SOIL AMENDMENTS TO CORRECT IRON AVAILABILITY IN EGYPTIAN SOILS

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ABSTRACT

The aim of the present study is a trial to establish some effective soil management and amendments procedures that can help in curing Fe malnutrition in some Egyptian soils rich in natural reserves and poor in available iron.

The main results being drawn from this investigation could be summarized as follows:

1. The acid treatment affected the levels of mobile iron significantly at about pH 4. Maximum values of mobile iron were obtained by the further rise in soil acidity to pH 3.10 and 3.25. When further acidification was performed, it was noticed a turn-over in the quantities of mobile iron.

2. In a study on the effect of waterlogging the soil and application of organic matter on the mode of releases of available iron were obtained with passage of time whether in the control treatment or in any special organic matter treatment. Under waterlogging conditions, it is noticed that a moderate level of organic matter increases available Fe, while higher amounts of organic matter depressed the release of Fe from its labile pool.

INTRODUCTION

Some procedures can be taken as a tool to release iron in a soluble form, and hence can aid in correcting its level in soils rich in total iron, yet poor in the available form.

Attacking the soil natural reserves of iron with acids was proposed by many authors as a soil amendment to transfer some of these reserves to a soluble form to prevent iron chlorosis. Waterlogging, or saturating a soil with water, causes drastic changes in the normal biological reactions in the soil because the oxygen is curtailed. In the absence of oxygen, anaerobic microorganisms become active and reduced organic and inorganic substances are produced. The level of oxygen supply, type, and amount of organic matter have direct effects on the oxidation-reduction status.
Extracting from many researches, aside from the poverty of soil in total iron reserves, the most pronounced procedures which may help in correcting iron deficiency in alkaline soils with ample supply of iron (through bringing more iron in solution) can be summarized in: a. Inducing soil acidity by applying acid-forming material; b. Inducing soil reduction by means of lowering the redox potential and c. Raising the level of natural chelating materials in the soil.

In this study, the first two of these points will be handled in a trial to establish some effective, yet cheap, soil management and amendments procedures that can help in curing Fe malnutrition in soils rich in natural reserves and poor in available iron.

MATERIALS AND METHODS

Materials

Ten surface soil samples (0-30 cm) were chosen to represent alluvial, sandy, and calcareous arable soils in Egypt. The soils were air dried, ground, and allowed to pass through a 2 mm sieve.

Analytical procedures and methods of analysis

Characterization of the studied soils

a Texture grade was defined by means of mechanical analysis according to the pipette method.16 
b Organic matter content by oxidation with dichromate as described by Walkley and Black.8 
c Calcium carbonate content by a Collin's calcimeter.8 
d pH value in a 0.01 M CaCl₂ solution (at 1:5 soil-solution ratio) using a Beckman pH-meter (Model H-2). 
e Total iron was determined by digesting 1.0 g portions of air-dried soils with hydrofluoric-perchloric acid mixture in a platinum crucible.2 Iron in the digest was measured colorimetrically by the O-phenanthroline method as described by Jackson.8

Some characteristics of the studied soils are given in Table 1.

Enrichment of soluble iron by raising soil acidity

Five soils (Nos. 1, 2, 4, 5, and 10) were used in studying the effect of pH changes on iron concentration in the soil solution. Eight 2.5 g portions from each of these soils were treated in 150 ml beakers with 25 ml of either one of eight 1 N ammonium acetate solutions adjusted to pH values of 2, 3, 4, 5, 6, 7 (by HCl) and pH values of 8 and 9 (by NaOH).

The suspensions (1:10 soil-solution ratio) were incubated overnight at 30°C to achieve equilibrium. Thereafter, the pH values of these suspensions were measured. To collect the soil solution, the suspensions were centrifuged and soluble iron was measured in the supernatent solutions by an atomic absorption using a Unicem Mod. 1900 spectrophotometer.

Enrichment of soluble iron by inducing soil reduction

For this study, five soils (Nos. 3, 6, 7, 8, and 9) were handled. To 100 g portions of air-dried soils, in 120 ml glass bottles, 0, 2, 4, or 8 g starch were added and mixed thoroughly. The moisture of the soil + starch mixture was brought to either 60 per cent of the water holding capacity (WHC), or to