GENE EXPRESSION AND HORMONE LEVELS IN DIFFERENT GROWTH HABITS OF PEACH AND APPLE

Thomas Tworkoski¹, Kevin Webb¹, Ann Callahan¹, and Ralph Scorza¹

ABSTRACT

Branch orientation (direction of branch growth) and distribution (position along the trunk) establish a fruit tree’s canopy architecture and amenability to mechanized technologies. Branching patterns associated with tree architecture are consistent within cultivars and are altered by pruning and training to obtain management goals. Natural branching patterns in peach (Prunus persica L. (Batch)) and apple (Malus domestica) trees are likely controlled, at least in part, by endogenous hormones and associated gene expression. Previous work demonstrated that genetically based variation of branch angle and distribution exist in peach and apple trees and auxin concentrations were higher in shoots that have more columnar than spreading branch growth habits. In herbaceous species MAX and related genes are associated with auxin and these genes have been shown to affect branching by regulating bud outgrowth. Objectives were to (1) determine if ‘branching genes’ found in herbaceous species (i.e. MAX4) are also in peach & apple trees; (2) determine if ‘branching genes’ express differently in Pillar (upright branch orientation) than Standard (spreading branch orientation) peach trees; and (3) determine if ‘branching genes’ are expressed in roots as well as shoots of peach trees.

Functional primers were obtained for the MAX gene by matching MAX sequences in Arabidopsis, pea, petunia, and grape. DNA extracts of apple and peach leaves were probed with the designed primers. The designed primers were then used to generate PCR products from apple and peach DNA. The PCR product was cloned and sequenced. Those sequences enabled the MAX primer design and were then applied to total RNA extracted from leaves and roots of two growth habits of peach trees: pillar, standard and upright (intermediate branch orientation). Using RT-PCR amplification the primers specific to MAX4 gene were normalized using primers specific to actin.

Following multiple sequence alignments, four sets of degenerate PCR primers were designed to isolate the MAX4 gene from genomic DNA extracted from peach and apple leaves. The MAX4 gene found in herbaceous species were also in peach & apple trees. Preliminary data suggests that MAX4 was expressed more in Pillar than Standard peach trees and was also expressed in roots. These results support the hypothesis that growth habits with higher auxin and less branching also have higher MAX4 expression.

¹ USDA, ARS, Appalachian Fruit Research Station, 2217 Wiltshire Rd., Kearneysville, WV 25430 USA.