain with 200 N + 100 P_2O_5 + 50 K_2O kg/ha was 54.8, 47.0 and 50.8% during 2000, 2001 and pooled data respectively. High seed yield with nursery fertilization might be owing to production of healthy seedling, consequently improved yield attributes like panicles/m^2 and grains/panicle. Increasing fertility levels in rice nursery increased the grain yield of rice, as also reported by Lal and Roy (1996), Maskina *et al.* (1985) and Singh (1999).

Straw yield increased significantly with an increase in

Table 1. Seedling characteristics of rice as influenced by different fertility levels

Treatment		Seedling length (cm)		Dry weight of 50 seedling (g)		Seedling growth (mg/cm)		Nitrogen content (%)		N uptake (kg/ha)		Apparent N recovery (%)	
		2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
N + P_2O_5 + K_2O (kg/100 m^2)													
0.0	0.0	20.7	20.5	3.3	3.8	3.18	3.70	1.52	1.62	4.26	4.65		
50.0	25.0	12.5	25.0	25.5	3.9	4.2	3.12	3.29	1.67	1.69	5.32	5.57	2.1	1.8
100.0	50.0	25.0	28.0	26.2	5.2	5.8	3.71	4.42	1.81	1.85	7.84	8.27	3.6	3.6
150.0	75.0	37.5	29.7	30.2	5.5	6.0	3.70	3.97	1.93	1.99	9.00	9.03	3.2	2.9
200.0	100.0	50.0	32.7	31.0	6.2	6.6	3.79	4.25	1.98	2.07	10.03	10.71	2.9	3.0
CD (P = 0.05)			2.7	2.3	0.8	0.4			0.10	0.05				

Table 2. Effect of fertility levels in rice nursery on yield and yield attributes of rice and relative economics

Treatment			Grains/ panicle		Panicle/ m^2		Grain yield (q/ha)			Straw yield (q/ha)		Cost of cultivation (Rs/ha)*	Gross profit (Rs/ha)*	Benefit: cost ratio*
			2000	2001	2000	2001	2000	2001	pooled	2000	2001			
$N + P_2O_5 + K_2O$ (kg/ha)														
0.0	0.0	0.0	65	63	310	315	45.2	46.8	46.0	68.7	70.2	16,407	43,745	2.67
50.0	25.0	12.5	68	72	315	320	46.7	50.6	48.6	70.0	72.8	16,432	46,060	2.80
100.0	50.0	25.0	70	77	330	332	51.7	55.2	53.4	72.8	74.1	16,457	50,105	3.04
150.0	75.0	37.5	79	80	350	356	64.7	62.6	63.6	79.0	75.8	16,483	58,740	3.56
200.0	100.0	50.0	85	84	365	360	70.0	68.8	69.4	82.5	80.6	16,508	63,675	3.86
CD (P = 0.05)				4	11	13	3.2		2.8	4.2	3.3			

*Pooled over 2 years

fertility level up to 200 N + 100 P_2O_5 + 50 K_2O kg/ha during both the years. However, 150 N + 75 P_2O_5 + 37.5 K_2O kg/ha was at par with 200 N + 100 P_2O_5 + 50 K_2O kg/ha during 2000. The control was at par with 50 N + 25 P_2O_5 + 12.5 K_2O kg/ha and 150 N + 75 P_2O_5 + 37.5 K_2O kg/ha was at par with 100 N + 50 P_2O_5 + 25 K_2O kg/ha during 2001. However, difference between 100 N + 50 P_2O_5 + 25 K_2O kg/ha and 50 N + 25 P_2O_5 + 12.5 K_2O kg/ha was not significant during both the years.

Highest grain and straw yields were recorded at highest fertility level in nursery, may be owing to healthy seedlings, which ultimately showed improved yield-attributing characters. Raju *et al.* (1989) reported that fertilizer application to rice nursery resulted in less root damage and seedling breakage during uprooting. Further, low mineralizing rate due to low temperature during nursery raising period (1 April to 15 May) may be the reason for high requirement of fertilizers for raising healthy seedling. Alexander (1983) reported that mineralization is reduced at low temperature.

Nitrogen uptake (kg/ha) increased by increasing fertility levels and apparent nitrogen recovery (%) was recorded very low (Table 1). Frequent irrigation, leaching losses which may be exceedingly high because rice nursery is normally surrounded by arable land. Low nitrogen uptake may be due to short growth period of rice nursery coupled with low temperature.

Economics

Profit and Benefit : cost ratio was highest with 200-100-50 kg/ha N-P_2O_5-K_2O fertilization. Thus for healthy rice nursery and higher rice yield, an application of 200 N + 100 P_2O_5 + 50 K_2O kg/ha may be recommended.

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