I. INTRODUCTION

Since the passage of the Surface Mining Control and Reclamation Act of 1977 (SMCRA), surface mine operators have become more aware of the deleterious effects of soil compaction on crop yields. Soil compaction may be defined as the compression of soil making it more dense (Gill, 1961). Thus, bulk density increases and fewer large pores are present. A compacted soil generally has poor aeration, low nutrient and water availability, slow permeability, and mechanical impedance to root growth (Raney et al., 1955).

Phillips and Kirkham (1962) have stated that soil strength measured with a penetrometer may be a better indicator than bulk density for root penetration since a penetrometer resembles the resistance a root may encounter. Thompson et al. (1987) found both bulk density and penetrometer resistance highly correlated to root length density in the lower portion of a reclaimed root zone.

Voorhees (1990) stated that freeze-thaw cycles failed to alleviate compaction caused by large farm machinery even nine years after the initial compaction. In arid climates such compaction may last even longer since soils in the fall generally contain insufficient amounts of soil water for frost heaving to occur (Brenneman, 1991).

One method that has been employed to alleviate soil compaction has been tillage. Subsoiling increased wheat yields significantly over non-ripped areas for two out of three years in one study (Barnhisel et al., 1988a). In a similar study, Barnhisel et al. (1988b) stated that ripping and/or subsoiling had no significant effect on bulk density and subsoiling generally reduced alfalfa yields. Meek et al. (1988) showed that traffic on the surface similar to what a producer would apply, reduced alfalfa yields by 10% compared to areas with no traffic. Compaction on 100%

of the surface after harvest each year reduced alfalfa yields by 17% compared to areas with no traffic.

One study by Materechera et al. (1992) evaluated the influence of a compacted subsoil on root characteristics of different plant species. Their data suggests that the size of a root has a significant influence on whether or not the compacted layers are penetrated. The study also showed that root tips were consistently larger for plants grown in compacted versus noncompacted subsoil.

Modeling efforts to describe compaction caused by mining equipment are now being done. In recent papers by Bingner and Wells (1992a and 1992b), compaction processes that are caused by equipment are described. Furthermore, their model allows several parameters to be changed to allow a better understanding of the soil compaction processes at surface mine sites.