The improvement of efficiency of N-fertilizers

By

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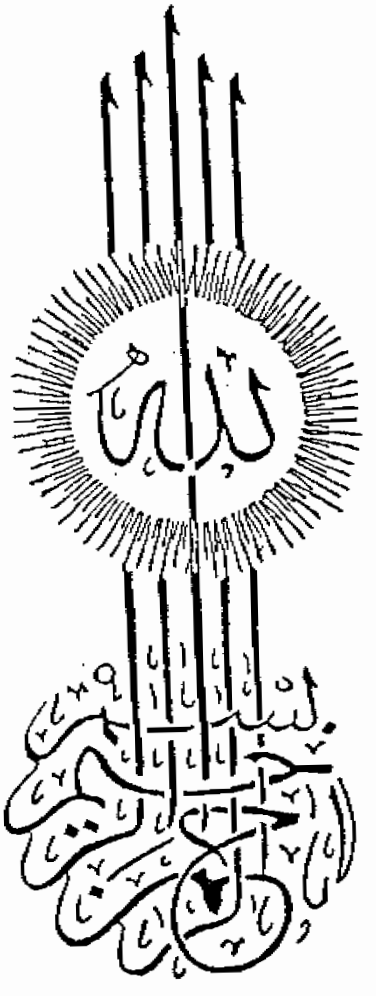

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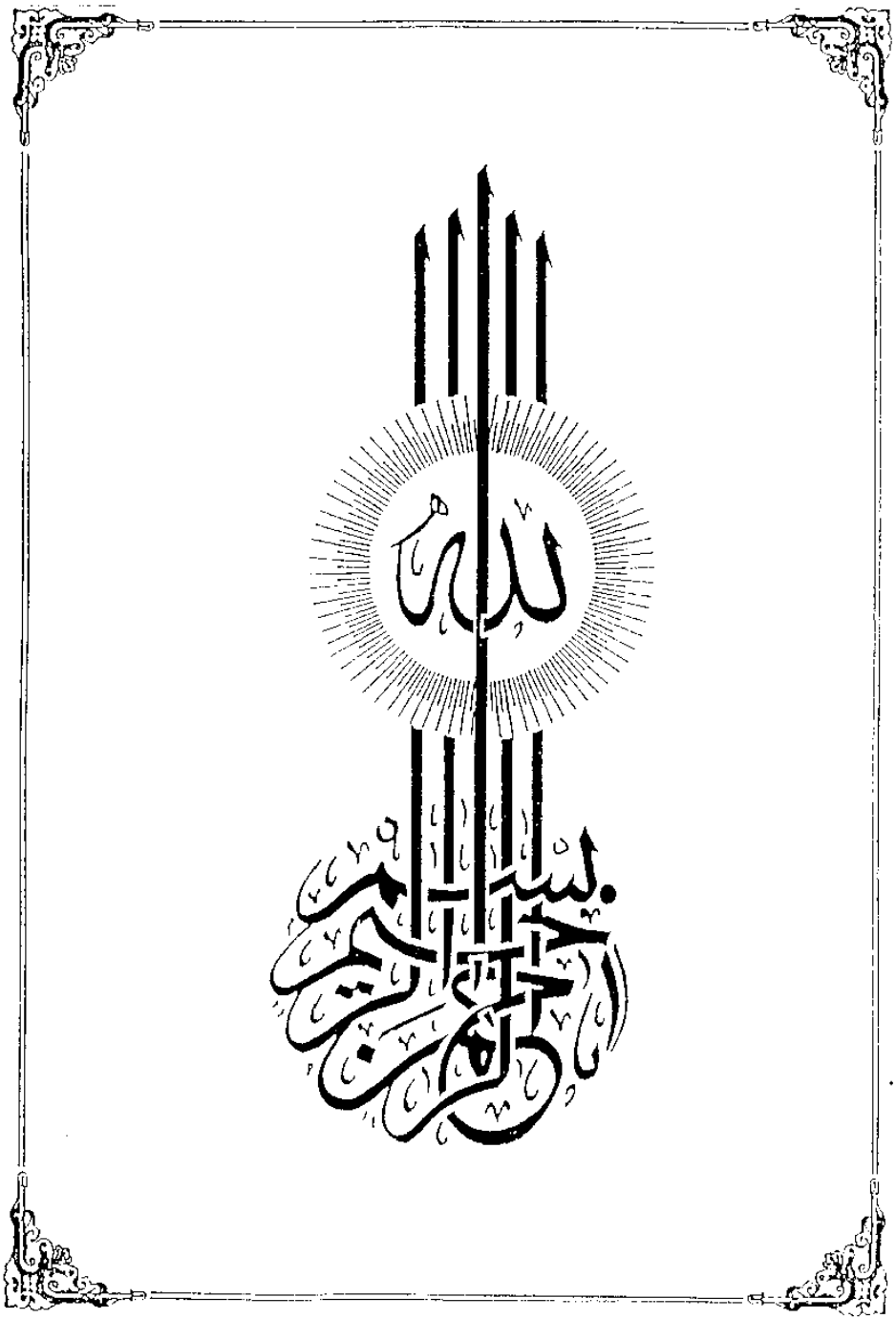

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CONTENTS

INTRODUCTION

1 INTRODUCTION

Nitrogen is the most frequent limiting nutrient for crop production. Thus, keeping the nitrogen in the root absorption zone is, of course, one means where by efficiency of recovery may be increased. Whereas, leaching of NO_3^- below the rooting zone results in low nitrogen fertilizer efficiency and NO_3^- pollution of sub surface drainage waters. Therefore, the nitrification of ammonium (NH_4^+) to nitrate (NO_3^-) is a stepwise biological oxidation in which NH_4^+ ions are converted to nitrite (NO_2^-), mainly by the bacteria of the genus Nitrosomonas, and NO_2^- is further oxidized to NO_3^- by Nitrobacter. One way to retard nitrification and possibly increase the efficiency of applied nitrogen in the soil might be to utilize a nitrification inhibition. The control of nitrification by 2-chloro-6-(trichloromythyl)pyridine as a method to reduce nitrogen losses from ammonical fertilizers applied to soils has been studied by many investigators in recent years. The use of nitrapyrin as a nitrification inhibitor of ammonium fertilizers has gaind widespread interest because it is nitrification inhibitor provide a mean of potentially increasing the efficiency of nitrogen fertilizer by retaining nitrogen in the ammonical form for a longer time. Also, nitrapyrin inhibits Nitrosomonas activity and tends to conserve the more stable ammonical-N in the

growth medium (Pill, 1981).

The aim of this study is to evaluate the efficiency of nitrapyrin as nitrification inhibitor in improving the recovery of mineralised nitrogen.

REVIEW OF LITERATURE

2. Review of literature

Improvement of efficiency of N-fertilizers using nitrapyrin as nitrification inhibitors was investigated by many workers. Nitrapyrin is the current name of a nitrification inhibitor developed by Dow chemical company, 1977 . It was formerly traded as N-serve nitrogen stabilizer. The active ingredient of the compound is 2-chloro-6-(trichloromethyl)-pyridine. The literature concerning this subject will be reviewed under the following headings.

2.1. The effects of nitrapyrin on nitryfying organisms:

It is generally accepted that Nitrosomonas spp. are the most prominent NH_4^+-oxidizing bacteria and that Nitrobacter species are concerned in the oxidation of nitrite. Soriano and Walker (1973) and Bhuija and Walker (1977) found as an exception to this rule, that Nitrosomonas spp. occured only in soils treated with stable manure; in other soil the ammonium oxidisers were Nitrosocystus and Nitrosopira. Shanker et al (1976) stated that heterotrophic nitrifying bacteria such as Aspergillus flavus species play a minor role in nitrification but these organisms are not affected by nitrapyrin at concentrations up to 10 mg/L of a synthetic medium. Neunylov et al (1977) showed that N-serve

decreased soil populations of nitrifying and denitrifying micro-organisms. Laskowski and Bidlack (1977) observed that nitrapyrin does not kill the whole population of nitrifiers.

Rodgers et al (1980) found that nitrifying bacteria from four different soils took approximately 40 days to recover from a 1 Ug ml^{-1} addition of nitrapyrin to aqueous suspensions of the soil, even when the bacteria were cultured under favourable conditions. No evidence was obtained for the devlopment of nitrapyrin resistant nitrifiers, even after prolonged incubation. Gostkowska (1980) in his studies on the influence of some nitrification inhibitors on the activity of nitrifying bacteria and the number of heterotrophic micro-organisms, found that N-serve showed the greatest effectiveness in three different soil types. Rempe et al (1982) study the effect of N-serve on ammonifying, nitrifying and denitrfying in green house experiments with barley grown in a derno podzolic soil. They concluded that N-serve suppressed nitrifying bacteria and denitrifiers. The latter effect decreased the gaseous losses of fertilizer nitrogen. The inhibiting effects were temporary and were followed by a flush of microbial growth and fixation of fertilizer nitrogen by the soil.

Belser and Schmidt (1981) stated that five strains of

Nitrosomones and one each of nitrosospira and Nitrosolobus showed considrable variation in senistivity to the nitrification inhibitor nitrapyrin, with some strains about five times more resistant than others. Sensitivity to nitrapyrin varied more with strain than with genus. On the other hand, Rodgers (1986) reported that nitrapyrin resulted in increased senistivity of ammonium-oxidizing bacteria to nitrapyrin.

2.2.The effect of nitrapyrin on nitrification :

Study the effectiveness of 24 compounds proposed as inhibitors of nitrification in soils by determining the effects of 10 p.p.m. (soil basis) of each compound on the amounts of nitrate and nitrite produced when soils treated with ammonium sulphate (200 p.p.m. of ammonium N) which were incubated at 30 C° for 14 days, appeared that the effectiveness of 2-chloro-6-(trichloromethyl)pyridine (N-serve) was most than the other compounds (Bundy and Bremner, 1973). Thus, some workers have studied the effect of nitrapyrin (N-serve) on the rate of nitrification (Hughes and Welch, 1970; Hendrickson et al, 1978; Apltauer,J 1979; Li et al 1981; Barker et al, 1983; Maddux et al, 1985; Wickramasinghe et al, 1985;). They concluded that N-serve decreased the rate of nitrification. Listanska (1982) reported

that N-serve markedly inhibted nitrification of the urea treatments, the effect persisted for (8-10) weeks and was observed at different soil moisture contents, although most pronounced at 15% soil moisture. In pot trails, Mathers et al (1982) showed that nitrapyrin was effective in delaying nitrification ensuring a better N supply later in the growing season, precautions should be taken to avoid grass tetany in cattle feeding on wheat forage.

Gasser (1965) found that when the ammonium sulphate was broadcast on the soil surface, 2% of the N-serve inhibited nitrification of the ammonium-N more than 1% , but when it was placed in the soil both rates were equally effective. Notton et al (1979) have shown that nitrification of ammonium or urea in sand cultures of turnip, cauliflower and radish was reduced but not prevented by N-serve present at 5 and 20 p.p.m. in solution or by weight of sand. In incubation experiments and field trails, Gorlitz and Hecht (1980) demonstrated that when N-serve was applied at rates of 1 to 2% of the sulurry nitrogen applied, the nitrification inhibition reached 53% after 9 weeks. Laboratory experiment on the nitrification of soil nitrogen and applied ammonia nitrogen in a silty-peat soil was carried out by Kucharski (1980). He stated that N-serve inhibited nitrification longer at higher rates of application although 60 p.p.m. was only

slightly more effective than 30 p.p.m. . Morris et al (1980) reported that nitrapyrin (N-serve) was effective in inhibiting nitrification up to 104 days at 20 p.p.m.. Laboratory tests which carried out by Rodgers and Ashworth (1982) indicated that nitrapyrin at 1 Ug/g soil could inhibit nitrification by approximately 40%, compared with untreated soil, for 10 weeks at 10 C° . In field tralis, Mochkova (1983) stated that application of nitrapyrin as N-serve with 60-90 Kg N/ha as aqueous ammonia decreased its nitrification for 4-6 weeks.

In greenhouse studies Rudert and Locascio (1979) roperted that nitrrapyrin reduced NO_3^--N form in a Kanapha fine sand for only the first 2 weeks of 5 weeks leaching period. Rodgers and Ashworth (1982) have shown that the applied nitrification inhibitor (N-serve) after ploughig prevented formation of NO_3^--N which could be lost by leaching and denitrification. McClunget et al (1983) found that NO_3^--N production decreased with increasing inibitor (N-serve) concentration. The effect of water application level and nitrification inhibitor (N-serve) on NO_3^--N leaching from a sandy loam soil were evaluated by Timmons (1984). He observed that addition of N-serve to column (297 mm diam. by 1.2 m deep) firtilized with 224 Kg N/ha reduced NO_3^--N leaching losses.