CHLOROSIS of corn (Zea mays) has been observed in central Washington since 1947 on the desert soils after they are reclaimed for irrigation. Prevention of this chlorosis and restoration of growth by spray application of ZnSO₄ solutions to the foliage were reported in 1951 (18). No response has been noted to foliage sprays containing Cu, Mn, B, Fe and Mo, but applications of ZnSO₄ have been consistently beneficial in stimulating vegetative growth.

The observed symptoms are similar to the “white bud” symptoms of corn described by Barnette and Warner (2), and Barnette et al. (1) except that the unfolding leaves are seldom white or very light yellow as they describe them, but are greener than any others on the plant. This difference may be due merely to the degree of Zn deficiency, but differences in Zn translocation may also be involved. “White bud” is an inappropriate name for the symptoms observed in Washington and is not used by farmers.

The deficiency symptoms have been observed in corn and beans grown on some areas of nearly all of the major soil types in central Washington. Deficiency is more prevalent on soils where topsoil has been removed by erosion or land leveling for irrigation. These Zn-deficiency-producing areas are generally more alkaline within the plow depth (pH 7.6 or above) and the zone of lime accumulation is nearer the surface than in normal soils. However, unleveled soils and soils without lime in the profile may also produce Zn-deficient plants. On the other hand, calcareous soils may not produce Zn deficiency. Therefore the presence of lime and higher pH may only be modifying factors and not dominant factors in Zn availability.

Barnette et al. (1) reported prevention of Zn deficiency symptoms and increases in corn yields on Florida sands by use of 10 to 20 pounds of ZnSO₄ or Zn-carrying organic materials in the row at planting.

Hoagland, Chandler and Hibbard (5) found that sheep manure applied to Zn-deficient Delhi silt sand in jars did not prevent Zn deficiency symptoms on corn, but did in tomatoes, sunflowers, squash, mustard, barley and tobacco.

Reed and Beck (9) found a greater curtailment of cob and kernel development than of stalk and leaf growth when Golden Bantam sweet corn was grown with low-Zn supply in solution cultures. In the case of extreme Zn deficiency in Washington, no ears are produced, but there is some vegetative growth (18).

Leukel and Camp (7) claimed that Zn-deficient corn plants were low in total N, indicating some specific effect of Zn on N absorption. The relative proportions of various soluble N compounds and protein was not greatly different in Zn-deficient plants than in normal plants.

Although it is beyond the scope of this paper to discuss the extensive and somewhat contradictory literature in relation to Zn availability and symptom expression, these papers deserve mention for their pertinence to the problem. Barnette et al. (1) found that applications of Zn fertilizers with ZnSO₄ reduced the effectiveness of increasing corn yields. In fruit trees in Utah, Wann (14) have shown that Zn deficiency symptoms of CO₂-soluble P in the soil are associated with textured soils of low lime content.

Soil studies on Zn in relation to corn nutrition have been very limited, but Wear and Sommer (20) state that Zn is soluble in 0.1 N HCl is an adequate indication of deficiency symptoms.

This paper presents the results of some basic approach to Zn problems on corn, and includes a summary of field experiments and analytical data from plant and soil samplings. The work has been paralleled by extensive studies on field beans to be published later. This latter work corroborates many of the findings with corn.

SAMPLE PREPARATION AND ANALYTICAL METHODS

All corn yields are expressed on the basis of 100 lb. of the shelled grain, and plant composition data are oven-dry weight at 70°C.

All leaf samples were washed in a Dextsol solution twice in distilled water prior to drying. Total top samples were unwashed. Root samples were washed in tap water, 0.5M HCl, and finally rinsed twice in distilled water.

All leaf samples were ground in an intermediate Wiley mill fitted with all steel parts, except those supplied by table 2, which were ground in a standard intermediate mill. Total top samples were ground in a hammer mill after sampling for further grinding.

Soil samples were collected and prepared for analysis using steel equipment and sieves, Zn-free containers, etc.

All plant analyses except N were made on perchloric-nitric acid digests using standard precautions against contamination. Zinc and Cu were determined by adaptations of the procedure of Holmes (6); Mn was determined by oxidation with periodate; Mg by the thiazole yellow method; Fe by the o-phenanthroline reagent; Ca and K by flame photometry, and N by the Kjeldahl method modified to include nitrate.

On soils ammonium acetate dithizone extractable (or extractable Zn) was determined by the procedure of Dean (11). Holmes' method (6) was used for Zn. Zinc soluble in 0.1N HCl was determined with 0.1N HCl to 5 gm. soil in a 100 ml. beaker and