

EFFECTS OF NAPHTHALENE ACETIC ACID ON NUTRIENT UPTAKE BY TWO VARIETIES OF RICE (*ORYZA SATIVA* L.)

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Abstract

An experiment was conducted to find out the responses of two varieties of rice to NAA on nitrogen (N), phosphorus (P), and potassium (K) uptake by straw and root at three different stages and NPK concentrations in grains. Nitrogen, P and K uptake by both straw and root were found to increase and decrease depending on the concentration of NAA and also on the stages of development. Uptake of NPK were recorded higher at the tillering stage and at harvest with a few exceptions, whereas, lower uptake at the flowering stage in most cases. However, NPK concentrations in grains were favourably influenced by 200 ppm NAA in both the varieties except K concentration of BRRI dhan-29 (V₁). Variations among the treatments were non-significant in the majority of cases. Out of the two varieties BRRI dhan-29 (V₁) showed comparatively more positive response to NAA than BRRI dhan-50 (V₂).

Introduction

Use of fertilizer, particularly nitrogen, phosphorus, and potassium to increase rice yield is a widespread practice among the farmers. Recently in many countries of the world the strategy is to maximize the production with minimum use of fertilizers and agrochemicals. Use of growth stimulating chemicals for increasing yield has drawn the attention of plant physiologists all over the world⁽¹⁻⁵⁾. But investigations regarding the uptake of nutrients due to growth regulator treatments are scanty⁽⁶⁻⁸⁾. Naphthalene acetic acid (NAA), a synthetic growth regulator is known to affect the growth, development and other physiological and biochemical processes of plants^(4, 9-11). Investigations in other countries have shown that foliar application of NAA improves yield, nutrient content and uptake by cotton⁽¹²⁾, tomato⁽¹³⁾, greengram⁽¹⁴⁾ and fenugreek⁽¹⁵⁾. Reports regarding the effect of NAA on nutrient content and uptake by crops including rice are lacking in Bangladesh. Therefore, the present research work was undertaken to find out the responses of two varieties of rice to NAA treatment.

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Materials and Methods

A pot experiment was carried out at the Botanical Garden of Dhaka University during November, 2009 to April, 2010. The experimental soil was analyzed and the optimum levels of nitrogen and potassium and high level of phosphorus were recorded⁽¹⁶⁾. Each pot was filled with 9.0 kg air-dried soil. Cow-dung (0.5 kg/pot) was mixed uniformly during preparation of soil and 2 g of gypsum was also added in each pot. The experiment was laid out in a RCBD with three replications. Seeds of two varieties of rice were collected from Bangladesh Rice Research Institute (BRRI), Joydebpur, Gazipur. BRRI dhan-29 (V₁) is a high yielding variety released in 1994 and BRRI dhan-50 (V₂) is an aromatic variety released in 2008. Seeds were sterilized with 0.5 % calcium hypochlorite solution and were sown on 7th November, 2009. Seedlings were transplanted to experimental pots at 5th leaf stage at the age of 36 days after sowing. Thinning was done in such a way that a healthy seedling of uniform size and vigour was allowed to grow. Irrigation was done as per requirement. Weeding was done twice at 25 and 45 days after transplanting (DAT). Split applications of urea were done twice at the rate of 1 g per pot at 20 and 50 DAT. There were three treatments: T₀ = Distilled water (Control), T₁ = 100 ppm NAA, and T₂ = 200 ppm NAA.

Treatments were applied as foliar spray at 57 DAT. Dry weights of straw and root were recorded at three different stages viz., tillering, flowering and harvest. Grains were collected after harvest. Nitrogen (N), phosphorus (P), and potassium (K) concentrations of straw and root were determined at tillering, flowering, and at harvest, whereas, those of grain were determined after harvest. Straw, root and polished grain were crushed and then used for the determination of NPK content and uptake. The N, P, and K content of straw, root, and grain were determined by micro-Kjeldahl's method, ascorbic acid blue colour method⁽¹⁷⁾ and flame photometer, respectively⁽¹⁸⁾. Uptake of NPK of straw and root was calculated using the formulae of Nyborg *et al.*⁽¹⁹⁾. Data were analyzed statistically⁽²⁰⁾ and treatment means were compared by LSD test at 5% level of significance.

Results and Discussion

Results presented in Tables 1 - 3 revealed that N, P, and K uptake by both straw and root varied non-significantly in most of the cases. At the tillering stage of V₁, NPK uptake by straw decreased due to both the treatments. However, NPK uptake by root increased due to both treatments except N uptake due to application of T₁ treatment (Table 1). In the variety V₂, both straw and root NPK uptake were found to increase due to both the treatments except K uptake by straw due to T₂ treatment. At this stage no significant variations due to treatment effects were observed.

Table 1. Effect of NAA on N, P and K uptake by straw and root of BRRI dhan-29 (V₁) and BRRI dhan-50 (V₂) at tillering stage.

Treatments	BRRI dhan-29 (V ₁)						BRRI dhan-50 (V ₂)					
	Straw			Root			Straw			Root		
	N	P	K	N	P	K	N	P	K	N	P	K
T ₀	27.70	1.08	6.68	3.19	0.26	0.77	16.43	0.97	6.48	3.09	0.28	0.84
T ₁	22.60	1.07	6.61	2.01	0.32	0.89	27.00	1.47	8.69	4.89	0.59	1.18
T ₂	15.52	0.78	4.45	3.21	0.38	1.31	20.52	1.04	6.18	4.01	0.35	1.69
CV (%)	49.50	46.39	50.72	50.87	45.48	57.60	35.16	35.96	33.26	52.15	48.13	62.54
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Effect of NAA on N, P and K uptake by straw and root of BRRI dhan-29 (V₁) and BRRI dhan-50 (V₂) at flowering stage.

Treatments	BRRI dhan-29 (V ₁)						BRRI dhan-50 (V ₂)					
	Straw			Root			Straw			Root		
	N	P	K	N	P	K	N	P	K	N	P	K
T ₀	69.02	3.69	20.44 b	13.19	1.24 a	4.17 a	79.12a	5.40	35.30	18.24 a	1.11	1.75
T ₁	62.40	3.97	22.17 b	5.58	0.75 b	1.53 b	41.51b	3.81	28.12	9.76 b	1.03	2.83
T ₂	69.16	4.58	28.06 a	7.47	0.60 b	1.87 b	33.57b	3.98	23.67	7.13 b	0.80	3.24
CV (%)	28.34	25.14	26.27	51.41	37.85	53.29	55.25	41.76	46.77	59.55	24.71	52.90
LSD (0.05)	NS	NS	5.550	NS	0.312	1.306	36.00	NS	NS	7.72	NS	NS

Mean in a column followed by same letter do not differ significantly at 5% level.

Table 3. Effect of NAA on N, P and K uptake by straw and root of BRRI dhan-29 (V₁) and BRRI dhan-50 (V₂) at harvest.

Treatments	BRRI dhan-29 (V ₁)						BRRI dhan-50 (V ₂)					
	Straw			Root			Straw			Root		
	N	P	K	N	P	K	N	P	K	N	P	K
T ₀	13.87	1.26	27.91	4.56	0.45 b	1.07	15.29	1.38	23.24	3.60	0.49	1.05
T ₁	17.75	1.61	31.16	5.19	0.59 a	1.23	18.75	1.42	22.76	3.47	0.40	1.10
T ₂	19.01	1.43	30.19	6.99	0.65 a	1.64	14.58	1.51	23.10	3.73	0.47	1.59
CV (%)	24.48	21.56	17.22	46.74	23.61	40.92	33.10	30.52	17.51	22.26	28.89	44.69
LSD (0.05)	NS	NS	NS	NS	0.124	NS	NS	NS	NS	NS	NS	NS

(mg/plant)

Mean in a column followed by same letter do not differ significantly at 5% level.

Table 4. Effect of NAA on N, P and K concentrations of grain of BRRI dhan-29 (V₁) and BRRI dhan-50 (V₂).

Treatments	BRRI dhan-29 (V ₁)						BRRI dhan-50 (V ₂)					
	N			P			N			P		
	N	P	K	N	P	K	N	P	K	N	P	K
T ₀	0.612	0.040	0.029	0.807	0.042	0.019	0.807	0.042	0.019	0.807	0.042	0.019
T ₁	0.612	0.043	0.023	0.750	0.040	0.019	0.750	0.040	0.019	0.750	0.040	0.019
T ₂	0.669	0.041	0.023	0.850	0.044	0.024	0.850	0.044	0.024	0.850	0.044	0.024
CV (%)	9.40	6.00	11.20	9.70	6.40	20.90	9.70	6.40	20.90	9.70	6.40	20.90
LSD (0.05)	NS	NS	NS	0.088	NS	NS	0.088	NS	NS	0.088	NS	NS

(%)

Mean in a column followed by same letter do not differ significantly at 5% level.

Results indicated that NPK uptake by straw of V₁ at the flowering stage was recorded higher than the control due to both treatments except straw N uptake due to T₁ application, where it was found to decrease. In case of root, NPK uptake decreased due to both the treatments (Table 2). Significant variations were observed in uptake of straw K due to T₁ and root P and K due to both the treatments. But in V₂, both straw and root NPK uptake decreased due to both the treatments except K uptake by root, where it was increased due to both the treatments. The values of N in both straw and root varied significantly due to both the treatments.

At the harvest NPK uptake by both straw and root of V₁ increased due to both the treatments and the increase was significant only in case of P uptake due to both the treatments (Table 3). The NPK uptake by both straw and root did not show any definite trend in change in V₂ depending on the concentrations and part of plant tissues.

Results presented in Table 4 revealed that N concentration of grain increased due to T₂ in V₁, but irregular variations were observed in V₂. Phosphorus concentration of grain increased due to application of both the treatments in V₁, whereas increase was recorded due to T₂ treatment only in V₂. In case of V₁, K concentration of grain decreased due to both the treatments, whereas increased due to T₂ in V₂. Increased N, P and K contents of grain following NAA application was reported in maize⁽²¹⁾ and fenugreek⁽¹⁵⁾.

Results also indicated that NPK uptake by both straw and root was increased and decreased depending on the concentration of NAA and also on the stages of development. Uptake of NPK was recorded higher at the tillering stage and at harvest with a few exceptions, whereas lower uptake at the flowering stage in most of the cases. However, NPK concentrations in grains increased due to T₂ treatment in both the varieties except K concentration of V₁. Moreover, two varieties of rice responded differently.

In tomato leaves, decreased N content and increased P and K contents were found at different days after spray with NAA⁽¹³⁾. Uptake and content of NPK by straw were also increased when fenugreek leaves were sprayed with NAA⁽¹⁵⁾. Foliar application of NAA significantly enhanced the uptake of more NPK in greengram at different days after spray⁽¹⁴⁾. The favourable effect of NAA in enhancing the nutrient uptake was also reported in cotton⁽¹²⁾ and in maize⁽²¹⁾. The reason for decreasing NPK uptake at the flowering stage could be due to more absorption of these nutrients by rice plant for dry matter production.

The overall result is in conformity to the findings that plant growth regulators at different concentrations can have quite different effects in different plants and sometimes the same plant growth regulator at identical concentrations can have different effects on various organs of the same plant⁽²²⁾. Out of the two investigated rice varieties, BRRI dhan-29 (V₁) showed positive response to NAA and BRRI dhan-50 (V₂) responded rather negatively.

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