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Nitrogen in Paddy Soils

by

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Green manures are perhaps the most self-supporting manures in the tropics and are often claimed to be quite as effecient as Ammonium sulphate in rice production. This is of course, not surprising, seeing that they contain nearly 3–4% of nitrogen on dry weight basis, and a carbon/nitrogen ratio of about 10.

The leafy portion in green manures is naturally richer in nitrogen content than the stems and the decomposition may be noted in two stages, with the leaves figuring in the first stage and stems in the second. Thus green manures serve as a mixture of a quickly efficacious, concentrated nitrogenous fertiliser similar to ammonium sulphate and a more slowly-acting manure similar to compost or cattle manure.

The practice of green manuring is common both in garden lands and in wetlands, but in the former certain precautions are necessary, because with the large quantities of readily decomposed carbohydrate material, there is a possibility of the soil nitrogen getting impoverished. That is why in tea and coffee plantations, green manure applications are always accompanied by liberal doses of amonium sulphate.

In wetlands, the conditions are different. Though green-manuring is well-known as a very beneficial practice in rice culture, how exactly this beneficial response is brought about is still not settled. If a cross section of paddy field soil is taken it will be seen that only the top half to one inch layer is under aerobic condition and all the lower portion is under anaerobic conditions. The question therefore arises as to the nature of the decomposition of the proteins in the green manures applied. From their classical experiments in 1913 to 1916 in the early days of the Agricultural Department, Harrison and Subramania Ayyar were led to conclude that green manures had little or direct manurial value; and as the rice crop depended primarily on the nitrogen for its growth, green manures were useful only in an indirect manner, by helping to improve the soil aeration.

Joachim and Kandiah working in Ceylon, obtained supporting evidence for this indirect effect, but they found that there was also a direct effect, by minimising loss of soil nitrogen and improving plant growth thereby.

This problem has also attracted the attention of Japanese workers; but they held the view that nitrogen fixation by blue-green algae was an important factor in flooded rice fields. In fact some even claimed that one of the causes of the relatively high level of fertility of Japanese paddy fields, was attributable to nitrogen fixation by blue-green algae.

Here again, though the fact was well recognised, the actual mechanism involved is still a matter of discussion. Thus P. K. De in Bengal claimed to have proved that the algae themselves are responsible for nitrogen fixation while other workers (Choudhuri, 1940) hold that this function is attributable not to the algae. This divergence of views is unfortunately not an easily resolvable one, on account of the practical difficulty in isolating pure cultures of uncontaminated blue green algae, as they are usually covered with a gelatinous sheath wherein bacteria like *Azotobacter* can survive. The task of separating the bacteria from the sheaths is a difficult one.

Japanese workers have on the other hand, attempted to isolate algal cultures with high nitrogen-fixing ability and studied the inter-relations between the degree of nitrogen fixation by algae to other environmental factors like fertilising. In 1941 Watanabe collected over 600 soils from tropical paddy fields and from them isolated ten species of blue-green algae. Out of these ten, three species were claimed to have a high power of fixing atmospheric nitrogen, viz. *Tolypothrix tenuis* from Borneo, *Calothrix orevissima* from Parao and *Arabaenopsis* sp. from Sumatra.

Attempts have also been made in Japan (Konishi, 1951) to see the effect of artificial inoculation of Japanese rice fields by tropical blue green algae. A significant effect was perceptible after inoculation, in plots which had also been limed, but not otherwise, indicating that the soil reaction (pH. value) played a decisive role in determining the degree of algal effect. Whether the practice would prove to be an economic proposition has not, however been determined so far.

Denitrification under water-logged conditions: The surface water of a flooded rice field gets sufficient oxygen from the atmosphere and also from the photosynthetic action of hydrophytes like blue-green algae. This oxygen has an influence only on the uppermost layer, extending to not more than one inch at the most. Below this "aerobic" or "oxidised" layer there is a much larger "reduced" layer where micro-organisms live under anaerobic conditions. This reduced layer constitutes the main portion of the paddy soil, and under the anaerobic conditions existing here, the question is still open whether the paddy plant utilises nitrogen in the form of ammonia. Experiments in Japan and also at Cuttack, with placement of fertilisers like ammonium sulphate have shown that placement arrests the oxidation of ammonia to the easily leachable from of nitric-nitrogen. If the paddy plant is capable of utilising ammonia, there must be some form of ammoniacal nitrogen detectable under paddy field conditions. So far experiments by various workers and in particular the latest investigations carried out at Coimbatore have indicated only the presence of soluble proteins. So that the questions as to the form in which the paddy plant absobs and utilises its nitrogen requirement, still remains unsolved, awaiting further investigation for its elucidation.

CROP AND TRADE REPORTS

Crop Statistics—1953—'54—Madras State. Groundnut Final Forecast: The area sown in the Madras State upto 25th December 1953 is estimated at 1,872,000 acres evealing an increase of 1·1% over last year and 2·2% over the average area calculated for the five years ending with 1951—'52. The increase in area this year is due mainly to timely rains at the time of sowings. The yield per acre is expected to be normal in the districts of Salem, Tiruchirapalli and Tanjore and slightly below the normal in all the other districts of the State. The seasonal factor for the State as a whole works out to 96 percent of the normal as against 75 percent of the normal estimated for the corresponding period of the previous year. On this basis, the total yield is expected to be 902,600 tons of unshelled nuts representing an increase of 30·5%. The average wholesale price (machine shelled) per maund of 82–2/7 lb. or 3,200 tolas as reported from important market centres on 9th January 1954 reveal an increase of 22·2 percent in Erode, 10·8 percent in Vellore, 7·6% in Salem, 7·9% in Cuddalore and 4·4% in Coimbatore.

Gingelly—Third Forecast: The area sown in the Madras State upto 25th December 1953 is estimated at 3,46,000 acres an increase of 10·8% percent over the five year average. The main crop has been harvested. The yield per acre is expected to be normal in Salem district and slightly below the normal in all the other districts of the State. The seasonal factor for the State as a whole works out to 95 percent of the normal as against 79 percent of the normal in the corresponding period of last year. On this basis, the total yield is estimated at 43,200 tons revealing an increase of 33·7% over last year and 31·3% over the five years average. The average wholesale price of gingelly seed per maund of 82-2/7 lb. as reported from important market centres on 9th January 1954 reveals a decrease of 17·2 percent in Tiruchirapalli and 15·2 percent in Tirunelveli. (Director of Statistics, Madras).
