Geophysical Research Abstracts,
Vol. 11, EGU2009-12899-1, 2009
EGU General Assembly 2009

Mitigation of soil water repellency improves rootzone water status and yield in precision irrigated apples

S. Kostka (1), N. Gadd (2), and D. Bell (3)

(1) Aquatrols Corporation of America, Paulsboro, New Jersey, United States (stan.kostka@aquatrols.com), (2) Aquatrols Corporation of America, Gray, Georgia, USA (nick.gadd@aquatrols.com), (3) David J Bell & Associates Pty Ltd, Arcadia 3631, Victoria, Australia (david.j.bell@telstra.com)

Water repellent soils are documented to impact a range of hydrological properties, yet studies evaluating the consequences of soil water repellency (SWR) and its mitigation on crop yield and quality are conspicuously absent. With global concerns on drought and water availability and the projected impacts of climate change, development of novel strategies to optimize efficient rootzone delivery of water are required. Co-formulations of alkyl polyglycoside (APG) and ethylene oxide-propylene oxide (EO/PO) block copolymer surfactants have been shown to improve wetting synergistically. The objectives of this study were to determine if this surfactant technology: 1) increased soil water content and wetting front depth in mini-sprinkler irrigated, water repellent, Goulburn Valley clay loam soils and 2) assess the consequence of SWR mitigation on yield of *Malus domestica* Borkh.

Three trials were conducted in the apple varieties 'Pink Lady' (2006/07 and 2007/08) and 'Gala' (2007/08) growing on Goulburn Valley clay loam soils in Victoria, AU. The test design was a randomized complete block with treatments replicated 5-6 times. Plot size varied by location. SWR was mitigated by applying surfactant at initial rates of 0, 5, or 10 L ha^{-1} in the spring, then at 0, 2.5, or 5 L ha^{-1} monthly for up to four months and compared to an untreated control. Treatments were applied to tree lines using a hand held small plot sprayer (118 liters of spray solution ha^{-1}) followed by irrigation within 1-3 days of treatment applications. At each location, plots were irrigated by mini sprinklers and received the same irrigation volumes and management practices. Soil volumetric water content (VWC) was monitored at depths of 0-10 and 10-20 cm using a Theta probe (Delta-T Devices, Cambridge, UK). At harvest, fruit number and weights were measured and used for crop yield estimations. Data were analyzed using analysis of variance with mean values summarized and separated using Least Significant Test at 5% level of probability.

As surfactant rate increased, wetting front depth increased and soil VWC increased for the surfactant treatments (p=0.05). Soil VWC was significantly lower (p=0.05) in untreated soils than in the surfactant treatments on each measurement date throughout the growing season. In the surfactant treatments, soil VWC at the 0-10 cm and 10-20 cm depths of the soil profile were 2-5 percentage points higher than at the same depths in the untreated control (p=0.05). Mean fruit size for the variety 'Pink Lady' was 17-33 g greater in the surfactant treatments than in the untreated control in the 2006/07 and 2007/08 seasons, respectively (p=0.05). Mean fruit size differences of 41 g were observed between surfactant treatments and the untreated control in the single year of results for the variety 'Gala'. Due to thinning, there were no differences in fruit number. Total yield (kg tree^{-1}) differed significantly between the untreated and surfactant treated plots (p=0.05), however, yields between the two surfactant treatment rates were statistically equivalent. In the variety 'Pink Lady', surfactant treatment increased total yield by approximately 20% in each of the two test seasons. Yield increases in the surfactant treated 'Gala' were nearly 50% greater than the untreated control. When examining the yield differences on a hectare basis, yield increases of 3.7 – 6.0 Mg kg ha^{-1} were encountered between the surfactant treatments and the control in the two varieties tested. Mitigation of SWR resulted in increased net return of \$6,000 - \$9000 ha^{-1} for the variety 'Pink Lady' and \$3,600 ha^{-1} for the cultivar 'Gala'.

This study demonstrates that simple innovative management strategies such as low level surfactant treat-

ments to water repellent soils resulted in improved infiltration, increased rootzone water reserves, and significant increases in apple yield and quality under deficit irrigation.