

Uptake Pattern in Relation to Form and Time of Application of Nitrogen for Rice

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A study was made to find out the uptake pattern of rice IR.20 under moderate level of nitrogen in relation to the time of application as well as form of fertilizers. The result shows that the nitrogen content increased after each split application and there was a general drop in the nitrogen content at around 67 days after transplanting due to transition phase from vegetative to reproductive phase. The nitrogen uptake followed the trend of dry matter production and nitrogen content.

High yielding varieties generally absorb more N, P and K than tall improved varieties.

Murthy and Narasingh Rao (1971) observed that the total N content in the plant was high with late application of N i.e., when N was top dressed rather than applied basally. He also observed that the percentage of fertiliser N in the plant appeared to decrease with age of the crop. Chaplin (1972) observed that grain yield increased with N uptake at flowering stage upto approximately 120 kg/ha but decreased when uptake exceed this level. Grain yield was reduced when grain content of N exceeded approximately 1.5 per cent. High N uptake at flowering was presumed to lead to depletion of carbohydrate reserves during the critical grain ripening phase.

Based on N¹⁵ studies, Patnaik (1965) reported that fraction of plant

N coming from fertiliser was relatively high (about three fourths) early in the season but decreased to as little as one fourth as the season progressed. Total N uptake and uptake of fertiliser N were high for the 112 kg/ha rate than 56 kg/ha rate. Ramanathan and Krishnamoorthy (1973) recorded high degree of nutrient uptake with increase in fertiliser level in case of IR 20.

From a study of the review it could be seen that quite extensive studies have been made on the uptake pattern of rice in relation to nitrogen dose. However, with the introduction of slow release fertiliser a more detailed study can be considered to be a gap for the increased efficiency and grain production.

MATERIALS AND METHODS

With a view to find out the uptake pattern of Nitrogen, a trial was conduc-

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ted during Kharif seasons of 1973 and 1974 at Tamil Nadu Agricultural University, Coimbatore with variety IR.20. The details of treatments are furnished in Table I.

TABLE I. Details of Treatments

Treatments	Total N	At planting	At tillering	At 7 days before panicle initiation	At panicle initiation
1	0	0	—	—	—
2	50	50	—	—	—
3	50	50 ^a	—	—	—
4	50	50+	—	—	—
5	50	50@	—	—	—
6	50	25 ^a	—	25	—
7	50	—	50	—	—
8	50	—	—	50	—
9	50	—	25	25	—
10	50	—	25	—	25
11	50	25	25	—	—
12	50	25	—	25	—
13	50	25	—	12.5	12.5
14	50	12.5	25	—	12.5
15	100	100	—	—	—
16	50	50 ^b	—	—	—

^a Sulphur coated urea (SCU)

+ Shellac coated urea (LCW)

@ Neem oil + Urea

^b Iso Butylene Diurea (IBDU)

In the 1st year there was only 15 treatments excluding IBDU which was included only in 11nd year.

The soil type was clay loam low in available N, and medium in phosphorus and potassium.

The design was randomised block with four replications. For assessing

the nitrogen uptake, four hills were pulled out from each plot, dried in oven the dry matter was assessed. From this nitrogen content was estimated by wet digestion method suggested by Yoshida *et al.* (1971). The percentage of nitrogen was multiplied by dry matter to get total nitrogen uptake. The uptake estimation was done once in 10 days. At harvest nitrogen content in both grain and straw was separately estimated and uptake computed with corresponding dry matter.

RESULTS AND DISCUSSION

The data on the nitrogen content and uptake of nitrogen at 10 days interval are furnished in Table II to V for the two seasons.

N CONTENT OF THE PLANT

The data presented in Table II indicate that the time of application of N had significant influence on the N absorption by the plant. When single dose of 50 kg N/ha was applied as basal dressing, there was moderate absorption of N which was reflected at 20th day itself. This treatment recorded the highest rate of absorption. There was slight increase in the N content when it was applied 7 days before panicle initiation indicating a second highest peak

In the case of two splits the N content was significantly improved immediately after the application of N on each dose. In all the cases there was a general drop at 60th day which is exactly the transition period between vegetative and reproductive phases and the panicle initiation was around 6

UPTAKE PATTERN OF NITROGEN IN RICE

TABLE II. N% plant — 1973

	10th	20th	30th	40th	50th Day	60th	70th	80th	90th	At har- vest
1	0.82	1.70	1.37	1.09	1.08	1.00	0.66	0.59	0.60	0.62
2	1.77	2.77	1.75	1.50	1.02	1.06	1.23	1.07	0.74	0.85
3	1.59	2.16	2.20	1.62	1.07	1.21	1.20	0.64	0.71	0.82
4	2.07	2.49	2.32	1.83	1.00	1.15	0.92	0.68	0.64	0.70
5	1.92	2.95	2.16	2.01	0.89	1.30	1.02	0.78	0.62	0.78
6	1.66	2.43	2.32	1.75	1.10	1.01	0.98	0.73	0.65	0.79
7	1.24	2.00	2.20	2.01	1.07	1.10	1.99	0.73	0.88	0.83
8	1.20	2.09	2.07	1.79	1.20	1.00	1.29	0.69	0.76	1.24
9	1.50	2.26	1.72	1.69	1.27	1.10	1.28	0.90	0.81	0.90
10	1.41	1.98	1.70	2.00	1.27	1.25	0.82	0.62	0.81	0.91
11	1.63	2.38	1.80	2.01	1.20	1.50	0.99	0.73	0.62	0.84
12	1.88	2.18	1.97	1.60	1.10	0.99	2.25	0.82	0.74	0.90
13	1.86	1.30	1.77	1.75	1.10	1.52	1.00	0.85	0.71	0.90
14	0.70	1.76	2.03	2.00	1.06	1.07	0.89	0.69	0.88	0.91
15	1.87	2.70	2.17	1.62	1.36	1.27	0.88	0.67	0.22	0.76
S. E.	0.07	0.13	0.11	0.09	0.09	0.07	0.12	0.07	0.05	0.05
C. D.	0.20	0.38	0.30	0.27	0.24	0.20	0.34	0.20	0.15	0.14

days after transplanting. Although the 65th day was the panicle initiation day, the actual change in the physiological process of panicle initiation would have started by around 60th day. This observation of low N content is in confirmation with Matsushima (1969).

After the panicle initiation stage, all the treatments recorded increased N content except T_7 and T_8 upto a week time. This indicated that when the second split application was delayed to 7 days to panicle initiation or at panicle initiation the same would have been absorbed effectively. This is reflected in the dry matter production also which

is discussed in later section. Such increased growth would have caused a dilution effect and reduced apparent N content.

In the case of three splits, it was noticed that application of N at panicle initiation did not effectively increased the N content.

DRY MATTER PRODUCTION

The estimate of dry matter production was done at an interval of 10 days after transplanting.

The dry matter production increased after basal application of N, the

TABLE III. N% Plant — 1974

	10th	20th	30th	40th	50th	60th	70th	80th	90th	At har- vest
	Day									
1	1.02	1.90	1.54	1.28	1.28	1.22	0.81	0.77	0.70	0.70
2	1.89	2.97	1.96	1.72	1.26	1.26	1.48	1.27	0.84	0.92
3	1.80	2.38	2.27	1.86	1.29	1.43	1.44	0.84	0.81	0.88
4	2.28	2.69	2.56	2.03	1.23	1.36	1.14	0.88	0.74	0.77
5	2.14	3.15	2.38	2.24	1.09	1.51	1.23	0.98	0.72	0.85
6	1.86	2.66	2.52	1.99	1.33	1.26	1.16	0.93	0.75	0.68
7	1.44	2.20	2.42	2.21	1.37	1.32	1.19	0.95	0.83	0.89
8	1.44	2.34	2.28	1.99	1.40	1.22	1.56	0.94	0.86	0.95
9	1.75	2.48	1.92	1.89	1.47	1.30	1.50	1.09	0.91	0.94
10	1.61	2.17	1.92	2.17	1.58	1.47	1.02	1.13	0.91	1.02
11	1.83	2.59	2.03	2.21	1.44	1.75	1.16	0.82	0.72	0.86
12	2.08	2.38	2.17	1.82	1.37	1.16	2.45	0.98	0.84	0.95
13	2.03	1.50	1.97	1.96	1.37	1.97	1.16	1.02	0.81	1.00
14	0.98	1.96	2.27	2.14	1.26	1.33	1.08	1.05	0.98	0.95
15	2.07	2.94	2.38	1.82	1.58	1.58	1.19	0.89	0.72	0.83
16	2.07	3.34	2.29	1.91	1.54	1.37	1.11	0.89	0.74	0.90
S. E.	0.09	0.14	0.13	0.09	0.08	0.08	0.01	0.11	0.05	0.07
C. D.	0.23	0.40	0.37	0.24	0.22	0.22	0.04	0.30	0.13	0.18

quantity being higher under entire dose of N as basal. The general effect of application of each dose was seen after 20 days. In all the cases, there was steady increase in the total quantity of dry matter accumulation. There was not much difference in the behaviour of the slow fertilisers as well as straight fertilisers on the dry matter accumulation.

On the rate of dry matter production, it was seen in general that a very high rate was observed between 60 and 70 days and at 80 and 90 days. Further,

it was noticed that in general, the dry matter production rate was higher at all stages when the N was applied in two splits. Under three splits it was steady but the rate was lesser compared to single and two splits. The treatment T₂ recorded higher rate of dry matter production upto 50th day as compared to other treatments. This can be mainly attributed to the application of entire dose of fertiliser at planting. On the other hand between 50 and 60th day the maximum of 1611 kg per hectare was recorded in T₂, which receive N in two splits of 25 kg N per hectare at

TABLE IV. Uptake of N kg/ha — 1973.

	10th	20th	30th	40th	50th	60th	70th	80th	90th	At harvest
	Day									
1	0.31	1.87	2.16	5.23	6.91	19.00	17.16	15.97	24.74	26.39
2	0.83	4.71	7.36	19.02	17.14	30.45	30.99	40.91	35.89	51.65
3	0.89	3.29	8.33	18.53	16.26	27.50	31.33	24.61	36.96	47.97
4	1.23	4.24	8.19	19.57	14.23	14.84	22.59	26.46	32.06	37.68
5	0.93	3.86	6.02	17.06	9.97	22.10	24.99	31.98	33.53	47.05
6	0.81	3.15	4.64	10.64	8.78	19.25	22.91	32.54	30.88	47.22
7	0.48	1.82	3.65	10.21	7.18	23.10	56.05	26.82	40.48	50.66
8	0.47	1.46	3.62	9.68	8.57	21.07	30.72	19.71	35.12	68.65
9	0.69	2.24	2.84	8.79	8.62	24.19	28.16	29.48	41.77	55.08
10	0.60	1.96	2.50	9.01	7.65	21.38	20.15	19.13	37.91	51.57
11	0.78	2.59	4.90	12.70	10.14	23.82	28.18	20.81	30.59	45.73
12	1.06	2.94	7.46	13.42	12.26	16.20	52.45	27.40	36.32	52.86
13	0.85	1.43	4.72	14.13	11.86	35.91	25.80	30.60	30.03	52.52
14	0.28	2.11	5.56	16.64	11.76	20.17	24.53	24.15	37.25	53.04
15	1.26	4.85	5.90	13.28	14.81	35.63	35.62	31.58	37.82	52.28
S.E.	3.11	0.45	0.91	3.31	3.03	4.39	3.51	7.70	4.25	4.87
C.D.	0.32	1.29	2.60	9.43	8.64	12.51	10.01	21.93	12.10	13.88

tillering and 25 kg N per hectare at seven days before panicle initiation. However, the rate of dry matter accumulation was higher in T_{10} during the later stages. The T_{10} which receive the same quantity of 50 kg N at tillering and at panicle initiation would have induced a high rate of grain formation during later stages as discussed earlier. This is also indicated by the production of grain being higher in this particular treatment.

The total nitrogen uptake was increased considerably with increasing level

of nitrogen. In case of the rate of uptake, it was observed that at 50 kg levels the same was found to be higher at all stages. In all the cases, these two peaks of uptake one around 50-60th day and the others at grain maturity stage. In the present study, the panicle initiation stage was found to be around 63 days from sowing during which period it is said that the nutrient absorption is likely to be at its minimum (Matsushima, 1969; Rajasekara and Morachan, 1974). The higher rate of nitrogen uptake under 50 kg level can be attributed to the greater availability of the same due

TABLE V. Uptake of N kg/ha — 1974

	10th	20th	30th	40th	50th day	60th	70th	80th	90th	At har- vest
1	0.49	2.56	2.57	6.20	8.30	23.83	22.31	21.85	29.66	40.40
2	0.10	5.02	5.78	21.80	22.00	29.80	33.46	51.86	43.49	68.42
3	1.30	3.83	9.14	20.20	19.70	18.39	40.01	34.82	44.91	70.80
4	1.33	4.88	9.18	21.80	18.40	18.63	29.35	37.58	59.01	62.00
5	1.24	4.39	6.53	18.40	12.30	26.82	31.61	42.38	40.47	62.79
6	0.93	3.72	5.24	12.30	10.00	25.39	38.32	43.78	37.08	66.62
7	0.66	2.16	4.18	11.30	29.33	22.09	35.61	36.61	47.38	68.78
8	0.67	3.04	4.03	10.80	10.20	26.30	39.44	32.02	43.23	69.13
9	0.87	2.71	3.44	10.70	10.50	34.16	35.33	37.13	48.10	69.29
10	0.87	2.30	3.06	10.80	9.60	26.25	27.03	36.57	45.70	69.29
11	1.01	2.93	4.31	14.20	12.30	29.19	35.68	25.28	36.64	59.36
12	1.30	3.99	10.48	15.30	15.40	19.65	32.14	34.95	43.76	66.95
13	1.14	2.10	5.33	15.90	16.90	31.34	30.93	38.55	36.05	68.18
14	0.49	4.18	6.42	17.90	13.90	26.11	30.25	38.37	41.58	72.61
15	1.37	5.47	6.52	14.90	17.70	48.99	50.63	44.00	46.46	76.09
16	1.35	4.41	8.48	27.70	30.50	24.64	25.76	27.81	31.47	73.37
S.E.	0.13	0.47	0.98	3.21	3.49	3.88	3.62	8.21	4.06	5.16
C.D.	0.36	1.33	2.80	9.95	9.94	11.04	10.30	23.39	11.56	14.70

to the different forms of nitrogen as well as split application over which the mean uptake was arrived at for the dose response.

On the effect of time of application it could be seen from the data presented that split application is generally favourably increasing the uptake of nitrogen. Chaplin (1972) observed that when the same quantity of nitrogen was applied in more splits, there was steady increase in the nitrogen content and uptake than

single doses.

The senior author wishes to acknowledge the authorities of Tamil Nadu Agricultural University, Coimbatore for permitting him to do the work on part time basis for the M.Sc. (Ag.) degree course as well as for the permission granted to publish the material. The supply of slow release fertilizers and permission to take uptake project of AICRIP for post graduate studies by ICAR is gratefully acknowledged.

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