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Ammonium chloride and Urea as Fertilizer for Rice

by

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Synopsis : The results of the trials conducted at the Agricultural Research Stations, Aduthurai, Pattukottai and Thirurkuppam to study the efficacy of application of nitrogenous fertilizers in the form of ammonium sulphate, ammonium chloride and urea are reported in this paper.

Introduction : Among the nitrogenous fertilizers, ammonium sulphate is the best known and is being used for intensive cultivation. Ammonium chloride and urea are two other fertilizers under this group and they have the prospect of being produced in large quantities. The experts are of opinion that the scope for increased production of ammonium sulphate is very limited in view of the prohibitive cost of raw materials like gypsum and sulphur and that ammonium chloride can be produced at comparatively lower cost in alkali plants and soda ash industries. Before recommending to ryots the use of ammonium chloride as well as urea in the place of ammonium sulphate in the manuring schedule for successful crop husbandry, systematic trials have necessarily to be conducted, as the crop yield is the only safe index that decides the value of a fertilizer.

Review of Literature : Although ammonium chloride is not widely used as a fertilizer, a number of trials carried out in other countries particularly in U. S. A. have shown that it is as efficient a source of nitrogen as sulphate of ammonia to crops like cotton and potato (Skinner and Buie, 1926). The findings reported by Russell (1950) go to show that ammonium chloride has been found to be better than ammonium sulphate in respect of crops like barley and buckwheat. Cheng *et al.* (1952) have reported that in Formosa the efficiency of ammonium chloride was 98 per cent for a second crop of rice as against 100 of ammonium sulphate and both were superior to urea and ammonium nitrate. In Japan, ammonium chloride is being used on a large scale by rice growers as a substitute for ammonium sulphate (Desai 1956). Harada (1952) reported that ammonium chloride was as efficient as ammonium sulphate in increasing the yield of rice crop. Srinivasan and Balasubramanian (1959) reported that over a basal dressing of 5000 lb. of green leaf and 30 lb. P_2O_5 in the form of superphosphate, application of 15 lb. in the form of any of the three fertilizers viz., ammonium sulphate, ammonium chloride and urea was observed to be optimum to obtain the maximum yield under the conditions existing at Aduthurai.

Materials and Methods : With a view to assess the comparative efficacy of ammonium chloride and urea with ammonium sulphate as a nitrogenous manure for swamp paddy a randomised and replicated experiment with four levels of

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nitrogen viz., 15 lb. N, 30 lb. N, 45 lb. N, and 60 lb. N over a basal dressing of 5000 lb. green leaf and 30 lb. P_2O_5 as superphosphate was initiated during 1956-57 *Samba* season in the main single crop fields at the Agricultural Research Station, Aduthurai and the study was pursued for a period of three years in succession. On similar lines the experiment was started at the Agricultural Research Station, Pattukottai as well as at the Rice Research Station, Tirurkuppam deleting urea conducted during three consecutive years. Strain Co. 25 a blast resistant variety was grown in the experiments at Aduthurai and Pattukottai while ASD. 5 was grown at Tirurkuppam. The transplanting was done 6" apart using two seedlings per hole. The nitrogenous fertilizers at four levels of N were topdressed 45 days after transplantation in one dose. The grain yield data of the experiment in respect of three Research Stations were analysed statistically and the results are furnished below.

AGRICULTURAL RESEARCH STATION, ADUTHURAI:

Results of ammonium chloride, urea and ammonium sulphate experiment

S. No.	Treatments	Acre yield of grain in lb.			As percentage on control		
		1956-'57	1957-'58	1958-'59	1956-'57	1957-'58	1958-'59
1.	0 lb. N Control	3449	2939	3607	100·0	100·0	100·0
2.	15 lb. N per acre as ammonium sulphate	3784	3103	4093	110·8	105·5	113·4
3.	30 lb. N per acre as ammonium sulphate	3562	3200	4131	103·2	108·9	114·6
4.	45 lb. N per acre as ammonium sulphate	3358	3240	4118	97·3	110·3	114·2
5.	60 lb. N per acre as ammonium sulphate	3309	3049	3961	95·9	103·8	109·8
6.	15 lb. N per acre as ammonium chloride	3627	3122	4080	105·2	106·3	113·1
7.	30 lb. N per acre as ammonium chloride	3482	3004	3659	100·9	102·2	101·5
8.	45 lb. N per acre as ammonium chloride	3286	3016	4027	95·2	102·7	111·6
9.	60 lb. N per acre as ammonium chloride	3198	3010	3842	92·7	102·4	106·5
10.	15 lb. N per acre as urea	3562	3332	3961	103·2	113·3	109·9
11.	30 lb. N per acre as urea	3466	3082	4014	100·2	104·9	111·3
12.	45 lb. N per acre as urea	3449	3016	3987	100·0	102·7	110·3
13.	60 lb. N per acre as urea	3263	2912	3757	94·6	99·1	104·2
"F" Test satisfied or not P=0·05		No	No	Yes	No	No	Yes
Standard error		151·8	110·8	105·4	4·4	3·8	3·2
Critical difference P=0·05		...	...	302·5	...	...	9·2
Conclusion:	1956-'57 and 1957-'58	Treatment differences not statistically significant					
	1958-'59	3, 4, 2, 6, 8, 11, 12, 5, 10, 9, 13, 7, 1					

AGRICULTURAL RESEARCH STATION, PATTUKOTTAI:

Results of ammonium chloride and ammonium sulphate experiment

S. No.	Treatments		Acre yield of grain in lb.			As percentage on control		
			1956–'57	1957–'58	1958–'59	1956–'57	1957–'58	1958–'59
1.	0 lb. N	Control	3120	1552	4050	100·0	100·0	100·0
2.	15 lb. N	per	3407	1276	3949	109·2	82·2	97·5
3.	30 lb. N	acre as	3431	1260	4011	110·0	81·2	99·0
4.	45 lb. N	ammonium	3221	1095	4006	103·2	70·6	98·9
5.	60 lb. N	sulphate	3461	539	3649	111·0	34·7	90·1
6.	15 lb. N	per	2676	1428	3773	85·8	95·2	93·2
7.	30 lb. N	acre as	3563	1618	4115	114·2	104·2	101·2
8.	45 lb. N	ammonium	3509	1210	4147	112·5	77·9	102·4
9.	60 lb. N	chloride	3201	1174	3813	105·4	75·7	94·1
"F" Test satisfied or not P=0·05			No	Yes	No	No	Yes	No
Standard error			250·0	169·0	203·0	8·0	10·9	5·0
Critical difference P=0·05			...	488·0	...	...	31·5	...
Conclusion:	1956–'57 and 1957–'58		Treatment differences not statistically significant					
	1957–'58		7, 1, 6, 2, 3, 8, 9, 4, 5.					

RICE RESEARCH STATION, TIRURKUPPAM:

Results of ammonium chloride and ammonium sulphate experiment

S. No.	Treatments		Acre yield of grain in lb.			As percentage on control		
			1956–'57	1957–'58	1958–'59	1956–'57	1957–'58	1958–'59
1.	0 lb. N	Control	1768	1366	1128	100·0	100·0	100·0
2.	15 lb. N	per	1990	1435	1285	112·6	105·1	114·0
3.	30 lb. N	acre as	2208	1653	1537	124·8	121·1	136·2
4.	45 lb. N	ammonium	2309	1832	1522	130·5	134·2	134·9
5.	60 lb. N	sulphate	2309	2031	1830	130·5	148·7	162·3
6.	15 lb. N	per	2187	1441	1284	123·7	105·4	113·9
7.	30 lb. N	acre as	2096	1693	1492	118·5	124·0	132·3
8.	45 lb. N	ammonium	2177	1774	1557	123·1	129 9	138·0
9.	60 lb. N	chloride	2440	2024	1747	138·0	148·2	154·9
"F" Test satisfied or not P=0·05			Yes	Yes	Yes	Yes	Yes	Yes

RICE RESEARCH STATION, TIRURKUPPAM: *(Contd.)*

S. No.	Treatments	Acre yield of grain in lb.			As percentage on control		
		1956–'57	1957–'58	1958–'59	1956–'57	1957–'58	1958–'59
Standard error		84·4	89·9	23 8	4·8	6·6	2·1
Critical difference P=0·05		242·5	259·0	68·4	13·1	19·0	6·1
Conclusion:	1956–'57	9, 4, 5, 3, 6, 8, 7, 2, 1					
	1957–'58	5, 9, 4, 8, 7, 3, 6, 2, 1					
	1958–'59	5, 9, 8, 3, 4, 7, 2, 6, 1					

Results: At the Agricultural Research Station, Aduthurai during the first two years (1956–57 and 1957–58) the differences in grain yield due to the application of three different forms of nitrogen viz., ammonium sulphate, ammonium chloride and urea at four levels of nitrogen were not significant but, however, from the trend it was found that all the three forms of fertilizers were equally efficacious. During the third year of the trial (1958–59) the statistical analysis of grain yield data showed that there were significant yield differences between the control and the other variants representing different doses of three nitrogenous fertilizers. In the order of efficacy, ammonium sulphate was better than ammonium chloride and urea while ammonium chloride was better than urea. At the Agricultural Research Station, Pattukottai, where the two fertilizers viz. ammonium sulphate and ammonium chloride were tried at four levels of nitrogen, it was found that the grain yield differences were not significant in two out of three years (1956–57 and 1958–59). Ammonium chloride at 30 lb. N level recorded the maximum yield during the first two years and the grain yield increase ranged from 4·2% to 14·2% over control. During the third year also ammonium chloride (at 45 lb. N level) recorded the highest yield compared to other treatments. Under the conditions existing at Pattukottai, ammonium chloride appeared to be better suited than ammonium sulphate and application of nitrogen at 30 lb. N was found to be the optimum. At the Rice Research Station, Tirurkuppam, where two fertilizers, ammonium sulphate and ammonium chloride were tried at four levels of nitrogen, the grain yield differences were significant in all the three years (1957–57 to 1958–59). The crop response to nitrogen was very spectacular in respect of all the treatments and they recorded higher yield than the control. During the first year of trial ammonium chloride at 60 lb. N level recorded the maximum yield while ammonium sulphate at 60 lb. N level recorded the highest yield in the next two years. In general, ammonium chloride was observed to be as efficacious as ammonium sulphate and the crop response at higher levels of 40 lb. N and 60 lb. N was a unique feature under the loamy soil conditions existing at Tirurkuppam.

Summary: In the field experiments conducted at the Agricultural Research Station, Aduthurai for three years in succession ammonium sulphate, ammonium chloride and urea were found to be good sources of nitrogen for paddy and gave higher yields at four levels of nitrogen viz., 15 lb. N, 30 lb. N, 45 lb. N and 60 lb. N over the control receiving 5000 lb. green leaf and 30 lb. P_2O_5 per acre. Under the soil conditions existing at Aduthurai (Old Delta), application of nitrogen in any of the three forms of fertilizers beyond 15 lb. N level was not economical. The experiment tried at the Agricultural Research Station, Pattukottai (New Delta) for a period of three years with two fertilizers revealed the superiority of ammonium chloride over ammonium sulphate. With regard to the level of nitrogen, application of nitrogen at 30 lb. N level was observed to be the optimum. On the other hand the experiment conducted at the Rice Research Station, Tirurkuppam in light and open type of soil for three years with two fertilizers had shown that there was spectacular response for nitrogen application. Ammonium chloride was found to compare favourably with ammonium sulphate and the crop response at higher levels of nitrogen was more conspicuous than at lower levels.

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