Physical properties of five soils on Roper Farm (Mataranka) and one soil west of Eagle Farm (Katherine).

August 2010
Physical properties of five soils on
Roper Farm (Mataranka) and
one soil west of Eagle Farm (Katherine).

Methods: Field

Five soil pits were excavated on the property out of Mataranka (see map 1). Two of these had current land use melon cropping. Two were nominally undisturbed bush adjacent to the first two. Pit 4 was in a cleared but uncultivated area. A single pit was opened on a bush covered site west of Eagle farm out of Katherine (see map 2).

The soil and landform were described and sampled by the Department Natural Resources, Environment the Arts and Sport. Soil profile information and soil chemistry, particle size and additional bulk density results are stored in the Northern Territory Soil and Land Information System (SALInfo). That department will also publish this data.

The infiltration rate of the surface soil was measured using two 40 cm diameter rings and the oblique ruler method for water depth measurement. For deeper soil layers, a flat surface was excavated above significant soil layers on the edge of a trench and an infiltration rate measured the same way as the surface.

At each significant layer, three undisturbed soil cores were taken from the wetted area after the infiltrometer test. The core samples used thin walled techniques conforming to the Loveday\textsuperscript{2} criteria. The cores were 76mm diam x 50mm high.


Methods: Laboratory

Undisturbed soil cores
The soil cores were weighed to establish initial (field sampled) water content and dry sand used to measure the volume of any cavities, so that the soil volume and hence density and porosity could be calculated. Some soils were not fully wet so they were placed on a ceramic tension plate and further water added over 24 hours to wet them up.

The plates were then set to simulate a water table 5cm below the core base (0.5kPa suction). They were then allowed to drain for 12 hours and weighed. This provides the water content at 0.5kPa tension.

The water table was then lowered to 50cm ‘depth’ - equivalent to a suction of 5kPa and the cores allowed to equilibrate and then weighed. This process was repeated at 100cm (take as field capacity), 300cm and 700 cm water tension (10, 30 and 70 kPa)

The cores were then oven dried to remove all water and weighed again. The volume, the dry weight of soil and the amount of water in the soil at each stage was then calculated along with such values as the density, total porosity, air filled porosity at field capacity (afp10).

Penetrometer
While the cores were at a tension of 10kPa, 30kPa, and 70kPa, a micro penetrometer was used to measure the penetration resistance as a guide to root resistance in the field when wet and as the soil dries.
Wilting point
Small sub samples of disturbed soil were collected with the cores and used to measure water holding at higher suction levels. The loose soils were slurried onto a ceramic plate and subjected to air pressure of 300 kPa for 7 days, then removed and the water content measured. A similar set was set at 1500 kPa for 14 days and the water again measured (taken as wilting point).

These water content values measured as g/g were converted to a volume basis by using the density calculated from the core samples.

Site Location
The full identification of the sites is given in Table 1. Thereafter, the sites are referred to by the pit number.

<table>
<thead>
<tr>
<th>Pit number</th>
<th>Location on farm</th>
<th>Eastings</th>
<th>Northing</th>
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<td>Edge of melon crop, Roper Farm</td>
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<td>8341016</td>
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</tr>
<tr>
<td>4</td>
<td>Remnant bush near pit 2</td>
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<td>8341043</td>
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<td>Uncultivated area near bore</td>
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<td>6</td>
<td>Eagle park bush area</td>
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Pit location photo
### Results

Table 2. Results of field infiltration tests

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<th>Test 2</th>
<th>mean mm/min</th>
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Table 3. Summary of density and water retention data from undisturbed cores, and derived information from density. Detail of measurements from each core sample is listed in Appendix 1.

<table>
<thead>
<tr>
<th>Pit no.</th>
<th>depth cm</th>
<th>Water Content cc/cc @ suction in kPa</th>
<th>Density g/cc</th>
<th>Total porosity</th>
<th>AFP @FC</th>
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<tr>
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Conclusions

The major objective of this work was to measure and record soil properties in the area. While appearance of the soils differed, the water holding properties where not substantially different in surface and 50 cm depths in pits 1-5. The increasing clay content of the deep layer (180cm) probably caused the higher wilting point values (and hence they have lower water storage per unit depth).

A minor objective was to seek indications of the changes in the soils which may have resulted from clearing and cultivation.

Comparison of the results between pit 1 (cultivated) and pit 3 (adjacent to pit1 but un-cleared bush), between pit 2 (cultivated) and pit 4 (adjacent to pit2 but in un-cleared bush) indicate very little change in infiltration rate – where soil degradation would have caused a substantial decrease.

Water holding capacity figures also indicated little change. The pit 1 / pit 3 sites showed cultivation had increased density (possibly an effect of traffic at the sample site), but also the water holding capacity increased, as would be expected in an area receiving much more fertiliser than the bush area. The pit 2 vs pit 4 comparison showed no change at all.

Calculation of rootzone water holding capacity

Measurement of water holding properties of the soil allows the calculation of how much water can be added to dry soil without serious loss of water to deep drainage. Table 4 shows results of this calculation for the pit 1 and pit 2 areas. In these calculations, the assumption has been made that the dense part of the melon root systems extend only to 30cm depth. Melon roots were seen below this depth, particularly in pit 2, but the number of roots were too few to extract water in significant amounts during an irrigation cycle.

Table 4. Sample calculation of maximum water quantity to be added to dry soil to get maximum water stored with minimum water loss below the root zone by drainage.

<table>
<thead>
<tr>
<th>Pit no.</th>
<th>depth cm</th>
<th>Water content @ 10kPa</th>
<th>Water content @ 1500kPa</th>
<th>Multiply by depth of layer in mm</th>
<th>total kilolitre/ha</th>
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<tr>
<td>1</td>
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<td>0.17</td>
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</table>

* estimated

Note that wilting point (1500kPa) for pit 2 depth 50 has been estimated – the extremely high stone content makes a realistic measurement very difficult.

Other information available from the water retention measurements

Measurement of the water retention at a range of suction levels provides a lot of information about the pore structure and distribution on a soil sample. In particular, the amount of water extracted from a soil between one suction level and another is a measure of the volume of pores in the size range which drain in that range. It is possible to calculate for example, the hydraulic conductivity at different water contents, or the pore size distribution. This has been done for contrasting soils pit1, surface soil and pit 1 at 180cm depth. Results are shown in appendix 2 and 3.
Appendix 1. Detail of water release on individual cores.

<table>
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<tr>
<th>Pit no.</th>
<th>Pit depth cm</th>
<th>Water Content cc/cc @ suction in kPa</th>
<th>Density g/cc</th>
<th>Total porosity @FC</th>
<th>AFP</th>
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Appendix 2. Advanced analysis of water retention curve - Pit 1 surface soil
Appendix 3. Advanced analysis of water retention curve - Pit 1 soil at 180cm depth