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NOTE

USE OF WORN-OUT AUTOMOBILE TIRES AS A SOURCE OF ZINC FOR CORN PLANTS IN CALCAREOUS SOILS[1]

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Abstract – In a greenhouse study, corn (*Zea mays* L.) was grown as a test plant with or without Zn added as rubber from worn-out automobile tires. Growth measured in terms of fresh and dry weights was significantly higher in the former than in the latter. Plants which received rubber were bigger in size and green, whereas untreated plants were stunted and produced chlorotic leaves. Under the experimental conditions of the study, soil amendment with tire appeared to satisfy the Zn requirement of plant.

INTRODUCTION

Zinc is an essential minor element for plants and deficiencies of this element in plants usually result in morphological abnormalities and low production [2, 3, 10]. In crop plants, Zn deficiencies have been noted throughout the world [5, 6]. For correction of this problem various Zn-containing substances have been tested and used [1, 5, 6]. However, in many regions of Asia and Africa where Zn deficiencies are of wide occurrence, Zn fertilizers are not commonly available. Unavailability coupled with high costs, especially in the case of chelated Zn, often limits the use of Zn fertilizers by growers. Thus an effective, easily available and economical source of Zn is needed.

Poly rubber has been recently introduced as a mulching material in landscaping and there are indications that the rubber is phytotoxic especially in acid media because of the release of Zn and the resultant accumulation of large amounts of Zn in the plant. Limestone helped in correcting such a situation [8, 9]. This paper reports the results of an investigation in which rubber from worn-out automobile tires was used as a source of Zn for plants in a calcareous soil.

MATERIALS AND METHODS

A local cultivar of corn (*Zea mays* L.) was grown in 20-cm diameter plastic pots, using a calcareous soil from the College Experiment Station, Bajgah, Shiraz, Iran. The soil had a pH of 8.2, CEC of 16.7 m equiv/100 g with organic carbon content of 0.51%. It contained 24 ppm $NaHCO_3$ extractable P and 0.9 ppm 0.1 N HCl extractable Zn. The air-dried and sterilized soil received a uniform application of N, P, S and Fe at the rates of

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150, 75, 30 and 5 ppm, respectively, from a mixture of $(NH_4)_2SO_4$, NH_4NO_3, fertilizer grade superphosphate and Fe chelate (EDDHA).

Worn-out automobile tires were obtained, cleaned and cut into pieces. The outer layers of rubber was discarded to avoid contamination from the road. The inside rubber surface was chiseled into 1-2-mm slices which were subsequently recut into as many small granular pieces as possible. Plants were grown with or without 0.75 g of rubber placed about 4 cm deep beside the seed. Four seeds were sown per pot and the seedlings were thinned to two plants per pot. The plants were grown under greenhouse conditions and irrigated with distilled water. Two pots constituted a treatment and each treatment was replicated three times.

Six weeks after planting, the plant tops were harvested, fresh and dry weights were recorded and the samples were ground in Wiley mill to pass a 40-mesh screen. One 0.5 g sample was dry-ashed at successive temperatures of 225, 350 and 500°C, and the ash dissolved in 5 ml of 1 N HNO_3 and 20 ml of 0.1 N HCl. The zinc concentration was determined by atomic absorption spectrophotometry. The study was repeated twice and the data were combined for statistical analysis as in an earlier study [4].

RESULTS AND DISCUSSION

During the growth of the plants in both studies, there were considerable visual differences in the control and treated plants. After three weeks the leaves of plants from the control were interveinally chlorotic, similar to Zn deficiency symptoms as described by Viets *et al.* [10]. However, deficiency symptoms were not noted and plants were vigorous and normally green when grown in rubber-treated soil. It is possible that the application of rubber readily corrected Zn deficiency symptoms.

Table 1. Effect of added Zn in the form of rubber from worn-out automobile tires on the fresh and dry weights and Zn concentration of corn top*

Treatment	Fresh wt (g/plant)	Dry wt	Zn concentration (ppm)
Control	3.10	0.35	7.10
Rubber added	7.85	0.94	65.00
L.S.D. 5%	2.25	0.21	6.01

* Values are means of two studies (8 replications).

Growth measured as fresh or dry weights was greater for treated plants than for the control plants (Table 1). A similar trend is apparent with respect to the Zn concentration of plants. However, Zn was accumulated in the treated plants without any evidence of Zn toxicity. Similar accumulations of Zn have been reported in plants receiving Zn fertilization [4, 5, 7]. Zinc released from the rubber was presumably sufficient to satisfy the Zn requirement of plants without encountering any unfavourable effects.

There are reports indicating that in an acid media, poly rubber caused Zn toxicity in plants due to increased release of Zn from the rubber and ground limestone was

successfully used to control such a situation [8, 9]. However, the present study was conducted in a calcareous soil having a pH of 8.2. Under these conditions the Zn released from rubber appears to have been slow and steady. In another study, a negative trend was noted between plant Zn content and the pH of the medium (Asif and Khan, unpublished data). Thus it could be conjectured from the results obtained that the rubber may be used as a source of Zn for plants growing under alkaline conditions. Under acidic conditions, amendment with limestone is necessary to reduce the availability of the Zn released from rubber. Tire rubber appears to be an effective and economical source of Zn for plants grown in calcareous soils as exist in some parts of Iran. The use of worn-out automobile tires for fertilizer may prove to be a worthy means of disposing of this otherwise useless commodity. The slow degradation rate of tire rubber indicates that it may remain as a source of zinc for several years. Further research is suggested, however, before application in the field can be recommended.

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