NITROGEN NUTRITION IN SOME REPRESENTATIVE EGYPTION SOILS UNDER RECLAMATION

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ARABIC SUMMARY

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1. INTRODUCTION

Nitrogen, one of the essential plant nutrients, probably has been subjected to the greatest bulk of study and even yet is receiving much attention. Nitrogen, among all fertilizer nutrients, is usually the limiting factor for yield production. Its amount in soil is relatively small although quantity annually withdrawn by crops is comparatively large. At time, the soil nitrogen is too readily soluble as to be lost in drainage or suffers volatilization; at other times it is definitely unavailable to higher plants. Moreover, its effects on plant are usually marked and rapid; thus, over applications sometimes occur which may be harmful. All in all, nitrogen is a potent nutrient element that should not only be conserved, but also carefully regulated.

In most developing contries, maximizing the productivity of salt affected soils, through fertilizer application, seemed to be necessary to provide adequate food supplies for the progressive increased population as relative to the limited agricultural lands. The use of nitrogenous fertilizers in the Egyptian agriculture has greatly increased after cultivating the newly-reclaimed lands. Vast areas of those lands have a high percentage of calcium carbonate, such as the calcareous soils of Burg El Arab, calcium sulphate, such as the gypseous soils of Sanallot or soluble salts such as the salt affected soils in Kafr El-Sheikh.

As a resultant of all above mentioned facts, special attention has been paid to investigate the behaviour of applied nitrogen in soils under reclamation along with relationships to utilisation by crops in order to be able to select the form of nitrogen from which crops can benefit the most. A comparative study was carried out, using pot experiments, for investigating the response of barley plants to ammoniacal, ammonium-forming and nitrate fertilizers applied to certain representative samples of saline, alkali, calcareous and gypseous soils taken out from certain representative area of lands under reclamation in the A.R.E.

2. REVIEW OF LITERATURE

Nitrogen is an element usually occurs in the environment of plants in two different forms : elemental gaseous nitrogen and various inorganic and organic substances. The inorganic nitrogenous substances mainly exist in two forms : ammoniacal and nitrate.

Several investigators such as Tisdal *et al.* (1956) reported that the fate of ammoniacal nitrogen within plants was usually four-fold. According to their suggestions, considerable amounts are appropriated by some of the ammonifiers or other soil organisms capable for using this type of compounds. Higher plants are also able to use this form of nitrogen, oftenvery readily. Young plants of almost all kinds are specially capable in this respect, although they seem to grow better if nitrate nitrogen is also available. Plants, such as low-land rice, still prefers ammoniacal nitrogen.

Peterpurskii & Korchagina (1963) carried out certain short-term experiments using been and maize seedlings as indicator plants. Results showed that the fixed form of NH_4^+ in soil was partially used. This was in contrary to barley plants grown under conditions of long-term experiments as NH_4^+ which was practically unavailable when being in the fixed form. Grewal and Kanwar (1967) reported that ammoniacal fertilizer was favourable for both the yield and nitrogen uptake of paddy crop grown in sandy loam soil; residual effect was obtained on the following wheat but not the third paddy crop. Aleksic *et al.* (1968) proved that availability of soil nitrogen was not directly affected by the rate of nitrogenous fertilizer applied, the obtained increase in the uptake of soil nitrogen by millet was apparently due to an increase in the total uptake of nitrogen induced by fertilizer applications and related to the rapid development of both roots and shoots.

Several investigations reported in the literature were dealing with comparisons between both ammoniacal and nitrate forms of nitrogen. Nömmik (1957) proved that the effect of nitrate nitrogen was superior to that of ammonium; this was true regarding the yield of plants and their nitrogen uptake in both the nutrition stage and before flowering. Poulsen (1959) reported that whereas conventional application of nitrogen usually increased the dry-matter yields and nitrogen uptake to an optimum followed by the depressions due to poor nitrogen utilization and salt injury, treatment of plants with certain resins was found to permit the uptake of high amounts of N without impairing high yields. He added that unlike the calcium nitrate salt, high rates of nitrates given in the resin did not increase the conductivity of soil and caused no salt injury. Results also indicated that the ash content of the dry matter tended to be lower and consequently the content of organic fraction to be higher in plants given resin as compared with those receiving the fertilizer. Gouny *et al.* (1959) proved that high doses of nitrogen, in the ammoniacal form, produced lower yields than the nitrate form did. They showed that this was apparently due to the capacity of young grass to utilize large amounts of ammoniacal nitrogen preceding its nitrification; this, of course, would lead to an excessive accumulation of nitrogen, predominately, as a soluble organic fraction, within the plant tissues. Herath and Eaton (1968) added, however, that ammoniacal nitrogen gave a greater growth response than nitrate nitrogen whose higher levels caused severe leaf scorch. Shilova and Smirov (1968) stated that utilization of nitrate derived from $Ca(NO_3)_2$ fertilizer was practically ceased by the shooting stage, but that of ammonium derived from $(NH_4)_2SO_4$ continued up to harvesting. They added that utilization of soil-N was generally more increased by $(NH_4)_2SO_4$ than by $Ca(NO_3)_2$; growth of plants along with their total nitrogen uptake were practically the same for the two treatments. Results also showed that up to shooting; the lower rate in the nitrogen uptake from $(NH_4)_2SO_4$ was due to fixation of NH_4^+ by the soil along with the very slow release of available-N from the fixed form. Shilova and Smirov also reported that accumulation of organic N in soil was greater if the $(NH_4)_2SO_4$ fertilizer was used than if the $Ca(NO_3)_2$ was the form applied; loss of N from $Ca(NO_3)_2$ was greater than from $(NH_4)_2SO_4$.

Regarding the amide form of nitrogen, Enyi (1965) proved that split application of urea was favourable for growth of maize plants although $(NH_4)_2SO_4$ was favourable for sorghum. He also found that high concentrations of either one of the used fertilizers caused death of few plants, due to the high osmotic pressure. On a soil containing much free $CaCO_3$ derived from chalk, Gasser (1965) showed that urea either did not affect the yield or depressed it below that of the unfertilized crop. Tseng (1967) found that urea could be considered as effective as $(NH_4)_2SO_4$; it was cheaper with no residual SO_4^{--} left behind. Salonen (1968) added that urea was close to $Ca(NO_3)_2$ in effectiveness, within both clay and peat soils; the differences in effectivness were comparatively small.

To easily review the literature dealing with behaviour of nitrogenous fertilizers in the soils under investigation, each kind of soil will be separately discussed by itself.

2.1. Behaviour of nitrogenous fertilizers under conditions of saline soils.

According to Milne and Rapp (1968), salt-affected soils are those that contain enough water-soluble salts to affect crop growth. Saline soils are the most common type and are usually the easiest to reclaim. They are neutral to slightly alkaline. Their structure is generally good, and their permeability to water and tillage characteristics are like those of non saline soils. Saline soils are recognized by spotty growth of crops and often by white crusts of salt on the soil surface.

Khalil *et al.* (1967) reported that plant growth required the movement of essential nutrients from the soil system into the plant, i.e., release of nutrients from the salid phase into soil solution, their movement in the soil solution to root surface, their removal by plants, and finally subsequent utilzation within various tissues. Soil salinity might have its determinant effect on one or more of these four steps. Milne and Rapp (1968) reported that the more salts there were in the soil solution, the harder it was far plants to take up enough water; also very high salt levels were toxic to plants. They added that salts in the soil usually removed water from plant roots by plasmolysis causing their cells to collapse; besides, the presence of certain salts usually reduced the availability of some plant nutrients. Salts have also been shown to reduce the activity of soil micro-organisms which, in turn, could affect the availability of nutrients to plants along with other soil features such as the structure. The above mentioned investigators mentioned that plants might grow well in moderately saline soil when it was high in moisture, because the soil solution then was diluted. Soil salinity was suggested to affect plant growth in two distinct ways : 1) the increased osmotic pressure of the soil solution may cause a decrease in the physiological availability of water to the plant, and 11) the concentrated soil solution may cause the accumulation of toxic quantities of various ions within the plant.

The literature on the subject generally indicated a decrease in crop yields with salinity. Luken (1962) reported that the decrease in yield response with salinity could be due to reductions in the availability of plant nutrients. This may be confirmed by investigations reported by Amer et al. (1964) and Lunin et al. (1964) which showed that for a given salinity level there was an increase in yield with fertilizer application.
In fact, factors involved in the salinity-fertility interaction

are not well understood.

The utilization of nitrogenous fertilizers to overcome the adverse effect of salinity was studied by several investigators. Application of N fertilizers were usually effective if salts are not excessive. Idnani (1957) found that yields were favoured by application of ammonium sulphate fertilizer; further increases in yield were obtained when a high dose of $(NH_4)_2SO_4$ was supplemented with 300 lb NaCl. The effect of salt addition was reported to increase the utilization of fertilizer N by the crop from 44 to 61%. Further work, carried out by Harding et al. (1958), indicated that increasing salinity and nitrogen accumulation were caused by treatments including $NaNO_3$ and $(NH_4)_2SO_4$. They added that winter cover crops reduced salinity more in the $(NH_4)_2SO_4$ plots than in the $NaNO_3$ ones; plots treated with $Ca(NO_3)_2$ showed a relatively lower salinity. Medal (1962) stated that increasing salinity was beneficial in maintaining the available nitrogen at high levels; nitrogen loss from the added fertilizer was also reported to be reduced due to reductions in the rate of nitrification. Rice plants, grown by Palfi (1963) in saline nutrient solution, showed an increase in the levels of amino acids within the tested plants; high concentrations of asparagine were obtained indicating a disturbed protein