SOIL FACTORS AFFECTING ZINC AVAILABILITY IN SOME ALLUVIAL SOILS OF LEYTE AND SOUTHERN LEYTE

Faustino P. Villamayor

Assistant Professor, Department of Agronomy and Soil Science, Visayas State College of Agriculture, Baybay, Leyte, Philippines.

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ABSTRACT

The effects of pH, organic matter and available phosphorus on the available zinc content of Palo, San Manuel, Umingan and Mandaue soil series were investigated. Available phosphorus and pH exhibited an inverse relationship with available zinc. No relationship was found between organic matter and available zinc.

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INTRODUCTION

Research on the effect of different soil factors on zinc availability have been conducted by several authors. Udo (1969) found that the release of zinc from the soil is highly pH dependent. Castro (1976) noted that the solubility of zinc in water decreases 100 times with every unit increase in pH. Clark and Graham (1968) found a lower diffusion coefficient and a higher distribution coefficient of zinc with increasing pH.

Organic matter also affects zinc availability by binding it and this varies with pH. Katyal (1972) found that the stability values of metal-organic matter complexes vary with pH, i.e., the lower the pH values, the lower is the stability constant. The soil becomes depleted with zinc due to an increase in microbial population which may have competed with the plant for supply of a minor element in a deficient soil (Anonymous, 1978). Shafi (1969) noted that 50 mM bicarbonate generated by adding organic matter reduced the zinc uptake of rice. Forno *et al.* (1975) found that bicarbonate and acetic acids generated by organic matter can have an effect on zinc uptake and translocation to the shoots of rice. Organic matter can reduce zinc uptake by producing large amounts of ferrous iron. Redman and Patrick (1975)

noted a positive correlation between ferrous iron concentration and organic matter.

The concentration of phosphorus in the soil has an effect on zinc uptake of rice. Peterson *et al.* (1972) found no evidence that higher rates of phosphorus application had any influence on applied zinc or indigenous soil zinc. Gangwar and Mann (1974) reported that increasing phosphorus application up to 40 ppm did not reduce the zinc uptake of rice roots. However, considerable but statistically non-significant decrease in zinc was observed at 80 ppm.

Care must be taken when phosphorus is applied to soils poor in available zinc. A study of Prabha *et al.* (1975) revealed that for proper uptake and utilization of zinc, especially in zinc-deficient soil, the phosphorus level must be kept low. High levels of phosphorus may lead to zinc deficiency. Viets (1969) postulated that phosphate precipitates zinc as zinc phosphate. Zinc can be precipitated as zinc ammonium phosphate (IRRI, 1972).

Soils in Leyte and Southern Leyte are reported to be zinc-deficient. Pantastico *et al.* (1972) found that some soils in Leyte have low available zinc. Orticio and Ponnamperuma (1977) reported that current and potential zinc-deficient soils can be found in Leyte. An analysis of the trace elements of soils conducted by the regional office of the Bureau of Soils in Tacloban City showed that soils from the municipalities of Babatngon, Alang-Alang and Hilongos have low available zinc content.

To date, no detailed study has yet been conducted on the effect of some soil factors on the available zinc content of some alluvial soils in Leyte and Southern Leyte. Such study is needed to gain an insight into the nature of zinc deficiency on these alluvial soils. This study presents the effects of pH, organic matter and available phosphorus on the available zinc content of four alluvial soil series in Leyte and Southern Leyte.

MATERIALS AND METHODS

One hundred sixty soil samples from 4 alluvial soil series, namely Palo, San Manuel, Umingan and Mandaue were collected in Leyte and Southern Leyte. Bamboo samplers were used in collecting the soil samples at a depth of 30.5 cm, after which they were thoroughly air dried and sieved in a 2-mm sieve.

Alluvial soil samples were analyzed for available zinc, pH, organic matter and available P. The following were the analytical methods used for soil analysis:

pH (1:1 soil — water ratio)

organic matter (Walkey-Black Method; Jackson, 1958)

available P (Bray No. 2; Jackson, 1958)

available Zn (Katyal and Ponnamperuma, 1974)

Regression analysis was done on available zinc of all soils with their pH, organic matter and available P values.

RESULTS AND DISCUSSION

Effect of pH.

Available zinc exhibits an inverse relationship with pH (Fig. 1). Available zinc at a concentration of 1 ppm was observed at pH 6.1. Pantastico *et al.* (1972) also observed that for most cases there was an inverse relationship between availability of nutrient elements and pH except boron.

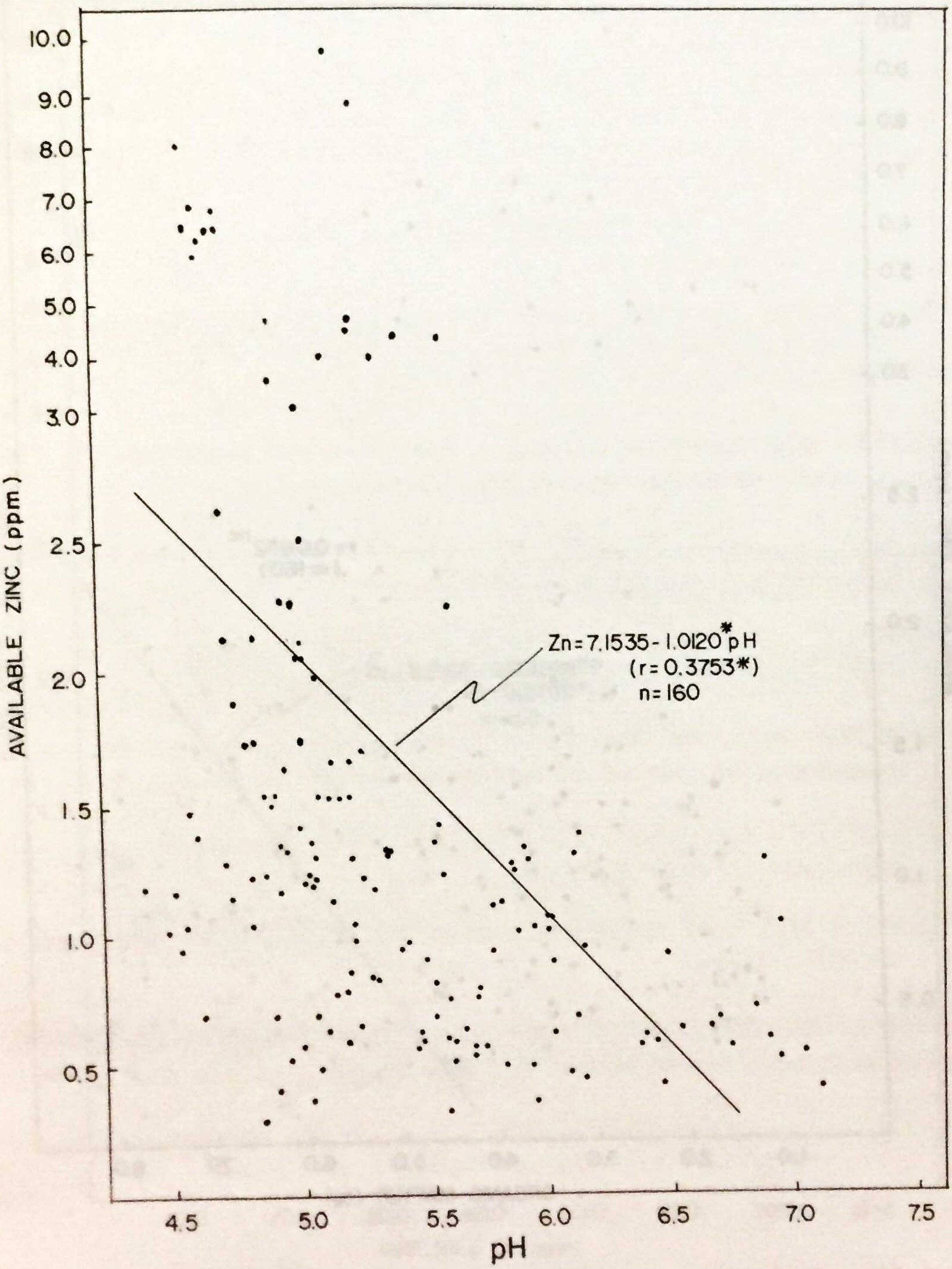

Fig. 1. Effect of pH on available zinc content of alluvial soils.

Effect of Organic Matter.

There was no correlation noted between soil organic matter content and available zinc (Fig. 2). The same result was obtained by Pantastico *et al.* (1972) who attributed this to very little or no zinc that can be chelated to organic matter.

However, Sharma and Monterami (1969) cited workers who reported that zinc increased with

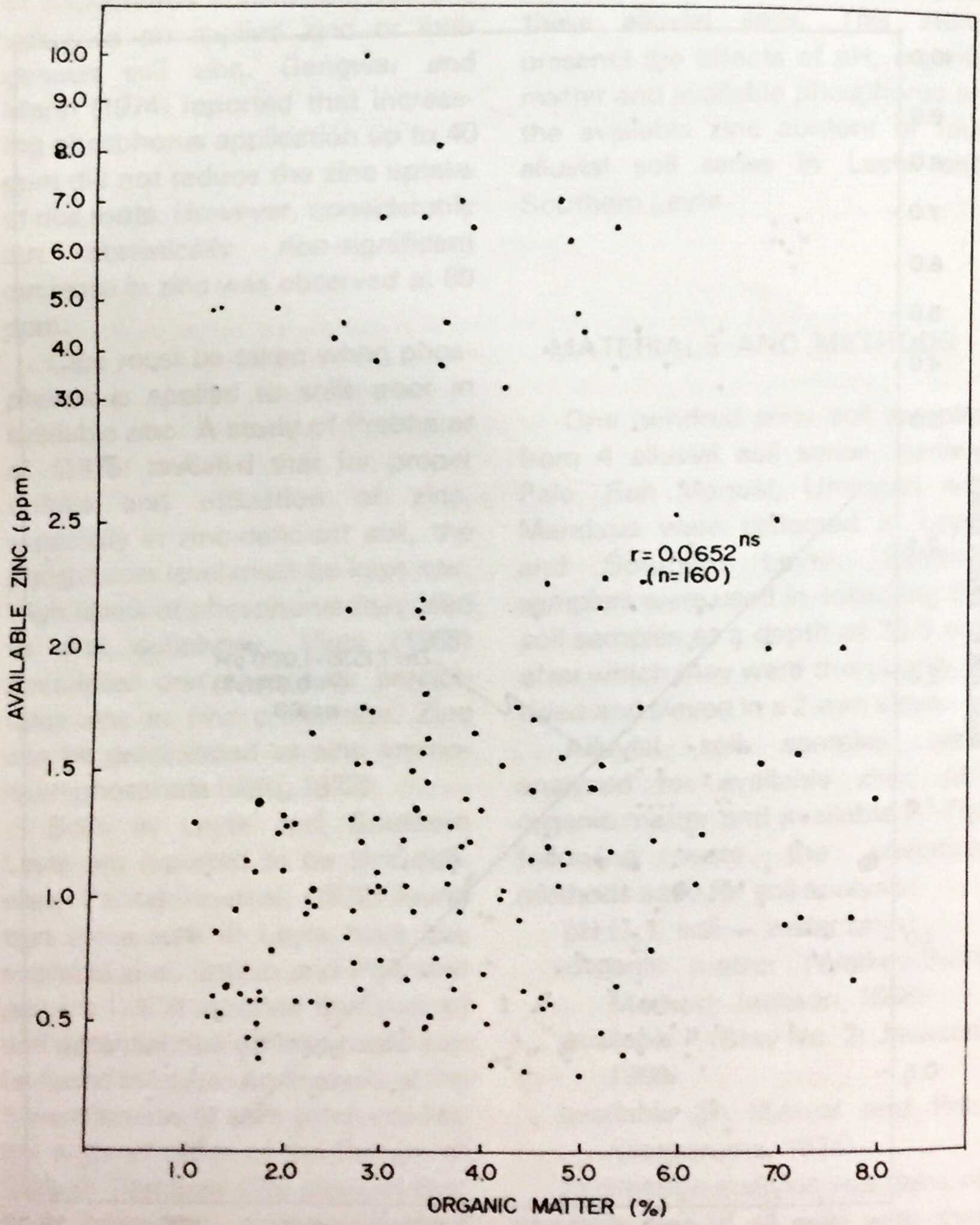

Fig. 2. Effect of organic matter on available zinc content of alluvial soils.

increasing organic matter. A negative relationship between organic matter and available zinc was observed on young volcanic soils (Anonymous, 1978).

The relationship between organic matter and available zinc could change with increasing organic matter content. Rajagopal *et al.* (1974) working on laterite soils of Nelgiris, Tamil Nadu, India found a positive relationship between available zinc and organic carbon. However, with an organic carbon

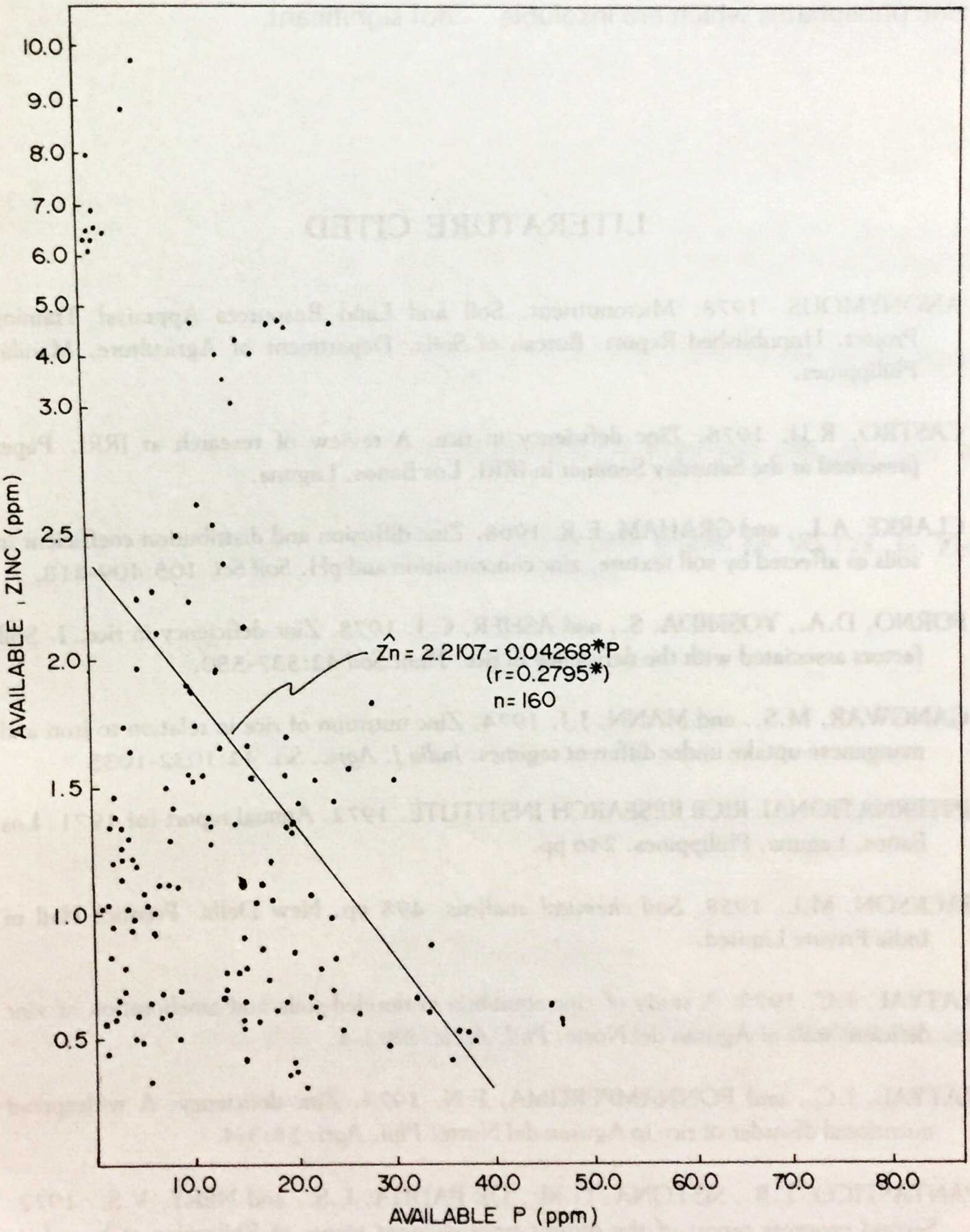

Fig. 3. Effect of available P on available zinc content of alluvial soils.

content above 3.0%, they observed a negative relationship.

Effect of Available Phosphorus.

An inverse relationship exists between available zinc and available phosphorus (Fig. 3). Formation of zinc phosphates which are insoluble at higher available phosphorus concentration can be postulated as one of the reasons for such inverse relationship.

Pantastico *et al.* (1972) however reported a positive relationship between available phosphorus and available zinc but this relationship is not significant.

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