A RATIONAL METHOD OF APPLYING SULPHATE OF AMMONIA TO RICE

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RICE is a semi-aquatic plant and is mostly grown in swampy and anærobic condition. A large number of investigations has been conducted to evaluate the response of the crop to the application of nitrogenous fertilizers. Among such fertilizers, sulphate of ammonia has been found to be the best, though the response may vary with different soil and other environmental conditions, (Sethi;[1] Ramiah *et al.*[2]). According to Dastur *et al.*,[3] rice plants unlike other crops uses ammoniacal nitrogen in early stages and nitrate nitrogen in later stages of its growth. Field experiments with a mixture of ammonium nitrate and ammonium sulphate did not however establish the superiority of the mixture over sulphate of ammonia.

Efficient use of fertilizer can result only when the fertilizing element is utilised by the plant to the maximum extent. The present method of applying sulphate of ammonia to rice throughout India consists of spreading the fertilizer on the surface in wet condition immediately after transplanting the crop or somewhat later. Immediately on application, ammonia which is in the most reduced condition of the nitrogenous compounds is partly utilized by the plant directly and the rest is converted into nitrates by oxidation. Nitrate which is the highly oxidized form of the nitrogenous compounds does not undergo any further change in the surface layer and since it is not absorbed by the soil colloids, it leaches down to the lower layer with the percolation water and some of it is drained off with the free water. Russel[4] states that the work of Prof. Pearsel has indicated that under marshy conditions oxidation takes place only near the soil surface and reduction down below. The nitrates formed on the surface when they get down to the lower reductive layer are reduced and gaseous nitrogen in the form of NO or N_2 is formed which is lost. Thus there is loss of nitrogen both as nitrates and free nitrogen gas and the full benefit of the fertilizer application is not obtainable.

The practical aspects of this finding have been recognised and made use of by Japan in their rice manuring practices.[5] In Japan, two-thirds of the nitrogen dose as sulphate of ammonia is applied in the dry condition of the soil 2"-3" below the surface a few days before water is let into the fields for puddling and transplanting. The other one-third is applied later when the plant is growing and even here, the sulphate of ammonia is first made into balls or pellets mixed with clay, and these are thrust into the soil a few inches deep. Their investigations have shown that ammonium sulphate applied directly in the reductive layer remains stable and the plant utilizes it gradually. Thus the loss of nitrogen is minimized and it has been estimated that the efficiency of sulphate of ammonia applied in this way is 50-70 per cent. as against 20-30 per cent. only with the usual wet application.

To test this method of 'dry' application in the lower layers an experiment has been conducted at Central Rice Research Institute, Cuttack, under medium and low land conditions during two crop seasons, 1949-50 and 1950-51. The quantity of nitrogen applied was 20 lb. per acre and the application of nitrogen resulted in a significant increase in yield, the response being about 268 lb. of grain over a control yield of 1667 lb. per acre. Between the two methods of applying sulphate of ammonia, on the surface of wet soil or 2-3 inches below the surface in dry condition, the latter has given a consistantly higher response though the differences between the two methods were not always significant. The average yield response for the two methods per lb. of nitrogen applied is given below :

TABLE I

Average of response of paddy in lb. per acre for every lb. of N applied

	Dry application	Wet application
Medium land ..	14·2	9·4
Low land ..	19·3	11·9
Mean ..	16·8	10·7

The above data clearly indicate that the dry method of applying sulphate of ammonia is more efficient than the usual wet method.

In large rice areas of N. E. India, Assam Bihar, Bengal and Orissa, rice is sown in the dry condition of the soil at or just before the break of the monsoon. Under such conditions, the application of sulphate of ammonia in the dry soil inside the plough furrows does not present any difficulties and should prove more efficient than later application when the monsoon is on in full swing. Where however the land

is not ploughed in the dry condition but puddled after first letting in the water, this dry application is not feasible.

To meet this situation another experiment on deep placement has been conducted at Central Rice Research Institute for two seasons. The required amount of sulphate of ammonia was mixed with 5 to 10 times its weight of soil and made into a soft dough with water. Small balls of about 1" in diameter were then made from this material and dried. These balls were thrust 2"-3" deep into the soil between rows of standing crop 12"-18" apart at the time of weeding in a transplanted crop or at the time of *bushening* in a broadcasted crop. It has been found that this method of application is much more efficient than the wet surface application as shown by the figures given in Table II.

The efficiency of the deep placement is 2·5 times that of the surface application. There is an indication that the response for 20 lb. N placed deep can be just as good as 40 lb. N applied on the surface.

While the detailed results of these trials will be published elsewhere, the experiments are being continued and arrangements are also in progress to test the dry application and deep placement on a large scale in the cultivators' fields.

TABLE II

Results comparing 20 lb. of nitrogen applied as ammonium sulphate either on the surface or deep-placed

	Earheads per plant	Mean height per plant (cm.)	Yield lb. per acre	
			grain	straw
No nitrogen ..	5·3	115·8	1575	1926
Surface application ..	5·8	120·5	1698	2089
Deep placement ..	6·3	126·0	1895	2395

1. Sethi. R. L., *I.C.A.R. Bull.*, 1943, No. 38. 2. Ramiah, *et al.*, App. II (*b*) to *I.C.A.R. Report on soil fertility investigations in India*, 1947, by Dr. A. B. Stewart. 3. Dastur, *et al.*, *Ind. Jour. Agri. Sci.*, 1933,-34, **3**, 963, and 4,803. 4. Russel, E. J., *World Crops*, 1949, **1**, 2, 72-6. 5. Dr. Morinaga, *Unpublished note.*

INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

IN the course of his address at the opening of the Indian Institute of Technology, Kharagpur, the Hon'ble Maulana Abdul Kalam Azad observed as follows:

"The Institute which is being inaugurated today will have provision for the teaching of 2,000 students at the undergraduate level, and 1,000 students for post-graduate study and research drawn from all over the country.

"In order to ensure that the Institute serves the needs of the country in the most effective manner, the course in the Institute will be planned on the advice of experts drawn from industry, Government Departments, other employing agencies and educational authorities. In fact, this close association between academic experts and practical administrators is essential for the proper development of an institution of this type. I would like to make a special appeal to our industrial and business magnates to take an active interest in the development of this Institute. They can help in many ways. Industry can assist financially by establishing Chairs in subjects in which it is especially interested. Such assistance would make it possible to have Professors, where necessary more than one, in subjects which are important from the point of view of the development of industry. I have no doubt that industrialists will also help to make the training in this Institute more practical and concrete by permitting students to visit Workshops and Factories and allowing them to go through organised courses of practical training in the industry. It will improve the quality of teaching in the Institute, and in the end help industrialists themselves, if staff members of the Institute are offered facilities for the study of industrial techniques. Promising employees should also be seconded to the Institute to undertake programmes of research or courses at the post-graduate level. Last but not least, industrial magnates can help by deputing engineers, technologists, and administrators in their concerns to deliver lectures or courses of lectures at the Institute.

"Though situated in one corner of India, this Institute is intended to cater to the needs of the country as a whole. We have been able to recruit very distinguished men to take charge as Professors in the different departments, and we are happy that a scientist of the calibre of Dr. J. C. Ghosh is its first Director. I have no doubt that they will devote themselves to building this institution on sound foundations so that it may take its place as one of the finest institutions of its kind not only in India but in the world."