Response of Corn (Zea mays L.) to Population, Bed Height, and Genotype on Poorly Drained Sandy Soil. I. Root Development

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ROOT development is of major significance in the growth of crop plants. Therefore the plant root response is an important criterion in the evaluation of different conditions of growth and is basic to the development of cultural and management schemes that will result in maximum yields. An examination of the root weight and distribution as affected by various cultural methods is the object of this study.

REVIEW OF LITERATURE

Root development of plants is limited by physical and chemical conditions of the soil, cultural and management practices, diseases, insects, and genotype (10, 11, 12).

Harris and van Bavel (5) found that the amount of root respiration in 24 hours per gram of dry root weight was fairly constant and concluded that root respiration per plant under favorable aeration conditions appears to be primarily determined by the weight of the root system. Long (8) obtained 69% of the total corn root weight in the top 6 inches of soil and 98% in the top 2 feet of soil. Foth (4) found that over 75% of the total oven dry weight of corn roots, sampled at 80 to 100 days after planting, occurred in the top 9 inches of soil within a lateral spread of less than 10 inches from the plant. Bloodworth et al. (1) studying the root distribution of mature sweet corn planted in 38-inch rows with 12-inch plant spacings obtained 81% of the total dry weight of roots in the top 9 inches of soil and 90% in the top 12 inches of soil.

Investigations have been reported (10) which showed that at low soil temperature little elongation of the subcrown internode occurred, and the first node and secondary roots developed immediately above the seed. Letey et al. (7) studying the oxygen supply of water-logged soils found that lowering the temperature reduced oxygen supply to a root surface and that oxygen supply was most detrimental during early growth until a good root system was developed. Miller and Duley (9) have shown that a period early in the growing season favored penetration of corn. Hays (6) believed that vertical downward penetration of corn roots on poorly drained soil was bounded by a zone approximately 18 inches parallel to the water table, but that the water table did not influence the horizontal distance to which roots extended. Tests indicated that if moisture extraction in a sandy soil is to be matched by capillary rise, the moisture content in the root zone must be near saturation (12).

EXPERIMENTAL PROCEDURE

The experiments were conducted on Leon fine sand near Gainesville, Florida, in 1960 and 1961 on an area that had been in a grass-white clover mixture for several years. Leon fine sand is characterized by level to nearly level topography and slow internal drainage. In a typical profile of Leon fine sand an organic pan exists between 24 and 30 inches below the surface. During periods of high precipitation, the water table is often at and sometimes above the soil surface.

A split plot design with 2 hybrids (Coker 811 and Florida 200) and 5 plant populations (5,000, 10,000, 15,000, 20,000, and 25,000 plants per acre) as the subplot treatments was used. The whole-plot treatments consisted of beds of different settled heights (0 or ground level, 3, 6, and 9 inches) structured over the entire plot area by tractor-mounted disk plows forming ridges or single row beds, 38 inches apart. Bed heights were then produced by lowering each pre-assigned level.

Twenty pounds of nitrogen, 17.6 of phosphorus, 200 of gypsum, 40 of No. 501 Fritted Trace Elements, and 5 of Aldrin was applied per acre each year and disked into the soil prior to bedding. The seed was hand planted April 14, 1960, with 2 kernels per hill, later thinned to 1 plant per hill. The hills were spaced 33.00, 16.50, 11.00, 8.25, and 6.60 inches apart in the row to obtain the desired plant population. Three replications of 3-row plots were used. The plots...