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INCREASING N-UTILIZATION EFFICIENCY IN RICE UNDER TIGHT FERTILIZER SUPPLY

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Nitrogen application at a rate of 0, 30 and 60 percent, respectively, of the locally recommended N rates were applied to rice IR 6 in the form of urea by broadcast before and after the puddling operation, before transplanting. Also applied was 100 percent of the locally recommended N rate in three split applications by conventional method, 7 days after transplanting and at the tillering and panicle emergence stages. Simultaneously, 60 percent of the locally recommended N rate was applied in the form of A/S before and after the puddling operation. The results have shown that N-utilization efficiency was considerably increased when 30 percent of the locally recommended N rate was applied in the form of urea before puddling by broadcast and incorporated in the soil with a local plough. This was closely followed by 60 percent of locally recommended N rate applied in urea by the same technique. Going beyond 30 percent of the locally recommended N rate seems to be un-economical.

INTRODUCTION

Rice is one of the most important crops of the world and of Pakistan today. More than half of the world population subsists on it. In addition, this crop is a major source of foreign exchange earnings and hence occupies an important place in our economy. There is therefore, need to explore the ways and means of increasing its production making good use of available resources.

The world is currently experiencing a shortage of major fertilizer nutrients N, P and K. It is estimated that the situation will, by and large, remain uncertain for quite sometime (Shield, 1974). Since the impact of this shortage is being felt particularly in the developing countries like us where the fertilizer production falls short of demand. Even when the fertilizer supply is satisfactory, the importance of increasing the efficiency of fertilizer utilization cannot be under-estimated.

Recently conducted studies (Brady *et al*., 1974; Su, 1974 and Yamada, 1976) indicated that 60 kg N/ha when placed in "mudballs" at the rice root zone gave a higher paddy yield than 100 kg N/ha applied conventionally by

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by broadcasting. Similar studies conducted in Philippines (1976) India, Laos, Thailand, Korea and China indicate that the efficiency of N fertilizer applied below the soil surface has generally been twice that when broadcast on the soil surface.

MATERIALS AND METHODS

The studies on increasing the N-utilization efficiency under tight fertilizer supply were carried out in the research fields of Department of Agronomy, University of Agriculture, Faisalabad during the years 1976, 1977 and 1978. The experiments were laid out in randomized complete block design with four replications, having a net plot size of 4.8 M^2 (3.2 x 1.5m). The treatments included were :

(a) Varieties : IR6, Bas. 370
(b) Fertilizers : Urea, A/S, Scu and IBDU

Fertilizer treatments and application technique for the year 1976.

T1 - No nitrogen
T2 - 30 lbs of N in urea applied at 2 stages, 21 days after transplanting and at panicle emergence as broadcast.
T3 - 60 lbs -do- -do-
T4 - 100 lbs -do- -do-
T5 - 60 lbs of N in urea applied 12 days after transplanting as "mudballs"
T6 - 60 lbs N in urea applied at transplanting as 'point placement'
T7 - 60 lbs of N in urea applied at transplanting as 'banded and burried'
T8 - 60 lbs of N in SCU applied at transplanting as 'broadcast and incorporated.
T9 - 60 lbs of N in IBDU applied at transplanting as 'broadcast and incorporated'.
T10 - 50 lbs of N in urea applied 30 days after transplanting as broadcast.

Fertilizer treatments and application technique for the year 1977

No.	Rate of N application (kg/ha) at 3 growth stages			Carrier	Application technique
	T0	T1	T2		
1.	0	0	0	—	—
2.	30	0	0	Urea	pp**
3.	60	0	0	Urea	pp
4.	90	0	0	Urea	pp

Cont.

5.	15	15	30	Urea	pp at T0, BC at T1, T2.
6.	45	0	15	Urea	pp at T0, BC at T2.
7.	45	15	30	Urea	pp at T0, BC at T1, T2.
8	60	0	0	SCU	BC & IC before transplanting.
9.	56	28	28	Urea (local)	BC, at T0, T1, T2.
10.	60	0	0	IBDU	BC, & IC before transplanting.
11.	45	0	15	T0 SCU T2 Urea	pp. at T0 BC at T2
12.	60	0	0	A/sulphate	pp at T0
13.	60	0	0	Urea	BC & IC at T0.
14.	0	30	30	Urea	BC at T1 & T2.
15.	30	0	30	Urea	pp at T0, BC at T2
16.	60	0	0	SCU	pp

* T0 : One week after transplanting, except No. 8 and 10.

T1 : Begining of rapid tillering stage.

T2 : 5-7 days before panicle initiation stage.

** pp : Point placement. urea wrapped in tissue paper placed centrally between every 4 hills at depth of about 8 cm.

BC : Broadcasting

IC : Incorporating

Fertilizer treatments and application technique for the year 1978

T1	—	30 kg N/ha in urea)	Added to the dry soil by broadcast and incorporated with local plough before puddling (B.P)
T2	—	60 " " ")	
T3	—	90 " " ")	
T4	—	60 " " A/S)	
T5	—	30 kg N/ha in urea)	Added to the puddled soil before transplanting (A.P)
T6	—	60 " " ")	
T7	—	90 " " ")	
T8	—	60 " " A/S)	
T9	—	100 " " urea) (50 + 25 + 25))	Applied by broadcast respectively, 7 days, 25 days, 45 days after transplanting.
T10	—	Check	

Seedlings in all the 8 experiments were raised in the month of June and transplanting done in 1st week of July. All other practices were kept normal and uniform for all the treatments.

RESULTS

TABLE 1. *Paddy yield (kg./ha) corrected to 13% moisture; 1976 & 1977*

1976

T. No.	Kg/plot		Kg/ha	
	IR6	B.370	IR6	B.370
T1	3.1	2.4	5618.74	4350.00
T2	3.4	2.4	6162.49	4350.00
T3	3.7	2.9	6706.24	5256.24
T4	4.1	2.3	7431.24	4168.74
T5	4.6	4.3	8337.49	5793.74
T6	2.5	1.6	4531.24	2899.99
T7	3.0	2.0	5437.50	3624.99
T8	3.8	2.6	6887.49	4712.49
T9	3.6	3.2	6525.00	5799.99
T10	4.1	2.6	7431.24	4712.49

1977

T. No.	Kg/plot	Kg/ha
	IR_6	
T1	2.75	4984.36
T2	3.63	6579.50
T3	3.69	8688.12
T4	3.46	6271.24
T5	3.65	6615.62
T6	3.28	5944.99
T7	3.46	6271.24
T8	3.43	6216.87
T9	3.68	6669.99
T10	3.40	6162.49
T11	3.26	5908. 7
T12	3.41	6180.62
T13	3.00	5437.50
T14	3.62	6561.24
T15	3.10	5818.74
T16	3.46	6271.24

The results of the last 2 years, 1976 and 1977, (Table 1) provided evidence to show that the N utilization efficiency was substantially increased with the application of 30 per cent and 60 per cent of the locally recommended N rate in the form of urea applied as placement technique in "Mudballs" or tissue paper 12 days after transplanting. These findings were considered significant for obtaining higher economic yields with lesser N supply. But since this technique being laborious and time consuming may not be adopted by the farmer, it was changed to avoid the practical difficulties and to reduce production costs and make inputs use more attractive to the farmer. The principle kept in view was, of course the same. The paddy yield of the year 1978 is given in Table 2 and the statistical results obtained are presented in Tables 3 - 6.

TABLE 2. *Paddy yields (1978)*

Treatments	Kg/plot	Kg/ha (Corrected to 13% moisture)	N-efficiency (Kg paddy/Kg N).
T1 30kg B.P. (Urea)	3,816	6916.50	120.83
T2 60kg B.P. (")	3.550	6434.37	52.38
T3 90kg B.P. (")	3.416	6191.49	32.22
T4 60kg B.P. (A/S)	3.103	5769.21	41.29
T5 30kg A.P. (Urea)	2,966	5375.87	69.47
T6 60kg A.P. (")	3,166	5738,37	40,78
T7 90kg A.P. (")	3.200	5799.99	27.87
T8 60kg A.P. (A/S)	3.066	5557.12	37.76
T9 100 kg (Conventional)	2.566	5345.83	20.54
T10 Check	1.816	3291.49	-

TABLE 3. *Plant height as influenced by N application technique*

Analysis of variance for plant height (cm)

S.V.	D.F.	S.S.	M.S.	F.R.	S.E.
R	2	895.56	447.58	-	4.802
T	9	2282.62	253.62	3.66*	
E	18	1245.34	69.18		
Total :-	29	4423.52			

Individual Comparison of Means

T_1	T_2	T_3	T_5	T_6	T_4	T_9	T_7	T_8	T_{10}
110.08	107.90	106.69	105.99	104.97	103.58	101.22	100.28	96.86	77.45

TABLE 4. *Panicle bearing tillers as influenced by N application technique*
Analysis of variance for panicle bearing tillers

S.V.	D.F.	S.S.	M.S.	F.R.	S.E.
R	2	6.56	3.28	–	1.07
T	9	79.30	8.81	2.53*	
E	18	62.75	3.48		
Total :	29	148.61			

Individual Comparison of Means

T_6	T_1	T_3	T_8	T_4	T_2	T_5	T_9	T_7	T_{10}
16.06	14.96	14.76	14.46	13.63	13.46	12.93	12.73	11.86	10.1

*Significant

TABLE 5. *Paddy yield (kg/4.8m²) as influenced by N application technique.*
Analysis of variance for paddy yields (kg)

S.V.	D.F.	S.S.	M.S.	F.R.	S.E.
R	2	10.33	5.16	–	0.346
T	9	8.35	0.92	2.55*	
E	18	6.58	0.36		
Total :	29	25.26			

Individual Comparison of Means

T_1	T_2	T_3	T_7	T_4	T_6	T_8	T_5	T_9	T_{10}
3.81	3.55	3.41	3.20	3.18	3.16	3.06	2.96	2.56	1.81

TABLE 6. *Straw yield (kg/4.8m²) as influenced by N application technique: Analysis of variance for straw yield (kg)*

S.F.	D.F.	S.S.	M.S.	F.R.	S.E.
R	2	48.76	24.38	–	0.916
T	9	50.60	6.51	2.58*	
E	18	45.46	2.52		
Total :-	29	152.02			

Individual Comparison of Means

T_1	T_2	T_3	T_8	T_6	T_7	T_5	T_9	T_4	T_{10}
9.38	8.96	7.96	7.90	7.78	7.63	7.25	7.18	7.06	3.90

*Significant

RESULTS AND DISCUSSIONS

There is a conclusive evidence to show (Table 1-6) that N in the form of urea applied to rice IR6 at a rate of 30 kgN/ha by broadcast and incorporating in the soil before transplanting prior to puddling produced yields as high as 60 kg N/ha applied by the same technique and significantly higher than 90 kg N/ha applied by the same technique and 100 kg N/ha conventionally applied.

Application of 30 kg N/ha in urea by broadcast and incorporating in the soil before transplanting prior to puddling also resulted in larger paddy yields compared to the rest of the N carriers like SCU and IBDU and their applying techniques.

Addition of N beyond 30 kg N/ha seems to be uneconomical and wasteful under Faisalabad conditions. On the basis of results obtained, SCU and IBDU, slow releasing fertilizers cannot be recommended under our conditions due to their non availability and high market prices.

N utilization efficiency seems to have been increased probably by minimizing the losses due to leaching and oxidation; nitrogen coming closer to the root system; uniform mixing up of the N, and creation of complete anaerobic conditions, from where the N may not escape.

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