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INFLUENCE OF VARIOUS CROPPING SYSTEMS ON THE BULK DENSITY OF A BURDEKIN FLOOD PLAIN SOIL

By R. E. CULLINANE, B.Sc., C. A. MUIR, B.Agr.Sc., and D. SETON, H.D.A.

I. INTRODUCTION

Numerous references are found throughout the literature to the beneficial effects of grass systems on soil aggregation. Baver (1961) has discussed this effect and states that "there can be no doubt on the beneficial effects of roots on soil porosity." The flood plain soils of the Burdekin River in North Queensland are extremely dense, are poorly aerated, and have low infiltration rates. In the Oakey Series the B horizon is high in exchangeable sodium. This leads to a dispersed B horizon with undesirable physical properties. A trial was commenced at the Millaroo Research Station to test the effects of several cropping systems on the physical properties of the Oakey soil series.

II. MATERIALS AND METHODS

Plots of Rhodes grass (*Chloris gayana*), para grass (*Brachiaria mutica*) and elephant grass (*Pennisetum purpureum*) were established in 1959. These were maintained with regular surface irrigation but no added fertilizer until late 1962, when they were ploughed out. During the same period comparable plots were also planted in an annual cropping sequence of maize, sorghum, cotton, fallow. These plots were replicated twice but were not completely randomized.

Although the various grass plots were well established and free of weeds, the annual cropping plots following the season's crop reverted to a "weed fallow" between crops. In general, crop and pasture growth was very poor.

In 1963 all treatments were ploughed out and a test crop of Benton oats was planted over the whole area.

In order to reduce as far as possible known nutritional deficiencies, an overall fertilizer application at the rate of 55 lb N, 67 lb P and 37 lb K per acre was incorporated in the soil before planting. When the plants reached the early heading stage samples were taken for oven-dry matter determination.

As a measure of soil structure change, bulk densities were determined according to the method described by Fox and Page-Hanify (1959).

III. RESULTS

Results of the indicator crop yield and bulk density determination are presented in Table 1. Bulk density for the 0–3 in. zone is not quoted, as the uneven soil surface precluded accurate volume measurement. Bulk density figures have been corrected to 20% gravimetric soil moisture, using a bulk density soil moisture relationship calculated from the results.

TABLE 1

OAT YIELDS AND SOIL BULK DENSITIES

Previous Treatment	Oat Yield (lb/ac oven-dry matter)	Bulk Density (g/c.c.)		
		3–6 in. Zone	6–9 in. Zone	9–12 in. Zone
Rhodes grass	4,325	1·52	1·58	1·59
Para grass	4,407	1·56	1·58	1·61
Elephant grass	4,160	1·59	1·60	1·61
Annual crop	3,980	1·55	1·60	1·60

IV. DISCUSSION

From the results it is evident that the period under grass and annual crops had no effect on the bulk density of the soil or on the subsequent growth of an oat crop. The reason for this becomes clear when we consider the nature of the soil. Zimmerman and Kardos (1961), working with sudan grass and soybean, found a strong negative correlation between bulk density and root penetration. With the high bulk densities found here, it would appear that roots would have difficulty in penetrating this soil. Gardner (1962) also found that penetrating ability of cotton roots decreased with increasing partial pressure of carbon dioxide. The poor aeration of these soils would therefore also hinder root penetration. If these conditions leading to poor root growth could be ameliorated and a vigorous rooting system established, it is possible that grass roots would have a greater soil aggregating effect on this dispersed soil. A further trial has been commenced, using grass roots in conjunction with deep ripping, to examine this effect.

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R. E. Cullinane is an officer of Agricultural Chemical Laboratory Branch, Queensland Department of Primary Industries, and C. A. Muir and D. Seton are officers of Agriculture Branch.