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EFFECT OF VARIOUS AMOUNTS OF SILICIC ACID ON THE ACTIVITY OF "ARYLSULPHATASE" IN AGRICULTURAL SOIL

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Abstract

In sulphur deficient soils, sulphatases, play an important role by releasing the sulphur from the organic compounds thereby making sulphur available to plants, which in turn make the soil more fertile. The effect of different amounts of silicic acid on the activity of arylsulphatase, was studied in silicon amended agricultural loan soil collected from Sheffield UK. Present study reveals that silicic acid has inhibitory effect on the activity of arylsulphatase in agricultural soil.

Keywords: Silicic acid, Soil, Arylsulphatase

Introduction

Sulphur, particularly in the form of sulphate (SO_4^{2-}) is an essential nutrient for most of the organisms. Almost all sulphur available in soils is in organic combinations, with two fractions accounting for most of the organic sulphur present (Freney, 1967). As studies have shown that up to 90% of soil sulphur is in the form of organic sulphate esters ($R\text{-}C\text{-}O\text{-}SO_3^-$), mineralisation of ester sulphates by the enzyme (sulphatase), in soil is an important process. In sulphur deficient soils, sulphatases, play an important role by releasing the sulphur from the organic compounds and thereby making sulphate available to plants, which in turn make the soil more fertile from the agricultural point of view.

Sulphatases are classified, on the basis of organic sulphate esters type which is hydrolysed by the action of these enzymes. The main recognized groups included arylsulphatases, alkylsulphatases, steroid sulphatses, chondrosulphatases glucosulphatases, and mycosulphatases (Roy, 1960). Arylsulphohydrolases, that are also termed as "phenolsulphatases" or "arylsulphatases", aryl-sulphate sulphohydrolase).

Arylsulphatases are ubiquitous in distribution. These enzymes are present in plants, animals, humans and microorganisms and are often released into soil, by plants and microbes. Tabatabai and Bremner (1970) first reported that the availability of arylsulphatases in soil and they mentioned that the organic soil sulphur mineralisation to $SO4^{2-}$, is the result of aryisulphatases and other sulphatases that have a major role in soil processes. Since then, several studies have been made on arylsulphatases in different soils (Cooper, 1972; Speir and Ross, 1975). These enzymes were also found in marine, lake sediment (Chandramohan *et al.*, 1974; King and Klug, 1980), in salt marsh soils (Oshrain and Wiebe, 1979; Wainwright, 1981) and in intertidal sands (Wainwright, 1981). The present work was undertaken to know about the effect of silicic acid on the activity of arylsulphatase in agricultural soil.

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Materials and Methods

Effect of various amounts of silicic acid on the activity of "arylsulphatase" in agricultural soil.

Agricultural loam soil was collected (10cm depth) from Sheffield UK, and divided into two groups, (a) soil amended with silicic acid and (b) soil lacking added silicic acid. To triplicate fresh agricultural loam soil samples (100g, sieved 2mm, roots and animals free soil) containing in polythene plastic bags were added, 1, 5, 10, and 20 grams silicic acid and mixed. The other soil set was lacking added silicic acid. 5 ml deionized (sterile) water were sprinkled, mixed thoroughly and the samples were incubated at 25^0C for 14 days. Measurement of enzyme-activity was made on 0, 7, 14, 21 and 28^{th} day. Control, was set-up without adding *p*-nitrophenyl sulphate solution and was compared with each sample of treatment.

Measurement of arylsulphatase activity in soil

To soil (1g), contained in universal vials (25 ml), 4 ml acetate buffer, 0.25 ml toluene and 1ml *p*-nitrophenyl sulphate solution were pipette, swirled for few seconds to mix the contents, screwed on top and placed in a water bath at 25^0C. After 1 hr vials were removed from the water bath, and 1ml $CaCl_2$ (0.5M), 4ml NaOH (0.5 M) were added, vials were swirled for few seconds, and the soil suspension was filtered through Whatman No: 1 folded filter paper into a test tube.

Control was performed with each soil sample analyzed to allow for colour not derived from *p*-nitrophenol released by arysulphatase activity. For control, above procedure was followed except 1ml of *p*-nitrophenyl sulphate solution. After incubation at 25^0C for 1 hr, 1ml of $CaCl_2$ (0.5 M) and 4 ml of NaOH (0.5 M) were added and then 1ml of *p*-nitrophenyl sulphate solution was added immediately before filtration of the soil suspension into a test tube. Filtrate was transferred to a 4ml cuvette and intensity of the yellow colour was measured at 400 nm in the spectrophotometer against a reagent blank.

Calibration curve

I ml of the standard *p*-nitrophenol solution was diluted to 100 ml in volumetric flask and mixed the solution thoroughly. The diluted standard solution was pipette as 0,1, 2, 3, 4 and 5ml into universal vials to give 0, 10, 20, 30, 40, and 50µg of *p*-nitrophenol in each vial (six vials total) and the volume was adjusted to 5ml by adding deionized water. Then I ml of 0.5 M $CaCl_2$ and 4 ml of 0.5 M NaOH, were added swirled the vial for a few seconds, and filtered through a Whatman No. 1 folded filter paper into a test tube. Filtrate was then transferred to a cuvette and the intensity of the yellow colour was measured at 400nm in the spectrophotometer against the reagent blank i.e. the filtrate that contains no *p*-nitrophenol. Calibration curves prepared from standard *p*-nitrophenol solutions are highly reproducible and are identical to those obtained when these standards are prepared in acetate buffer instead of water.

Determination of the dry weight

The dry weight was determined after leaving the filter papers (Whatman No 1) at 60^0C overnight. In all cases, triplicates were used.

Results and Discussion

Effect of silicic acid addition on soil arylsulphatase activity

These results show that silicic acid had an inhibitory effect on soil arylsulphatase activity in the agricultural loam soil over the full 28 day incubation period with inhibition increasing with increasing concentration of added silicic acid (Fig: 1).

The effect of silicic acid on arylsulphatase was studied because it is considered to be an essential enzyme in relation to the release of the sulphate ion from soil organic sulphates, and is therefore an important factor in relation to soil fertility. Soil enzymes can be measured in relation to enzyme activity at any one point (i.e. in the presence of an inhibitor, like toluene) or enzyme synthesis over a time period, without an inhibitor of microbial activity being added micro-fauna. Silicic acid inhibits, arylsulphatase in the soil derived from a number of sources, including microorganisms, plants and a soil. In conclusion the view that at least, silicic acid addition would have a negative impact on soil fertility.

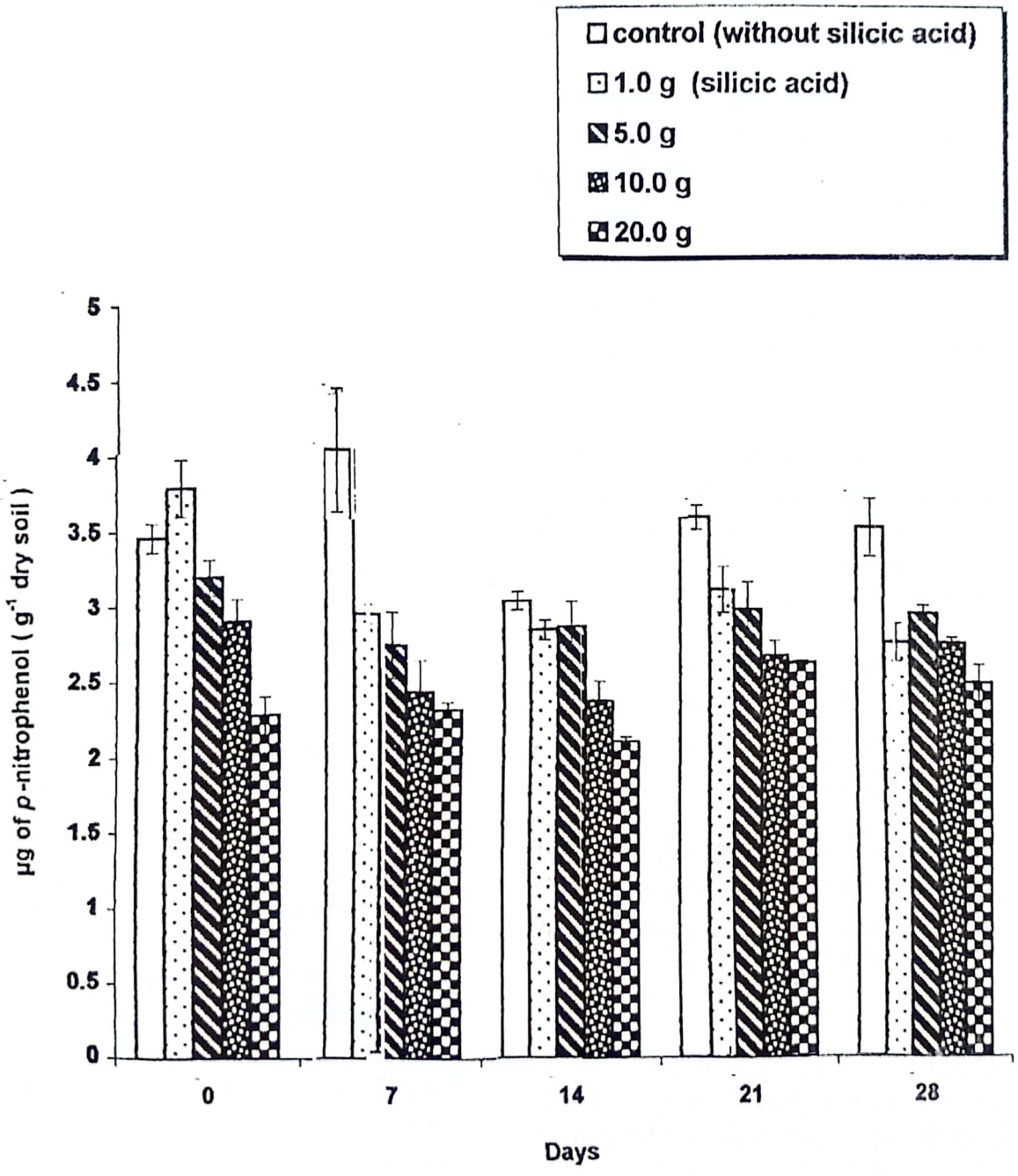


Figure 1 Effect of different amounts of added silicic acid on the activity of arylsulphatase in agricultural soil. (Means of triplicate, ± standard error)

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