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PROJECT CS44L: CLASSIFICATION OF IRRIGATED COTTON SOILS ACCORDING TO SUSCEPTIBILITY TO PHYSICAL DEGRADATION - FINAL REPORT.

AIMS

1. To extend the understanding of compaction/degradation of Namoi grey clays (developed in previous project) to cover the range of soil types important for irrigated cotton.

2. To classify the various soil types according to their susceptibility to degradation under a given set of conditions.

3. Hence to provide consultants, extension workers with guidelines for assessing compaction susceptibility of their soil types.

OUTCOMES OF THE PROJECT

20 different soils, ranging from lighter to heavier clays, from several areas of NSW and Queensland have been sampled and tested for a range of physical and mechanical properties (including moisture content, suction, density, Atterberg limits, and various strength and compressibility parameters).

The project then identified, from the empirical data set collected, the relationships between the "simpler" parameters (moisture content, density, Atterberg limits) and the more complicated parameters concerned with strength and compressibility.

With this information it has been possible to relate the deformation under a tyre (which is governed by the strength and compressibility of the soil) to the simpler parameters, which can be routinely tested by extension workers.

The moisture content is a useful predictor of strength and compaction, but the prediction is improved by normalising the moisture content with respect to the Atterberg limits. Thus, two different soils both at the plastic limit (and similar densities) will behave similarly. Hence, the soils studied do not have any intrinsic differences in their potential for physical degradation. Any differences that arise in practice do so because of differences in management (e.g. undertaking similar operations at different normalised moisture contents. The Atterberg limits (especially the plastic limit) should be measured and used in decision rules for management operations.

Soil strength and compressibility show considerable statistical variation. The response to operations will itself show variation. Physical degradation should therefore be seen in terms of the probability of its occurence and the probability of the soil being degraded to a particular depth.

This project has therefore extendeed the understanding of compaction/degradation to cover a range of soil types important for irrigated cotton (aim 1). The project has also shown that the soils do not have any intrinsic differences in their potential for physical degradation, but the susceptibility to degradation under a given set of

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conditions can be determined from the moisture content and the liquid and plastic limits (aim 2). Consultation with SOILPAK workers has already taken place to get this information into the SOILPAK system (aim 3).

RECOMMENDATIONS FOR FURTHER WORK

This project did not verify the findings directly against field performance; this was done by inference from other work. Furthermore, only traffic effects were investigated; no study of damage caused by incorrect tillage was made. It is recommended that the findings of this project be tested with field data which includes both tillage and traffic effects.

The measure of damage used in the project has been one of density change and/or shear deformation. However, a plant is affected by factors such as the change to soil hydraulic properties. It is rcommended that the affect of deformations on the permeability of soils be investigated.

PUBLICATIONS ARISING FROM THE PROJECT.

1 Kirby, J.M., 1988. Soil deformation. In, Understanding Soil Physical Conditions for Better Management Advice, SIRAGCROP meeting, Yanco, 16-17 Feb, CSIRO Divs. of Soils and Water Resources.

2 Kirby, J.M., 1988. Physical degradation of irrigated cotton soils beneath vehicles. The Australian Cotton Grower, Feb.-Apr.: 33-8.

3 Kirby, J.M., 1988. Soil management and soil mechanics. Aust. Soil Sci. Soc., Abstracts for the National Conf. Canberra, May 9-12, p. 206.

4 Ringrose-Voase, A.J., Blackwell, P.S., & Kirby, J.M., Effects of mechanical shear on soil macrostructure as measured by pedometrics and other physical methods. Int. Working Meeting on Soil Micromorphology, San Antonio, Texas, July 10-15, 1988.

5 Kirby, J.M., 1988. Soil Damage and the "Big Wet". Paper presented at the Aust. Cotton Growers Research Assoc. Conf., Surfers Paradise, 17-18 Aug.

6 Blackwell, P.S., & Kirby, J.M., 1988. The influence of soil geometry on soil compaction under wheels. Ag. Engng. Conf., Inst. Engnrs. Aust., Hawkesbury, Sept. 1988, pp 90-5.

7 Kirby, J.M., 1989. Measurements of the critical state and yield surfaces of some unsaturated agricultural soils. J. Soil Sci. 40(1): 167-82.

8 Kirby, J.M., & Blackwell, P.S., 1989. The design of narrow slots to protect included soil from compaction. Soil Technology 2, 147-61.

9 Kirby, J.M., 1989. Shear damage beneath agricultural tyres - a theoretical study. J. Agric. Engng. Res., 44, 217-30.

10 Kirby, J.M., 1989. Critical state soil mechanics for unsaturated soils - measuring the parameters and predicting deformations. NATO Advanced Workshop on Mechanics and Related Processes of Structured Agricultural Soils, Eds., Larson, W.E., Blake, G.R., Allmaras, R.R., Voorhees, W.B. and Gupta, S.C., Univ. Minnesota, USA, 13-16 Sept., 1988. Kluwer Acedemic Publishers, Dordrecht, 244 (abstract only).

11 Horn, R., Kirby, J.M., und Baumgartl, T., 1989. Einfluss der Belastungsdauer auf die Spannungsverteilung in Boden. Mitteilugen der Deutschen Bodenkundlichen Gesellschaft, 59 (1), 185-6.

It is also worth noting that as a result of my work on the mechanics of soils, which arises particularly from my work on cotton soils, I have been invited to give an introductory lecture to one of the sessions of the 14th International Congress of Soil Science in Kyoto in 1990.