Introduction

Soil compaction is a serious problem for many intensively tilled soils. It is estimated that two million acres in California have yields reduced by compaction, with another two to three million acres becoming marginally compact (10). Stockton et al. (9), Carter et al. (2), and Carter and Tavernetti (4), working in the San Joaquin Valley, California, developed a concept of "precision tillage" that consisted of chiseling soil to a depth of 50 to 60 cm in the drill row before planting cotton. Yields increased substantially with precision tilling and this was more effective than deep chiseling with no regard to the location of the drill row.

This report presents results of preliminary studies to adapt precision tillage to potato production, and those of a detailed study on the durability of the system on soil strength conditions, root development, and tuber production.

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production. Our earlier report (5) discussed potato tuber production in relation to soil physical properties in the potato bed zone. This study is concerned primarily with soil at depths below the bed.

**Materials and Methods**

Preliminary investigations were conducted in 1963-65, and detailed studies on precision tillage in 1971-74. All studies were at the U.S. Cotton Research Station, Shafter, California, on Wasco sandy loam (Typic Torriorthents). The soil is 70-75 percent sand and 11-14 percent (<2μm) clay through a depth of 91 cm. Bulk density below loosened bed zone is typically 1.6 g cm⁻³.

Plots were established with an initial furrowing operation to establish the location of rows. For precision-tilled plots, subsoil shanks were pulled through the soil directly in the center of the beds to a depth of 60 cm below the crest of the finished bed. Individual plots were two rows 81 cm apart. Row length varied between tests but was always long enough to facilitate sampling and accurate yield determinations. Plot length was 30.5 in the primary test of 1972-74. Tillage treatments were performed three to seven days before White Rose seedpieces were planted, in mid-February. Aside from the precision tillage, the tillage and cultural practices were standard for the area. Plots were arranged in a randomized complete block design with four to six replicates for all tests.

Precision tillage of the 1963-65 trials was combined with some soil amendments but no treatment interaction was found, so only standard vs. precision tillage comparisons are presented here. The 1971 trial was limited to standard and precision tillage. The 1972-74 study comprised five treatments: check plots receiving only standard tillage each year; three series of plots each precision-tilled one year only (1972, 1973, or 1974); and a treatment precision-tilled in each of the three test years. This treatment set allowed assessment of the annual effect of precision tillage, its length of effectiveness, and the influence of the practice on soils and yields when imposed every year. Plots were accurately maintained in the same location throughout the experiment.

Plots were uniformly furrow-irrigated in 1963-65 and sprinkle-irrigated in 1971 and 1972-74 to meet evapotranspiration demands of the plant.

Penetrometer soil strength was determined, and root density samples were taken at maximum plant development three to four weeks before harvest in mid-June for the 1972-74 study. The penetrometer used was that described by Carter (3) fitted with a 1.27 cm² (for high strength) or 3.09 cm² (for low strength) 30° cone attached to a recessed 0.95 cm diameter rod 92 cm long. To ensure a uniform matric water potential near −0.25 bar, plots were sprinkled two or three days before strength was