AN INVESTIGATION OF WATER REPELLENCY IN A RANGE OF NEW ZEALAND SOILS

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ABSTRACT

The severity of water repellency was investigated on a wide range of agricultural, horticultural and turf soils in New Zealand. All the soils studied had some degree of repellency, regardless of texture or land use. Techniques for repellency measurement and amelioration were evaluated and the organic component responsible for repellency development investigated. The temporal and extreme spatial variability of repellency expression was quantified using geostatistics.

The 'repellency index' (RI) based upon soil intrinsic sorptivity was developed and evaluated on 14 New Zealand soils. The RI measured undisturbed cores of all the soils water repellent at field moisture conditions and was more sensitive than the MED or water drop penetration time (WDPT) tests. The RI was used to demonstrate that repellency reduced the short-time infiltration rate, i of all the soils by approximately an order of magnitude, including those which appeared to wet normally (i.e. low WDPT). Calculations identified that the reduction in i would be hydrologically significant under intense rainfall and many irrigation systems.

Investigation of a development sequence of yellow-brown sands (Aquic Udipsamments) revealed maximum repellency in $<$ 130 y old Waitarere sand, which had the lowest level of organic carbon. Repellency was also severe in the Motuiti and Himatangi sands (c. 500 y) but declined in the Foxton (1600 - 6000 y) and Koputaroa (10000 - 25000 y) soils. While water repellency (measured with the Molarity of Ethanol Droplet, MED test) of the Himatangi sand profile was correlated with organic carbon content, this was not the case with the other soils. Organic matter composition is a more likely determinant of the degree of repellency than organic matter quantity *per se*.

Spectroscopic examination of extracts removed from Himatangi sand by an *iso*-propanol/ammonia mixture using a soxhlet apparatus indicated a range of long chain organic compounds comprising esters and fatty acids as the cause of repellency.

The spatial variability of volumetric soil water content (θ) to 200 mm depth at two

adjacent sites (A and B) of Himatangi sand, each c. 860 m^2, was studied with geostatistical techniques. At both sites θ varied isotropically and generally followed a normal distribution. Variograms of θ changed over time and were not transferable between the two sites, although there was evidence of drift in the mean at site B. At site A, compared to an October analysis, in summer the coefficient of variation (C.V.) of θ increased and the range of θ spatial dependence, a decreased. Irrigation of both site A and B with a travelling boom slightly increased C.V.(θ), markedly increased the semivariance and slightly decreased $a(\theta)$ at site A. When a wetting agent was applied prior to irrigation of site A the C.V.(θ) halved, $a(\theta)$ increased and the θ increase was improved by 63 % over irrigation of site A and 206 % over irrigation of site B.

Agitation of soil samples reduced repellency significantly, however the effect was somewhat reversible and field cultivation could be precluded by the degree and depth of the repellent topsoil. Soil wetting agents increased grass establishment and growth in both glasshouse and field experiments. In the glasshouse, wetting agent performance was not affected by delayed initial irrigation, however short irrigation return intervals improved plant growth in both untreated and wetting agent treated soil.

A survey of golf courses throughout New Zealand found that repellency was a major management problem. Soil cores were removed from areas of greens displaying repellency symptoms ('dry patch') and from areas of compatatively healthy turf. No significant difference was found between the MED profile or the thatch content of the dry patch and non-dry patch cores. Dry patch areas were found to match the poorly irrigated areas of a green using a simple 'catch-can' test, which indicated that irrigation uniformity affected repellency expression in turf.

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