STUDIES ON THE EFFICIENT USE OF SOME NITROGEN FERTILIZERS USING TRACER TECHNIQUES

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بِسْمِ اللهِ الرَّحْمٰنِ الرَّحِيمِ

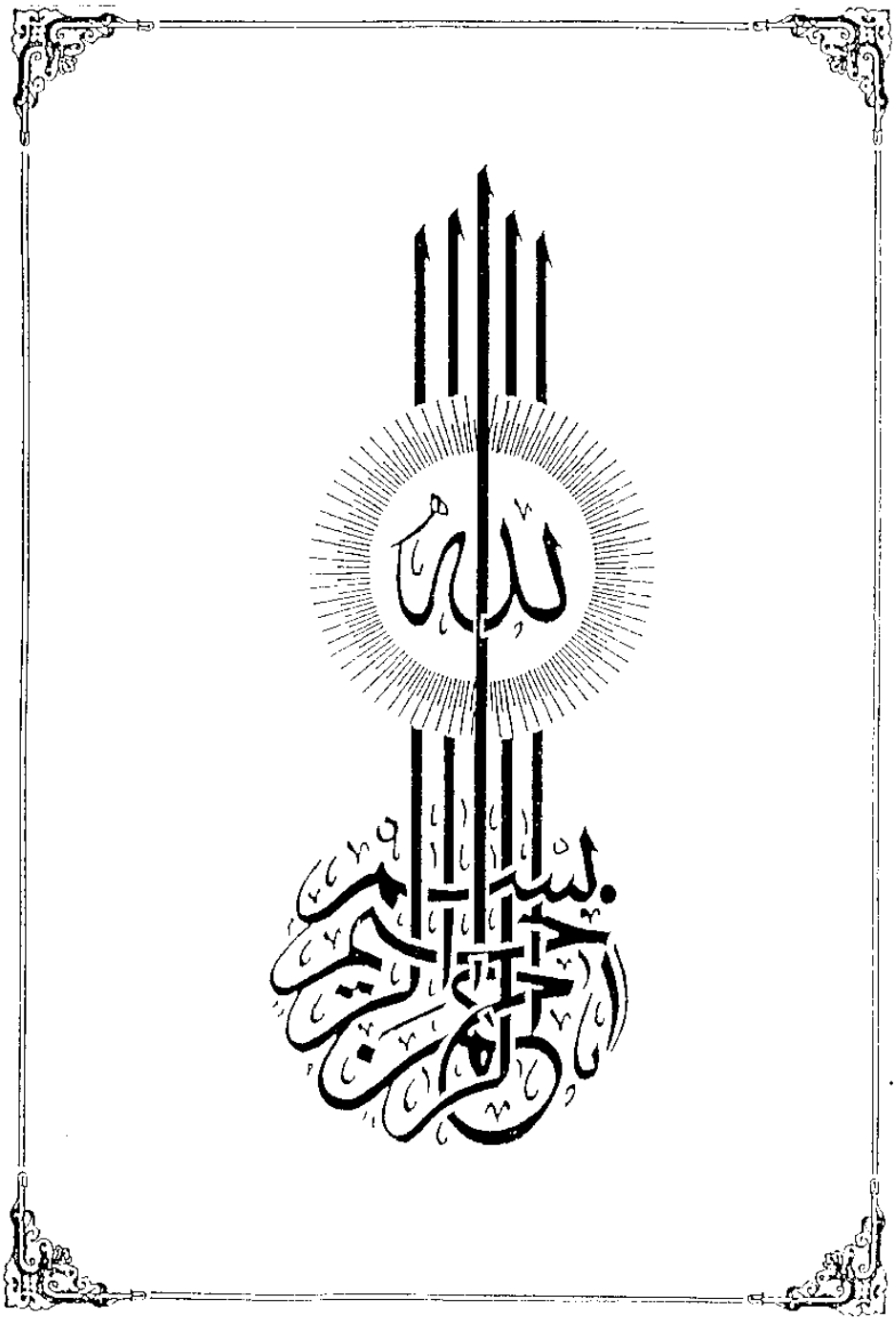
وَبِهِ نَسْتَعِين

"رَبَّنَا ...

آتِنَا مِن لَّدُنْكَ رَحْمَةً ...

وَهَيِّئْ لَنَا مِنْ أَمْرِنَا رَشَدًا "

صَدَقَ اللهُ العَظِيم



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C O N T E N T S

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I. INTRODUCTION

Nitrogen occupies a unique position among the elements essential for plant growth because of the large amount required by most agriculture crops. The combined nitrogen in soil is largely bound to organic matter and mineral materials, however, only a few kilograms per feddan exist in available mineral forms (as NO_3^- and exchangeable NH_4^+) for plant use.

Nitrogen fertilizers application has had by far the most important effects in terms of increasing crop production. Numerous field experiments carried out in the past have shown that for many soils,nitrogen is the most important growth limiting factor. The level of nitrogen that should be applied to a crop depends on the particular crop species and on the prevalent soil conditions.

The major characteristic of submerged soils is the depletion of O_2 throughout most of the root zone. The greater release of NH_4^+ during anaerobic decomposition is extremely important for lowland rice culture. In these soils the forms of N present are generally similar to those of upland soils with the exception in the relative

contents of NO_3^--N and NH_4^+-N. This difference in behavior of these soils is due largely to the difference in activity of the microorganism under aerobic and anerobic conditions. In a well drained soil, most N transformations are carried out by aerobic or sometimes facultative anerobic bacteria while in submerged soils facultative anerobic and true anerobic bacteria predominate. As in aerobic soils, the major microbial processes involving N in submerged soil are mineralization, immobilization, nitrification, denitrification, and N fixation.

A unique characteristic of flooded soils is that all of these processes could occur at the same time because of the presence of both aerobic and anerobic zones. Thus, N transformation is usually very difficult to evaluate the significance of any single reaction. Therefore, the present investigation was carried out to study the effect of different N forms, proper time and method of applications on dry matter, N, P, K contents and their uptake. Using the tracer technique, the utilization of N fertilizers was studied.

II. REVIEW OF LITERATURE

2.1. Forms of nitrogen fertilizers:

For N fertilization the following fertilizers are commonly used: ammonium sulphate, ammonium chloride, ammonium nitrate, potassium nitrate urea and anhydrous ammonia. For most N fertilizers, NO_3^- and NH_4^+ are the N carriers. NH_4^+ is partially adsorbed on soil colloids and its uptake rate is usually therefore lower than that of NO_3^- under field conditions. For this reason, most crops do not respond as quickly to NH_4^+ fertilizers as to NO_3^- application. On the other hand, the nitrate form is subjected to loss by leaching in coarse textured soils, under high rainfall, Tisdale and Nelson (1975). On the other hand, one form of organic N that can be taken up directly by plants is urea which is considered the primary dry N fertilizer source in agriculture today (Harris and Harre, 1979). Inorganic N that occurs in soil are NO_3^- (nitrate), NH_4^+ (ammonium), NO_2^- (nitrite), N_2O (nitrous oxide), NO (nitric oxide) and N_2 (elemental nitrogen). The last form of nitrogen is inert, except for its utilization by rhizobia and other nitrogen fixing microorganisms. From the standpoint of soil fertility, the NH_4^+, NO_2^- and NO_3^- forms are of

greatest importance. These three forms usually represent from 2 to 5% of the total soil nitrogen, Tisdale et al. (1985).

2.2. Factors affecting utilization of N fertilizer by rice plants:

2.2.1. Methods of application:

The efficiency of grain production and utilization of applied N from ammonium sulphate and urea was more or less comparable whereas in this respect nitrate fertilizers were inferior for rice plants. Placement of the former two fertilizers and their fractional, application further increased efficiency for grain production and fertilizer utilization compared to broadcast application on the surface. El-Kobbia and Shalaby (1969) showed that broadcasting of ammonium sulphate in nursery to rice plants is superior to deep application at all rates of N application. It seems that broadcasting allows rice seedlings to take up its nitrogen more rapidly during early growth. They also indicate that high yield could be obtained, if sulphate of ammonia is applied in deep layer instead of broadcast. Eid et al. (1974) found that percentage of N in the rice

plants derived from fertilizers ammonium sulphate and urea, were nearly equal in their efficiency, sodium nitrate was the least efficient and ammonium nitrate occupied an intermediate position. They added that this percentage was found to decrease in plants with time until it reached lowest values at maturity in grains and straw due to the contribution of soil nitrogen in supplying the plants with their needs of nitrogen. Moreover, amounts of nitrogen fertilizer utilized by grains and straw were found to be nearly the same for ammonium sulphate, regardless the time of its application, whereas, application of urea and ammonium nitrate on the soil surface two weeks before primordial initiation was more effective than their application on shallow placement at transplanting. However, sodium nitrate was found to be more effective when applied at two weeks before primordial initiation as a top-dressing but even so it did not reach the levels of efficiency of the other three nitrogenous fertilizers.

Muhamad et al. (1974) found that N-uptake by rice plant from the fertilizer top-dressed at the heading stage from an ammonium source was twice as much as that from