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Soil water repellency under pastoral land-use in New Zealand

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Soil water repellency (SWR) is a surface property of soil particles that reduces or prevents the infiltration of water into soils. It affects soils in a wide range of agricultural and natural environments in different climatic conditions, and has been observed worldwide. SWR has also been reported in New Zealand, but its spatial extent and importance for New Zealand pastoral industry are poorly understood. We thus conducted a survey on the occurrence of SWR in the top 4 cm of soils under pastoral land use across New Zealand. Our hypotheses were that SWR is dependent on the soil order and that it is correlated to the drought proneness of top-soils and the summer rainfall in humid temperate regions. We stratified our sampling taking into consideration the eleven major soil orders of New Zealand, six classes of drought proneness and three summer rainfall classes resulting in a total of 76 sampling sites. The top-soils of 67 out of 76 pastoral sites (=88%) showed the potential to become hydrophobic if they dried out, and 47 out of 76 (=62%) of the field fresh top-soils were hydrophobic at the time of sampling. Both potential persistence (P=0.012) and degree (P=0.007) of SWR were significantly higher in the North Island than the South Island, even under similar soil orders and identical summer rainfall or drought conditions. The soil orders Podzols and Histosols exhibited the highest degree and persistence of SWR, followed by Fluvisols and Luvisols. Andosols were least prone to SWR. There was no significant relationship between SWR and drought-proneness, but summer rainfall significantly influenced the degree of SWR (P=0.004). We further investigated potential correlations between measures of SWR and other soil properties such as organic carbon and nitrogen contents, pH, soil water content, and bulk density. The degree of SWR was positively correlated with the soil organic carbon (R=0.49) and nitrogen (R=0.47) contents, and negatively (R=-0.5) with bulk density. Our results contribute to the knowledge on which soil parameters affect SWR and which may be useful in predicting its occurrence and severity.