Validation of the MaluSim Carbohydrate Model

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In commercial apple (*Malus Xdomestica* Borkh.) orchards, farmers remove part of the crop each year in order to reduce biennial bearing and increase fruit quality. This process is referred to as "thinning" and is often accomplished through the use of plant bioregulators and/or caustic chemicals. Due to within- and between-year variability in environmental conditions and the differential response apple trees have to chemical thinners based on cultivar, rootstock, and tree health and age, thinning apple fruit remains one of the most difficult management tasks in an apple orchard. To help overcome this challenging task, researchers at Cornell University have developed MaluSim, a computer-based algorithm that estimates the daily carbohydrate balance for an idealized 'Empire' apple tree using daily high and low temperatures and total daily solar radiation as inputs. In theory, knowing the carbohydrate status of the apple tree at the time of thinning application should allow apple growers to alter products and rates so as to avoid over- or under-thinning. Five years of field trails have been conducted in Winchester, VA in an effort to validate the MaluSim model in the mid-Atlantic region. In these experiments, 6-benzyladenine (MaxCel, Valent BioSciences) and carbaryl (Sevin XLR Plus, Bayer CropScience LP) were applied to 'Bisbee Red Delicious' and 'Crimson Gala' trees on two- to three-day intervals from petal fall to a fruitlet size of approximately 20 mm in diameter. Crop load data was used to assess the effect of thinning from each application treatment. Through the use of cross correlations and the generalized additive model, the MaluSim model provided the most significant response when a six-day running average of the model output was used. Additionally, when the MaluSim model predicted greater carbohydrate levels at the time of thinning, the crop load at harvest was significantly greater. Through these experiments, the MaluSim model was shown to be a useful tool for understanding the impacts of environmental conditions on chemical thinning efficacy.

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