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Influence of N Supply on Growth Factors of Rice (*Oryza sativa* L.)*

by

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Introduction : With increasing knowledge about the major and micro nutrients, and their role in the life history of a plant and crop production, fertilizer application has become a part of cultural operation in a scientific way. Eventually the economic attributes such as the height of the plant, productive tillers, nutritive straw, and the high grain yield have to be taken into account. The amount of N utilised at different grǒwth phases of the rice plant varies from variety to variety. We have sufficient evidence to show that N supply increase in tillering, shoot growth, root development and other factors which have been amply demonstrated. N starved rice plant showed reduced shoot growth and poor tiller production. (Tanaka *et al*, 1964). Bhattacharya and Sircar (1963), Baba (1961), however, noticed that beyond certain limit, N no doubt increased productive tillers but decreased ripening percentage. Srinivasalu and Pawar (1963) observed a progressive increase in the shoot/root ratio corresponding to increase in N supply. The grain yield of rice naturally depends upon yield components and determinants, such as, number of panicles per plant, their length, number of spikelets, filled grain percentage and mean grain weight. Comparing *japonica* and *indica* varieties, Tanaka *et al.* (1958 a) observed that maximum number of filled grain was seen at 20 ppm level in *indica* varieties whereas in *japonica* varieties at 150 ppm level of N. They have also clearly indicated that for *indica* variety 30 to 40 kg N/ha and *japonica* varieties 80 to 90 kg N/ha were economic dosages.

Materials and methods : The high fertility ADT 27 strain of rice which is a cross between Norin 8 *(japonica)* × GEB 24 (*indica*) was chosen for the field study. Besides a basal dressing of 5000 kg/ha green lerf, 45 kg and 30 kg of P_2O_5 and K_2O per hectare formed uniform application of P and potassium. N was applied at 0, 30, 60, 90, 120, 150 and 180 kg/ha (C, T_1, T_2, T_3, T_4, T_5, and T_6 respectively) in three equal split doses at transplanting, after 30 and 40 days subsequent to transplanting. Growth characters like shoot height, root development, shoot/root ratio, were studied at three stages of the crop. Yield determinants like number of tillers, number of panicles per hill, length of panicle, number of filled grains and chaff per main panicle and 1000 grain weight weight were also studied.

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Results and discussion: (a) *General growth, plant height and tiller production*: The shoot height at tillering in 180 kg N/ha level was significantly superior to 90, 60, 30 and 0 kg N levels.

TABLE 1. *Growth of shoot and root and tiller production in relation to the treatments at two stages*

Treatment number	Tillering stage			Flowering stage			
	Shoot height cm	Root length cm	Tiller number	Shoot height cm	Root length cm	Tiller number	Number of productive tillers
C	41.4	23.2	4.0	85.7	26.0	5.0	5.0
T_1	45.4	23.4	6.0	102.6	24.9	8.0	6.2
T_2	48.7	23.0	7.6	106.6	24.9	10.3	8.1
T_3	51.9	22.6	8.8	112.2	23.8	13.7	11.4
T_4	57.2	22.1	10.6	112 5	23.4	15.5	13.2
T_5	60.9	20.8	12.0	119.6	22.6	18.3	16.3
T_6	66.3	20.6	13 2	128.1	22.9	20.2	17.6
Sig. at P=0.01	Yes	Yes	Yes	Yes	Yes	Yes	Yes
S.E.	4.64	0.51	0.90	3.61	0.47	1.39	0.64
C.D.	9.58	1.07	1.86	7.45	0.99	2.92	1.40

At flowering stage, the shoot height in respective treatments showed increasing trend as compared to the tillering stage and in 180 kg N level it was significantly superior to the other treatments. However, the plants did not lodge even in the highest dosage of 180 kg N/ha supplied. At flowering stage, the root length showed a significant decrease in the N treated plots as seen from the control. A significant difference was observed in respect of tiller production among the treatments. The data revealed that the different levels of N did affect or influence the performance and physiology of the plant. The shoot length was proportionate to the N levels supplied. The growth of roots in relation to the treatments in general was not in proportion at higher N levels. The view that increase in tillering habit was associated with the variety was supported by many earlier workers. There was proportionate increase in tiller production at both tillering and flowering stages.

(b) *Shoot weight, root weight and shoot/root ratio:* The weights of shoot and root per hill exhibited increasing values corresponding to the levels of N. A maximum shoot/root ratio of 11.28 was recorded at flowering stage under 60 kg N. Significant increase was noted corresponding to N levels in respect of shoot and root weights. N influenced the growth of the shoot positively. With regard to roots, though length was reduced, the number of roots produced and weight of these were proportionate to N levels. Heavy tillering and luxurious growth of shoot increased the shoot/root ratio,

TABLE 2. *Dry weight of shoot and root and shoot/root ratio in relation to the treatments*

Treatment number	Tillering stage			Flowering stage			Harvesting stage		
	Shoot weight g	Root weight g	Shoot/ root ratio	Shoot weight g	Root weight g	Shoot/ root ratio	Shoot weight g	Root weight g	Shoot root ratio
C	0.85	0.40	2.13	6.20	1.10	5.63	14.52	2.00	7.26
T_1	1.56	0.52	3.00	9.14	1.23	7.43	20.70	2.60	7.96
T_2	3.15	0.80	3.94	16.92	1.50	11.28	26.45	3.40	7.78
T_3	4.05	1.20	3.38	18.22	2.00	9.11	30.42	3.50	8.69
T_4	5.87	1.80	3.26	22.75	2.80	8.13	31.07	4.10	7.58
T_5	6.80	2.00	3.40	29.67	3.60	8.24	42.37	5.40	7.85
T_6	7.87	2.30	3.42	34.65	4.20	8.25	46.70	6.00	7.78

(c) *Yield components*: Number of panicles produced per hill in the highest two treatments was significantly superior to the other treatments. All the plots which had recived N showed a significant increase in panicle length as compared with the control. Among the levels of 180, 150 and 120 kg N/ha no significant difference was observed. As regards filled grains per main panicle, the treatments T_6 to T_2 were on par with one another and the control plot showed lowest values. No significant difference was observed among the treatments in respect of chaff per main panicle and 100-grain weight. The number of panicles per hill was decided by two factors viz., the tiller number and efficiency in the development of productive tillers. Since both these factors in ADT 27 rice were increased with higher levels of N supply, the increase in panicle number was reasonable.

TABLE 3. *Effect of N on yield components*

Treatment number	Number of panicles per hill	Panicle length cm	Number of grains in main panicle			1000-grain weight in g
			Filled grains	Number of chaff	Total	
C	5.0	20.8	94.2	21.2	115.4	16.758
T_1	6.2	21.5	113.0	22.8	135.8	16.810
T_2	8.1	21.9	132.0	22.0	154.0	17.096
T_3	11.4	22.0	144.6	25.6	170.2	17,149
T_4	13.2	22.8	136.2	28.6	164.8	16.864
T_5	16.3	23.1	133.6	27.2	160.8	17.105
T_6	17.6	23.1	149.4	28.4	177.8	16.905
Sig.	Yes (P=0.01)	Yes (P=0.01)	Yes (P=0.05)	N.S.		N.S.
S.E.	0.64	0.33	13.68			
C.D.	1.40	0.67	28.23			

The earlier workers in rice (Bosemark, 1954, Tanaka *et al.* 1958a and 1958b, Murayama, 1965, Srinivasalu and Pawar, 1963) have reported similar trend in other varieties. Statistically, the percentage of filled grain was not influenced much beyond 30 kg N/ha. The number of chaff and percentage of sterility did not indicate any significance in relation to the treatments since these factors are indicative of varietal characters.

(d) *Grain and straw yield*: The higher four levels, namely, T_3, T_4, T_5 and T_6 recorded significantly increased yields than the lower two levels and the control. A maximum of 4850 kg/ha was recorded in 90 kg level of N over control (3200 kg/ha) and a quadratic response was recorded for yield or grain (Fig. 1). A positive correlation was established between number of tillers per hill, number of panicles per hill and grain yield (Fig. 2) and (Fig. 3).

Tiller number × *Grain yield*

$$Y = 1421.3 + 402.949 x^{**} - 11.909^{**} x^2$$

$R^2 = 0.975$, $Sb_1 = 53.88$, $Sb_2 = 2.096$

Panicle number × *Grain yield*

$$Y = 944.45 + 570.176^{**} x - 20.443^{**} x^2$$

$R^2 = 0.981$, $Sb_1 = 60.6$, $Sb_2 = 2.66$.

Fig. 1

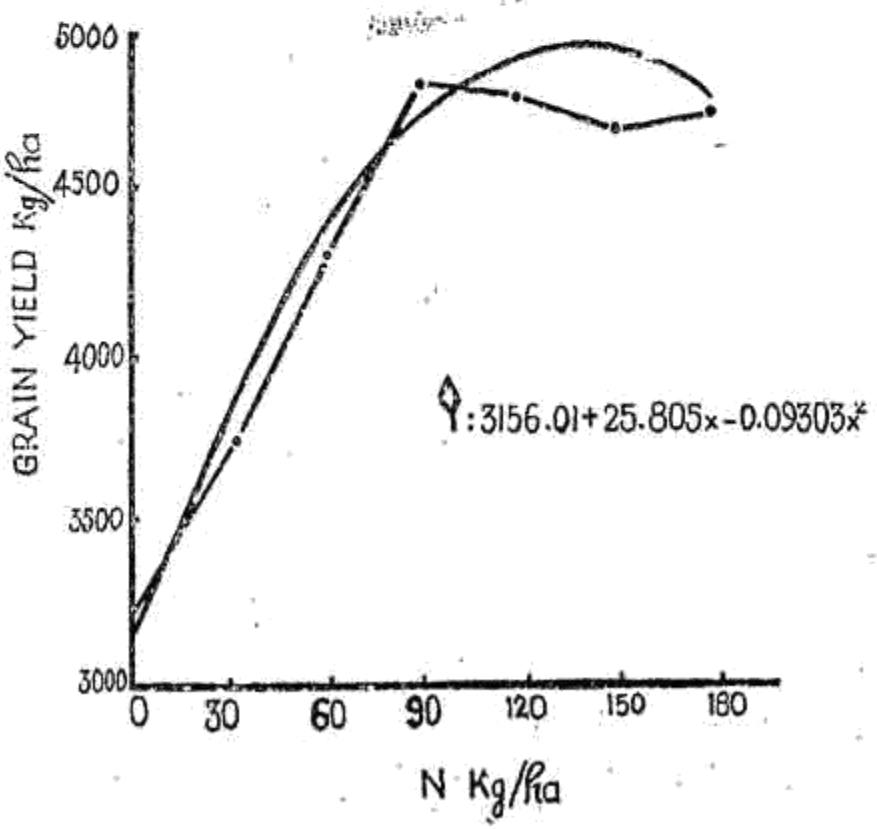


Fig. 2

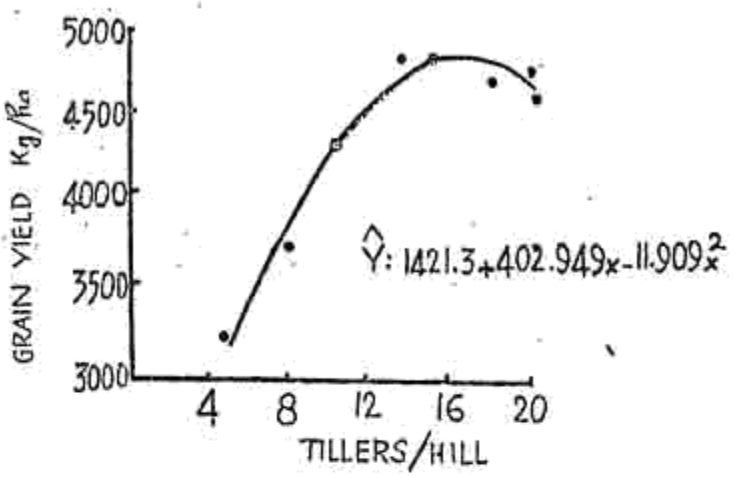
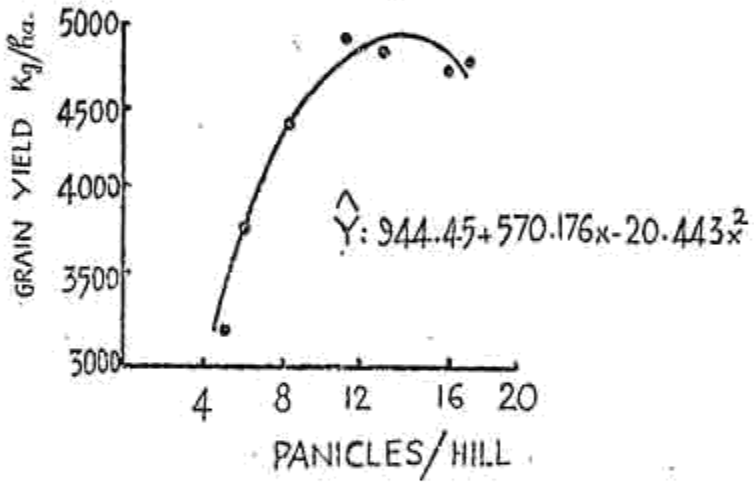


Fig. 3



A significant increase in the yield of straw was also recorded. The dosage of 90 kg N/ha was recorded highest grain yield and the yield at this level was on par with other three higher levels of N. It was evident that in respect of high fertility strains, the response to N was influenced by varietal character.

TABLE 4. *Grain and straw yield in kg/ha*

Treatment number	N kg/ha	Grain	% on control	Straw	% on control
C	0	3200	100.00	4625	100.0
T_1	30	3750	117.2	5200	112.4
T_2	60	4300	134.4	6000	129.7
T_3	90	4850	151.6	7500	162,2
T_4	120	4800	150.0	8700	188.1
T_5	150	4700	146.9	9100	196.8
T_6	180	4750	148.4	9650	208.6
Sig. (P=0.01)		Yes		Yes	
S.E.		91.20		21.22	
C.D.		198.72		65.38	

Summary: The study was initiated with the object of assessing the responsiveness of ADT 27 variety of rice to different levels of N. The shoot height indicated a positive relationship with N levels, while the root length showed a negative trend. Number of tillers per hill, shoot weight, root weight and shoot/root ratio were evidently influenced by N levels. Among the yield components studied, the number of panicle per hill and length of panicle were increased by higher levels of N, but number of filled grain percentage was not altered beyond 60 kg N/ha. A quadratic response was observed with regard to grain yield to the treatments and beyond 90 kg N/ha did not contribute for the yield.

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