Thresholds and Monitoring

INTERACTION OF HERBIVORY AND WATER STRESS ON WHOLE CANOPY PHOTOSYNTHESIS IN APPLE

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Keywords: photosynthesis, water stress, apple, *Tetranychus urticae*, *Panonychus ulmi*

Material and Methods

This experiment examined the interaction between two environmental stressors of apple trees, one biotic (mite feeding) and one abiotic (water stress). The goal is to refine thresholds for apple herbivores under varying conditions.

Experimental Design. This experiment was conducted in a 4-yr-old apple block (planted April 1996) composed of the cultivars 'Oregon Spur II/MM.111', 'Fuji BC2/EMLA7', 'Smoothee Golden Delicious/EMLA7', and 'Royal Gala/EMLA7'. Trees were planted 12 x 18 ft in 6 tree plots with 1 each of the four cultivars plus two 'Oregon Spur' guard trees at the ends of the plots. In addition to the experimental irrigation system described below, the orchard had a permanently installed undertree impact sprinkler system. The experimental design was a factorial treatment arrangement with the main factors of mite stress and water stress. Individual treatments were 1) High mites, high water; 2) High mites, low water; 3) Low mites, high water; 4) Low mites, low water. The plot layout was a randomized complete block with four replicate blocks.

Mite populations. Twospotted spider mites (*Tetranychus urticae* Koch) from a laboratory colony reared on bean were distributed in the treatments destined for high mite levels beginning in early May. Plots in the low-mite treatments were sprayed three times with various adulticidal and ovicidal miticides.

Moisture management. An above-ground microsprinkler irrigation system was installed in early July in order to control water on a plot-by-plot basis. Treatments with unstressed plants were watered weekly (during July and August), and treatments with stressed plants were watered every two weeks (8 h sets). Sentek EnviroScan® Soil moisture probes were installed two of the four replicates (A and C). The probes were installed close to the trunk of the 'Oregon Spur' tree from which all mite population and plant response measurements were taken. Each probe contained 4 sensors, at depths of 20, 30, 40, and 60 cm. Sensors were hard-wired to a solar-panel driven data logger, with readings taken every 10 minutes.

Photosynthesis measurements. Measurements of whole-canopy photosynthesis were taken 4 times at ca. 3-week intervals from late July to early October. Tree were enclosed in Mylar® chambers, and net carbon assimilation was estimated by the difference between CO_2 concentrations entering and exiting the chambers.

Tree measurements. Fruit circumference was measured weekly from late July through harvest. Trunk circumference was measured at the beginning of season and at the end (October).

Results

Preliminary results indicate a significant effect of mite feeding damage in depressing net carbon assimilation by 'Oregon Spur' trees in the range of up to 500 cumulative mite days (July 28 measurement) (Fig. 1). No effect was found in subsequent measurements. Water stress

significantly depressed NCA during the Sep 11 measurement (Fig. 2). No differences were found in fruit growth, although crop load was probably too light to be influenced by either mite feeding or water stress. Trunk cross-sectional area was similarly unaffected.

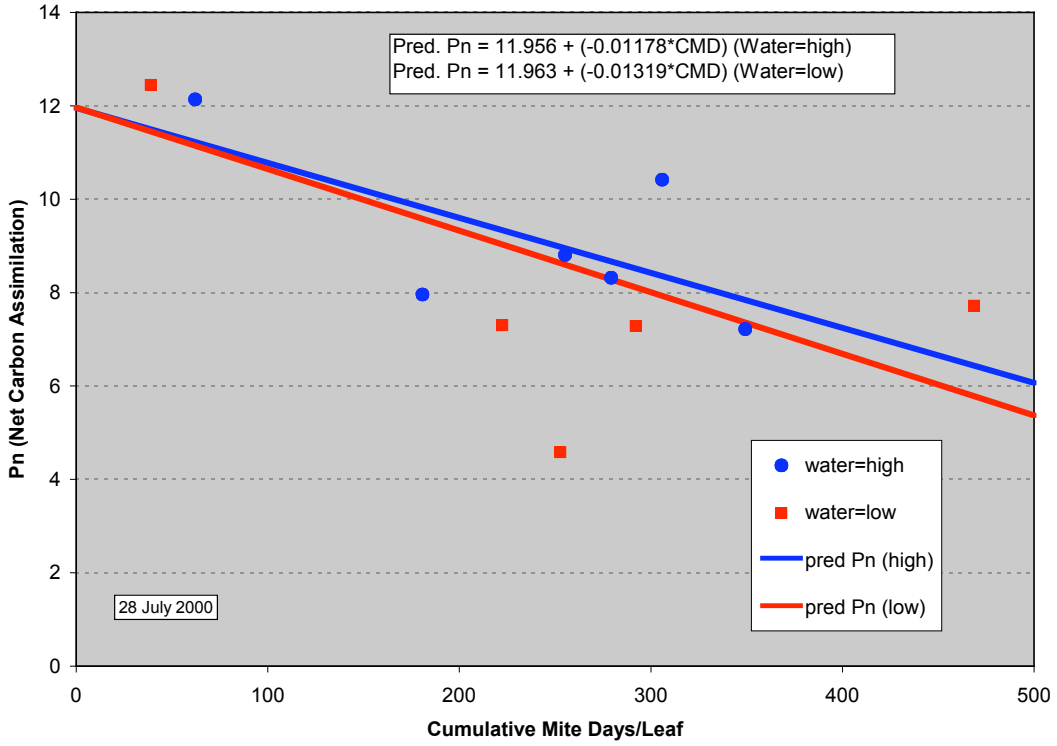

Fig. 1. Relationship between mite feeding damage and water stress, 28 July, 'Oregon Spur'.

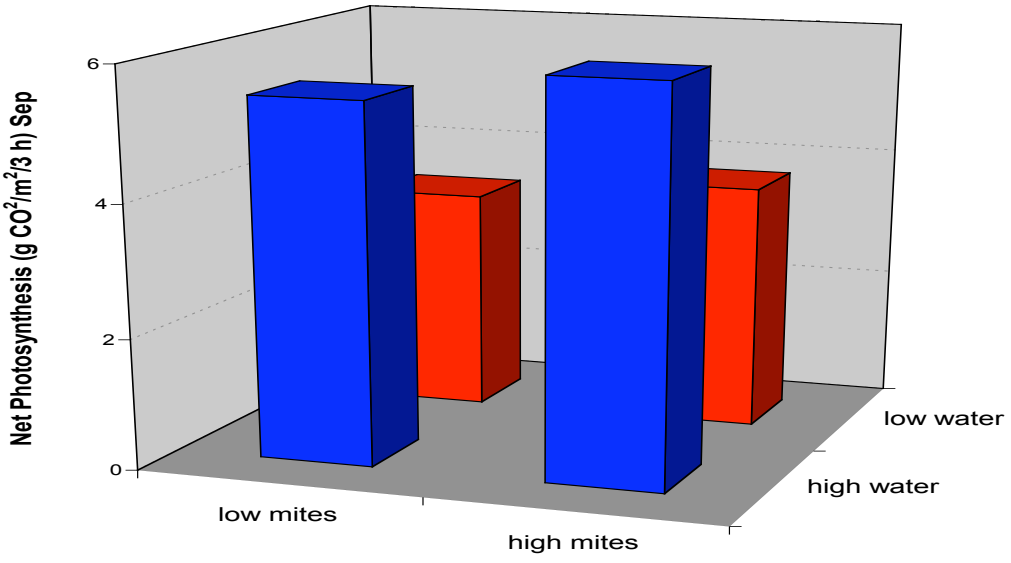

Fig. 2. Effect of water stress on net photosynthesis of apple, 'Oregon Spur', 11 Sep 2000.