

# THE SCIENCE OF RICE FERTILIZATION

(Extracted from World Farming)

Applying nitrogen in rice presents very complex problems. Not only is the quantity applied of significance, but the form of nitrogen, method of application and other management practices have great bearing on how rice responds to nitrogen.

## Varieties differ

Different varieties of rice differ in their response to nitrogen application. Tall varieties which are more susceptible to lodging respond only up to 50 kg. N/ha. The short duration dwarf varieties of rice show conspicuous increase in grain yield up to 100 kg. N/ha and thereafter there is no significant increase in yield due to increased nitrogen application. The medium or long duration dwarf varieties of rice, however, respond very well up to 150 kg. N/ha.

## Forms of nitrogen

Rice plants can use both ammonium ( $\text{NH}_4^+$ ) and nitrate ( $\text{NO}_3^-$ ) forms of nitrogen. The ammonium form is preferred, especially at early stages of growth. Application of the ammonium form is preferred under flooded anaerobic conditions because the nitrate form is readily lost through either deep percolation or denitrification. Under water-logged conditions, therefore, ammonium fertilizers are much superior to nitrate carrying fertilizers. The ammonical fertilizers are also beneficial in that they are less susceptible to leaching. After incorporation into the soil, the  $\text{NH}_4^+$  ions are fixed with the soil particles and they become available to the crop plants through exchange phenomena, whereas nitrate nitrogen does not get fixed and hence is highly susceptible to losses.

Out of the several nitrogenous fertilizers available in the market, ammonium sulphate is the best choice for rice as it provides nitrogen exclusively in ammonical form. Urea also supplies nitrogen in the form of ammonium ions after going through some changes in the soil. However, urea as such is highly susceptible to leaching losses. Any application of nitrate fertilizers should be made during the latter half of the crop life cycle. Efficiencies of different nitrogenous fertilizers, with respect to rice production as observed at the Central Rice Research Institute, Cuttack, India, are illustrated in Fig. 1.

Green manure crops

Apart from inorganic fertilizers, green manuring with some quick growing legumes is very beneficial. *Sesbania aculeata* is a very suitable green manure for rice. It thrives very well in standing water. It becomes ready for burying after 8 to 9 weeks of sowing and it rots into the soil in 10 to 15 days time. It gives on an average 40 to 60 kg. N/ha. If the *Sesbania* green manure crop is to be raised prior to rice cultivation, then it is desirable to apply all of the phosphorus requirement of rice to the preceding *Sesbania* green manure crop. Apart from supplying nitrogen, *Sesbania* improves the physical condition of the soil and reduces weed competition in the rice crop.

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Ammonium sulphate 100% . \* \* \* \* \*

Ammonium phosphate 97% \* \* \* \* \*

Ammonium chloride 96.5% . \* \* \* \* \*

Ammonium sulphate nitrate 96% \*\*\*\*\*

Ammonium nitrate 88% \*\*\*\*\*

Urea 86% \*\*\*\*\*

Calcium cyanamide 80% \*\*\*\*\*

Sodium nitrate 79% \*\*\*\*\*

Fig. 1 Relative efficiency of nitrogenous fertilizers in rice production.

Methods of nitrogen application

Water logged rice soils have two distinct zones the oxidized zones and the reduced zones. It is better if the nitrogenous fertilizers are placed at a point where the nitrogen is relatively stable (Fig.2). Just below the thick layer of water in the water logged soils there is an oxidizing zone where oxygen is present. The zone is about 5 to 6 mm. deep. The ammonium nitrogen (NH<sub>4</sub>) which is present in this zone is converted into nitrate nitrogen (NH<sub>3</sub>) and when it (nitrate) moves down to the reducing layer it gets denitrified and changed to nitrogen gas which escapes into the atmosphere and is thus lost. However no oxygen is present below this layer of oxidation and when any ammonium fertilizer is applied 5 to 10 cm. deep into the soil, the nitrogen will not be subjected to the changes and will be readily available to the growing rice crop. It is, therefore, beneficial to apply nitrogenous fertilizers by deep placement into the reducing zone rather than broadcasting on the surface.

## Time of nitrogen application

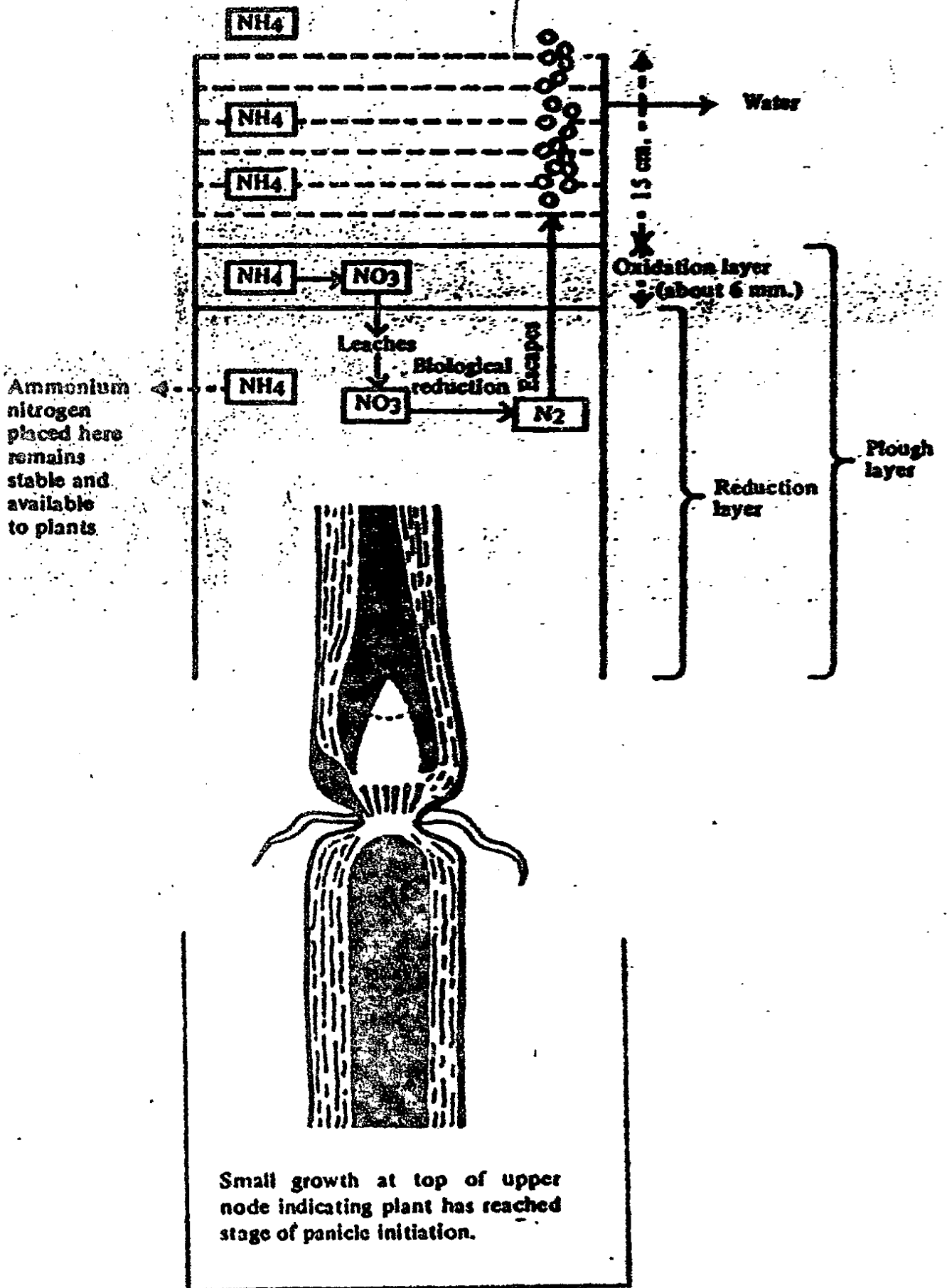
The two stages when nitrogen is required most by the rice crop are the early vegetative stage and the panicle initiation stage. The nitrogen supply should be split into three applications. Half of the nitrogen should be placed into the soil before transplanting., 1/4 applied at tillering and the remaining 1/4 should be applied at panicle initiation. To determine the stage of panicle initiation, take out a plant, cut a Tiller from the base and then dissect it lengthwise from the base. If the plant has reached the stage of panicle initiation, a small growth at the top of the upper node will be seen (Fig.3). This stage is generally reached after 70 days or more after seeding. Applying very much nitrogen after ear emergence induces sterility in rice.

## Water management

For efficient utilization of nitrogen it is important to keep rice submerged and to avoid long periods of drainage. This will prevent ammonium nitrogen being changed to nitrate nitrogen, which is readily subjected to leaching and volatilization losses. For applying fertilizers like urea, it is necessary to drain the field 24 to 48 hours before top dressing, and then the field should be reflooded two to three days after nitrogen application. Draining the soil during top dressing brings the fertilizer in closer contact with the soil and hence makes it less prone to losses, but the prolonged drainage would, on the other hand, encourage nitrification.

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Fig. 2 What happens to various forms of nitrogen in rice soils



## PLANT PARASITIC NEMATODES AND THEIR CONTROL

By G.A.W. Wijesekera,

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Nematodes belong to the phylum nemata are a group of worms very adaptable and found almost everywhere life exists. Some are serious internal parasites of vertebrates and invertebrates. Some feed on micro-organisms such as bacteria, fungi, algae, protozoa and also on other nematodes. Many species mostly microscopic, inhabit soils parasitize plants and may produce serious crop losses. For e.g. it has been estimated that percentage mean loss due to a single species (meloidogyne) are 29%, 23%, 12%, and 28% in case of tomato, egg plant okra and beans respectively. Almost all the crops and plant species have one or more nematode species associated with them. Plant parasitic nematodes cause an annual loss of 5% in the total world food production.

### General Characteristics.

Most plant parasitic nematodes are microscopic. Under a microscope they look like minute sluggish or actively undulating worms. Nematodes are white in colour. The spindle form may be considered the typical shape of nematodes. The body is circular in cross section. Essentially it consists of two tubes, an outer body wall and inner digestive tract. The body of nematode worms is not segmented internally. But some forms simulate segmentation which is confined only to the cuticle. The length of many plant parasitic and free living nematode ranges from 0.5 to 4.0 mm. They vary in width from 50 to 250  $\mu$ . The protrusible stylet or spear within the buccal cavity at the anterior end of the nematode body may be a characteristic feature of plant parasitic nematodes.

## Reproduction

Reproduction of nematodes usually is oviporous (from eggs hatching externally) but may also be ovoviviporous (from eggs hatching from within the uterus). Both males and females are generally necessary for reproduction. But hemaproditism and parthenogenesis is also reported. Plant parasitic nematodes may lay few eggs (which are generally oval and smooth) per day to a maximum of several thousands in a two month period. Eggs are deposited in the soil, within roots, inflower heads in infected plant tissues or in the case of cyst forming nematodes, within the swollen body of the female where the dead body wall forms a protective cyst. Time taken for the emergence of larva from eggs varies and sometimes may take over a period of eight years in the case of cyst forming nematodes. Nematodes have no marked metamorphosis. Growth occurs through a series of molts (usually four in number). Fully grown embryo within the eggs usually undergo one molt before emerging as infective larva. Nematode growth is fairly rapid under warm temperature. In most plant parasitic nematodes the life cycle completes in about one month.

## Dispersal

Plant parasitic nematodes move in water films around soil particles and plant parts. On its own a nematode moving in a water film may not travel more than a foot or two in a single season. That is why the expansion of initial nematode infestation in the field is very slow. However, they are dispersed over greater distances with running water or human assistance. They may be carried with soil, plants, or plant parts transported from place to place. Also with soil tillage equipments, run off water and irrigation water.