

A Comparative study of Urea and Ammonium sulphate as the source of Nitrogen for Rice in Kerala

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Introduction

Chemical fertilisers can considerably enhance rice production which is the need of the day for attaining self sufficiency in food. Application of fertilizers has resulted in , tangible crop responses in different parts of our country. Among the nitrogenous fertilizers Ammonium sulphate has been the most widely used, others available in the market being urea, ammonium sulphate nitrate and calcium ammonium nitrate. The limitation in the availability of ammonium sulphate makes it necessary to go in for other nitrogenous fertilizers and to find out other suitable substitutes. Urea is such a fertilizer which is becoming increasingly popular with the cultivators. The results of an experiment conducted at the Agricultural Research Station, Pattambi, Kerala during the years 1957 to 1961 to assess the relative efficacies of urea and ammonium sulphate as nitrogenous fertilizers for swamp rice are discussed in this paper.

Review of literature

Varying results have been reported by different workers on the relative efficiencies

of urea and ammonium sulphate as fertilisers for rice. Sethi *et al* (1952) reported from the Central Rice Research Institute, Cuttack that ammonium sulphate and urea are superior to ammonium nitrate. The response of rice to urea and ammonium sulphate was almost equal. However, at Nagina in Uttar Pradesh, ammonium sulphate gave better response than urea, though the difference was not significant. (Sethi *et al* 1952) Abdul Samad and Sahadevan (1952) summarised several manurial experiments conducted at the Agricultural Research Station, Pattambi and suggested a combination of green leaf and ammonium sulphate for low land rice varieties. Comparing the relative efficacies of ammonium sulphate and Chilean nitrate Sahadevan and Gopalakrishnan (1958) have reported on the superiority of ammonium sulphate in combination with green leaf and lime. Sreenivasan and Balasubramonium (1959), however, found that the response of rice to ammonium sulphate, ammonium chloride and urea was almost equal. Desai *et al* (1957) observed a significant lowering in the production of tillers and grain yield by the use of ammonium

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sulphate in ill drained soils, this reduction becoming more marked with increasing levels of fertilizer. According to Kellner (1884) low land rice grew better in nutrient medium containing ammonium nitrogen in the early stages of development. Abichandani and Patnaik (1958), while discussing the manurial trials conducted with different nitrogenous fertilizers in India, have concluded that ammonium sulphate and ammonium chloride are the best fertilisers for increasing rice yields. But the use of ammonium chloride was not recommended for acid soils. The results of the all India T. C. M. fertilizer trials showed that urea is as good as ammonium sulphate though the results varied from place to place.

The action of urea under flooded conditions also has been studied at the C.R.R.I., Cuttack, where it was found that urea well mixed with dry or semidry soils about 24 to 48 hours prior to flooding gave as good results as ammonium sulphate. In Japan, according to Sethi *et al* (1952), ammonium sulphate, urea and calcium cyanamide were found to show almost the same effect on crop yields.

Materials and Methods

An experiment to study the relative efficiencies of urea and ammonium sulphate was conducted at the Agricultural Research Station, Pattambi, Kerala, for eight seasons - four autumn (April—May to August—September) and four winter — (August—September to January—February) from 1957 to 1961. Urea (46% N) at three levels (viz., 30 lb N/acre, 60 lb N/acre and 90 lb N/acre) was tried alone and in combination with ammonium sulphate at the same three levels. The fertilizers were applied as top dressing, in two split doses, the first half one month after transplanting and the second half 15 days after the first application. All the treatments were given a basal dressing of green leaves @ 4000 lb per acre. Two strains of medium duration rice Ptb 2 (135 days) and Ptb 20 (125 days) were grown as autumn and winter crops respectively. The twelve treatment combinations were replicated four times in a randomised block design. Each sub plot had an area of 200 square feet. The treatments compared were as follows :

- 1 Urea at 30 lb N/acre.
 - 2 Urea at 30 lb N/acre + ammonium sulphate at 30 lb N/acre
 - 3 Urea at 30 lb N/acre + ammonium sulphate at 60 lb N/acre
 - 4 Urea at 30 lb N/acre + ammonium sulphate at 90 lb N/acre
 - 5 Urea at 60 lb N/acre
 - 6 Urea at 60 lb N/acre + ammonium sulphate at 30 lb N/acre
 - 7 Urea at 60 lb N/acre + ammonium sulphate at 60 lb N/acre
 - 8 Urea at 60 lb N/acre + ammonium sulphate at 90 lb N/acre
 - 9 Urea at 90 lb N/acre.
 - 10 Urea at 90 lb N/acre + ammonium sulphate at 30 lb N/acre
 - 11 Urea at 90 lb N/acre + ammonium sulphate at 60 lb N/acre
 - 12 Urea at 90 lb N/acre + ammonium sulphate at 90 lb N/acre
- Basal dressing : Green leaf at 4000 lb/acre in all plots

TABLE I

Grain yield in lb per acre-Autumn seasons

Treatments	1957-58	1958-59	1959-60	1960-61	Mean
1	3529	2719	3022	2583	2784
2	3328	2750	3036	2634	2937
3	3457	2746	2702	2848	3002
4	3318	2729	2746	2767	3002
5	3618	2689	2651	2797	2964
6	3383	2848	2865	2232	2991
7	3233	2617	2774	2780	3008
8	3063	2624	2386	2831	2980
9	3390	2804	2944	3155	2903
10	3601	2634	2627	2944	3042
11	3298	2818	2671	2821	3093
12	3247	2471	2212	2777	2869
S. Ed.	129.46*	175.6	201.5*	213.7*	703.8
C.D. (5%)	253.7	-	394.9	418.9	-

* Indicates significance at 5% level.

TABLE II

Grain yield in lb per acre-Winter seasons

Treatments	1957-58	1958-59	1959-60	1960-61	Mean
1	2107	1654	2345	2456	2164
2	2318	2090	2518	3138	2518
3	2808	2198	2460	3335	2699
4	2392	2443	2828	3192	2719
5	2563	1719	2529	3008	2454
6	2168	2321	2631	3100	2556
7	2195	2263	2842	3335	2626
8	2719	2443	2920	3318	2855
9	2239	1981	2733	2682	2413
10	2484	2212	2746	3168	2658
11	2379	2443	2872	3386	2774
12	2243	2348	2770	2971	2586
S. Ed	160.1	53.5*	117.1*	234.1	10.62*
C. D. (5%)	-	104.9	229.4	-	29.04

* **Indicates** significance at 5 per cent **level.**

Results

The yield data obtained were statistically analysed, separately for each season, and are presented in Tables I and II. It can be seen from the Tables that in five of the eight seasons the results were significant.

Two groups of pooled **analysis**, one for the autumn seasons and the other for winter seasons, were attempted. In the former case the error variances of individual seasons were found to be homogeneous and unweighted **analysis** was carried out, unlike in the latter case where the error variances of individual seasons were found to be heterogeneous and hence weighted analysis had to be adopted. The results of the above analysis are presented in Tables I and II in the column 'mean' of the respective seasons of the two groups. The treatment differences of **winter** seasons only were found to satisfy **the test** of significance.

Discussion

Tables I and II reveal that in three of the four autumn seasons and in two of the four winter seasons the results obtained have been significant. It can be seen that **Tr. 5** in 1957-58, **Tr 6** in **1958-59**, **Tr.2** in 1959-60 **Tr.9** in 1960-61 of the four autumn seasons and **Tr.3** in 1957-58, **Tr.4** in 1958-59, **Tr.8** in 1959-60 and **Tr.11** in 1960-61 of the four winter seasons had outyielded the others. This **would** mean that no one particular treatment maintained its superiority over the others in all the different seasons.

Though the results presented in Table I for the autumn seasons did not satisfy the test of significance, **Tr. 11** (90 Urea+60 Ammo **sulph.**) recorded the highest yield of 3093 **lb** of grain per acre in the **autumn**

season which is **113 lb** in excess of its parallel **Tr. 8** (90 **Amm.** sulph. + 60 urea). **Tr. 11** was followed by **Tr. 10** (90 urea + 30 **Amm.** sulph.) with a yield of 3042 **lb** of grain per acre, which again was 20 **lb** in excess of the **similar** **Tr. 4** (90 **Amm.** sulph. + 30 urea). From the results presented in the Table for winter seasons it can be seen that in the winter season **Tr. 8** (90 **Amm.** sulph. + 60 urea) had recorded a significantly superior **yield** of 2855 **lb** of grain per acre followed by its parrallel **Tr. 11** (90 urea + 60 **Amm.** sulph.) with 2774 **lb** of grain per acre. This was followed by **Tr. 4** (90 **Amm.** sulph. + 30 urea) recording a yield of 2719 **lb** per acre which is **61 lb** in excess of its counterpart **Tr. 10** (90 urea + 30 **Amm.** sulph.) which was found to secure only the sixth rank in the order of merit.

A comparison of the results of the autumn and winter seasons revealed the fact that though treatments with 150 **lb** N had recorded the highest acre yields in both the seasons they were found to differ in their composition. Thus when **Tr. 11** (90 urea + 60 **Amm.** sulph.) had outyielded others in autumn seasons, **Tr. 8** (90 **Amm.** sulph. + 60 urea) ranked first in the winter seasons. In other words, a **higher-proportion** of urea in the combination was preferred in the autumn season unlike in winter when a higher proportion of ammonium sulphate gave better results. The fact that three of the four autumn season treatments with a higher proportion of urea and three of the four winter season treatments with higher quantities of Ammonium sulphate produced better yields than the others was also in agreement with the above inference.

The economics of **manuring** indicated that the extra expenditure incurred towards manuring beyond a level of 90 **lb** N per

acre in any combination was not compensated by the increase in grain yield in both the **seasons**, even though linear increase in yields could be obtained by increased levels of N upto 150 lb N per acre. This was in conformity with the **earlier** findings of this station. (Unpublished records).

Summary

An experiment to compare the effects of urea and ammonium sulphate on the yield of rice was carried out at the Agricultural Research Station, **Pattambi**, for eight seasons from 1957-1961. The chief findings were as **follows** :-

1. In both autumn and winter seasons increase in yields for applications of fertilisers upto a level of 150 lb N per acre was obtained. But nitrogen applications above 90 lb per acre were not found to give economic returns.

2. In the autumn **seasons**, a higher proportion of urea in combination with Ammonium sulphate was found to have preference, unlike in the winter season when a higher percentage of Ammonium sulphate in the combination was found to give better results.

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