https://doi.org/10.29321/MAJ.10.A03814

A preliminary study on the efficacy of calcium ammonium nitrate for fertilizing rice*

by

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Synopsis: The comparative efficacy of calcium ammonium nitrate and ammonium sulphate for fertilizing paddy is reported in this paper, based on an experiment conducted with one short duration and one long duration strain (Co. 29 and Co. 25) during 1960-61 and 1961-62 respectively.

Introduction: The nitrogen industry of Europe has volunteered to help India in the production and distribution of a new fertilizer called calcium ammonium nitrate by establishing an organisation by the name Kisan Khad Scheme of India. With a view to assess the comparative efficacy of the new fertilizer with ammonium sulphate, an experiment was conducted and the results obtained are recorded in this paper.

Review of Literature: Calcium ammonium nitrate (CAN) contains 20.5 per cent nitrogen (like ammonium sulphate) of which half the quantity is in the nitrate form and the balance in the ammoniacal form. In addition to nitrogen it contains 36 per cent calcium carbonate which neutralises the acidity of the soil and keeps the soil in good physical condition (*Anon*, 1962). The application of CAN neither adds acidity nor alkalinity to the soil but supplements the loss of calcium that is being removed in large quantities from the soil every year by different crops (Nijhawan, 1960). Prasad (1958) has reported that trials conducted by the Kisan Khad Scheme of India on various crops go to show that CAN compares favourably with ammonium sulphate.

Materials and Methods: The experiment was laid out with two fertilizers *viz*, calcium ammonium nitrate and ammonium sulphate to supply 30 lb N and 45 lb N per acre. CAN was applied in two different modes *viz*, (a) half the quantity was applied at the time of planting and the balance one month after planting and (b) 1/3 was applied at the time of planting and 2/3 one month after planting while ammonium sulphate was applied in two equal split doses, half at the time of planting and the balance one month after planting. Ammonium sulphate was applied alone and in combination with lime to supply an equal amount of calcium carbonate that is available in CAN. The experiment was conducted with Co. 29 (short duration blast resistant *Arupathamkodai*) during 1960–61 *navarai* season and with Co. 25 (Blast resistant hybrid *sirumani* - long duration) during 1961–62 *samba* season at the Paddy Breeding Station, Coimbatore. Transplanting was

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* Received on 11—2—1966

done with a spacing of 10" x 4" for Co. 29 and 10" x 6" for Co. 25 with two seedlings per hole. The following nine treatments were randomized and replicated four times.

1. 5000 lb green leaf + 30 lb $P_2 O_5$ as super phosphate (Control).
2. Control + 30 lb N as CAN applied in two doses, half at planting + half one month after planting.
3. Control + 45 lb N as CAN applied as in treatment 2.
4. Control + 30 lb N as CAN applied in two doses, 1/3 at planting, + 2/3 one month after planting.
5. Control + 45 lb N as CAN applied as in treatment 4.
6. Control + 30 lb N as ammonium sulphate applied in two doses, half at planting + half one month after planting.
7. Control + 45 lb N as ammonium sulphate applied as in treatment 6.
8. Control + 30 lb N as ammonium sulphate applied as in treatment 6 + 52.7 lb of calcium carbonate as quick lime (to equalise the calcium carbonate available in CAN).
9. Control + 45 lb N as ammonium sulphate applied as in treatment 6 + 79.05 lb of calcium carbonate as quick lime (to equalize the calcium carbonate available in CAN).

The yield data of grain and straw were analysed statistically for an overall effect and also for individual effect *viz*, source of N, levels of N, mode of application and their interactions. The results are furnished in the tables I, II a, b, c and d.

TABLE I

Yield data

Treatment	Co. 29				Co. 25			
	Grain		Straw		Grain		Straw	
	Acre yield in lb	Percentage on control	Acre yield in lb	Percentage on control	Acre yield in lb	Percentage on control	Acre yield in lb	Percentage on control
1. (Control) ...	2579	100·0	3263	100·0	3062	100·0	3469	100·0
2. ...	2194	85·04	2394	73 4	3672	119 9	4376	126·3
3. ...	2656	103·0	3126	95·8	3749	122·5	4358	125·6
4. ...	2381	92·3	2708	83·3	3755	132 7	4187	120·7
5. ...	2336	90 6	2918	89 4	3656	119·4	4072	117·4
6. ...	2532	100·1	3292	100·9	4191	136·9	4912	141·8
7. ...	2632	102·1	3383	103·6	3984	130·1	5452	157·1
8. ...	2517	97 6	3158	96·8	3980	130 0	4785	137·9
9. ...	2858	110 8	3502	107·4	3940	128·6	5260	151·2
General Mean ...	2525	97·9	3083	94 5	3777	123·4	4542	130·9

TABLE I *(Contd.)*

Treatment	Co. 29				Co. 25			
	Grain		Straw		Grain		Straw	
	Acre yield in lb	Percentage on control	Acre yield in lb	Percentage on control	Acre yield in lb	Percentage on control	Acre yield in lb	Percentage on control
Standard error ...	93·28	3·62	138·8	4·25	25·74	0·8	47·1	1·3
'F' test ...	Satisfied		Satisfied		Satisfied		Satisfied	
Critical difference (P=0·05) ...	272·8	10·58	405·1	12·42	75·02	2·4	137·3	3·9

Conclusion:

	Grain	Straw
Co. 25 ...	6, 7, 8, 9, 4, 3, 2, 5, 1	7, 9, 6, 8, 2, 3, 4, 5, 1
Co. 29 ...	9, 3, 7, 6, 1, 8, 4, 5, 2	9, 7, 6 1, 8, 3, 5, 4, 2

TABLE II (a)

Source of Nitrogen.

Treatments	Co. 29				Co 25			
	Acre yield of grain in lb	Percentage on CAN	Acre yield of straw in lb	Percentage on CAN	Acre yield of grain in lb	Percentage on CAN	Acre yield of straw in lb	Percentage on CAN
CAN	2392	100·0	2787	100·0	3738	100·0	4248	100·0
Ammonium sulphate	2647	110·6	3334	119·6	4024	108·5	5104	120·1
G. M.	2520	105·3	3061	109·8	3866	104·4	4676	110·05
S. E.	46·7	1·95	69·45	2·49	28·3	0 76	207·2	4·88
'F' Test	Satisfied		Satisfied		Satisfied		Satisfied	
C. D. (P=0·05)	136·3	5·7	203·5	7·31	82·6	2·23	605·3	14·25
Conclusion	Ammonium sulphate, CAN				Ammonium sulphate, CAN			

TABLE II (b)

Levels of nitrogen

Treatment	Co. 29				Co. 25			
	Acre yield of grain in lb	Percentage on 30 lb N.	Acre yield of straw in lb	Percentage on 30 lb N.	Acre yield of grain in lb	Percentage on 30 lb N.	Acre yield of grain in lb	Percentage on 30 lb N.
30 lb. N.	2419	100·0	2888	100·0	3900	100·0	4567	100·0
45 lb N.	2621	108·3	3233	111·9	3832	98·3	4786	104·8
G. M.	2520	104·2	3061	105·9	3866	99·2	4676	102·4
S. E.	46·70	1·93	69 5	2·40	28·3	0·73	207·2	4·54
'F' Test	Satisfied		Satisfied		Satisfied		Not Satisfied	
C. D. (P=0·05)	136·3	5·64	203·5	7·04	82 6	2·12	...	...
Conclusion	45, 30		45, 30		30,45		30, 45	

TABLE II (c)

Interaction 'source × levels of N' for Co. 25.

Levels of N.	Grain Yield			Straw Yield		
	CAN	Ammonium Sulphate	G. M.	CAN	Ammonium Sulphate	G. M.
30 lb	3711	4088	3899	4282	4852	4567
45 lb	3705	3960	3833	4215	5356	4761
G. M.	3708	4024	3866	4248	5079	4676
S. E.	...	...	40·01	...	—	133·2
'F' Test		Satisfied			Satisfied	
C. D. (P=0·05)	...	...	116·8	...	...	...
Conclusion:	30 lb N: Ammonium Sulphate, CAN			30 lb N: Ammonium Sulphate, CAN		
	45 lb N: do.			45 lb N: do.		
	CAN: 30, 45			CAN: 30, 45		
	Ammonium sulphate: 30, 45			Ammonium sulphate: 45, 30		

TABLE II (d)

Grain yield for interaction 'mode of application × levels of N' for CAN

Mode of application	Co. 29			Co. 25		
	½ + ½ (a)	⅓ + ⅔ (b)	G. M.	½ + ½ (a)	⅓ + ⅔ (b)	G. M.
Levels of N						
30 lb	2194	2381	2288	3672	3755	3714
45 lb	2656	2336	2496	3749	3656	3702
G. M.	2425	2359	2392	3711	3705	3708
S. E.	...	...	93·26	...	...	56·57
'F' Test		Satisfied			Satisfied	
C. D. (P=0.05)	...	...	272·1	...	...	165·1
Conclusion:	30 lb N: b, a (a): 45, 30			30 lb N: b, a (a): 45, 30		
	45 lb N: a, b (b): 30, 45			45 lb N: a, b (b): 30, 45		

Results: The treatment differences were statistically significant for grain and straw yields of Co. 29. Treatment 9 recorded the maximum grain yield which was on a par with treatments 3 and 7. In the case of straw yield also treatment 9 yielded the highest and was on a par with treatments 7, 6, 1, 8 and 3. The yield increases over the control ranged from 0.1 to 10.8 per cent for grain and 0.9 to 7.4 per cent for straw (Table I).

The grain and straw yield differences were highly significant for source of N and levels of N but not for their interaction. The application of ammonium sulphate resulted in an increase of 10.6 per cent in grain yield and 19.6 per cent in straw yield. Between the two levels of N, the 45 lb dose was found to be superior to that of 30 lb irrespective of the source of N as the interaction between source and levels of N was not significant. There was no difference between the two modes of application of CAN in respect of grain and straw yields. However, the interaction between the mode of application and levels of N was significant for grain

yield alone. The application of 45 lb N was superior to 30 lb N when applied in equal split doses. The results of the treatment *viz*, 30 lb N applied in the ratio of 1:2 were similar to that of 45 lb N. Table II a, b and d).

In the case of Co. 25 also the yield differences due to various treatments attained statistical significance for grain and straw yields. The treatment 6 was superior with regard to grain yield and treatmeuts 7 and 9 for straw yield. The percentage of increase over the control ranged from 19·4 to 36·9 for grain and 17·4 to 57·1 for straw (Table I).

The treatment differences were significant for source of N, levels of N and their interaction for grain yield. With regard to straw yield, the differences were significant only for source of N and interaction between source of N and levels of N. Ammonium sulphate was found to be better than CAN, recording 8·5 per cent and 20·1 per cent more grain and straw yields respectively. The application of 30 lb N was found adequate for improvement in grain yield. The increase of 4·8 per cent in straw yield consequent on the application of 45 lb N was not statistically significant. Ammonium sulphate was found to be superior to CAN, when applied both at 30 lb and 45 lb levels. The two levels of nitrogen applied in the form of CAN gave almost identical yields. The yield differences did not attain the level of significance for the mode of application for CAN while the interaction between the mode of application and levels of N was significant for grain alone. 45 lb N was superior to 30 lb N when applied in equal split doses while 30 lb N was superior to 45 lb N when applied in the ratio of 1 : 2 (Tables II a, b, c, d).

Discussion: Short duration paddy strain, Co. 29 recorded maximum grain and straw yields with the higher dose of N *i. e.*, 45 lb while long duration paddy strain, Co. 25 recorded maximum grain yield with the lower dose of N *i. e.*, 30 lb and maximum straw yield with the higher dose of N *i. e.*, 45 lb in the form of ammonium sulphate. Though both the fertilizers contain same amount of N, the entire nitrogen in the ammonium sulphate is in the ammoniacal form, whereas in the CAN half the quantity of nitrogen is in the ammoniacal form and the other half, in the nitrate form. Paddy utilises its requirement of nitrogen in the ammoniacal form itself. Hence, the short duration crop utilises the readily available ammoniacal N from the higher dose of ammonium sulphate within its short life period and produces maximum grain and straw. It might be possible for the long duration crop to utilise the nirate form of N which would have been mineralised in the course of the long life period of the crop. Hence, the higher dose of inorganic N applied might not have influenced the yield of grain and the same would have been utilised better for the vegetative growth which resulted in higher straw yield.

Between the two sources of N, ammonium sulphate was found to be superior to CAN. As already explained, the paddy crop, a consumer of ammoniacal form of N, prefers ammonium sulphate where the entire N is in

the ammoniacal form. Moreover, the nitrate form of nitrogen is mobile in soil which is easily leached out. Further there is a possibility of denitrification of nitrate nitrogen to elemental nitrogen under the anaerobic conditions existing in the paddy field. Thus, the nitrate form of N in the CAN might not have been available for the crop and hence the lower crop yields.

Summary: The application of ammonium sulphate to supply 45 lb N recorded the maximum yield of grain and straw in Co. 29. This was on a par with the yields of grain and straw resulting from the application of 30 lb N as ammonium sulphate and 30 and 45 lb N as CAN. In the case of Co. 25, 30 lb N as ammonium sulphate gave significantly higher grain yield than others while application of 45 lb N as ammonium sulphate gave a higher straw yield. When the individual effects were tested, ammonium sulphate was found to be superior to CAN recording maximum yield of grain and straw in Co. 29 and Co. 25. Strain Co. 29 recorded increased yields of grain and straw with 45 lb N over 30 lb N while Co. 25 yielded increased grain and straw yield with 30 lb N respectively and with 45 lb N respectively. In the case of Co 25 application of ammonium sulphate yielded better than that of CAN, when applied at both the levels of Nitrogen. The dose of 45 lb N as CAN was superior to 30 lb N when applied in equal split doses. The application of 30 lb N was also found to be superior to the dose 45 lb N applied in the ratio of 1 : 2.

Acknowledgement: The authors wish to thank Sri A. Abdul Samad, Retired Paddy Specialist for his guidance in the conduct of the experiment. Our thanks are due to Sri R. Janakiraman, Statistical Assistant for his assistance in the analysis of the yield data.

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