

Top-Grafting: A Viable Alternative when Changing Cultivars in an Apple Orchard?

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Abstract

Top-grafting, a technique used to convert one cultivar to another on an existing tree, has several advantages over planting new trees in the same site. These include not leaving the land fallow for at least one year to avoid replant disease and having a full crop sooner than newly planted trees. Although top-grafting is a common practice in apple orchards, no studies to validate the sustainability and profitability of this technique have been conducted. A multi-disciplinary, multi-state long-term research project, *OrganicA Project* (<http://www.uvm.edu/~organica/>), was initiated in 2006 at the University of Vermont. One of the objectives was to evaluate the use of top-grafting as a viable option for organic apple growers to use when changing to new cultivars. An 18 year-old orchard consisting of McIntosh and Liberty trees on M.26 rootstock was top-grafted to the following cultivars: ‘Ginger Gold’, ‘Honeycrisp’, ‘Liberty’, ‘Macoun’, and ‘Zestar!’ Results indicate that the success of top-grafting as an economical and sustainable technique to change existing apple cultivars is cultivar dependent and several years may be necessary to determine its success or failure.

Objective

To evaluate the use of top-grafting as a viable option for apple grower to use when changing to new cultivars.

Materials and Methods

An existing orchard, planted in 1988, was top-grafted in spring 2006. The orchard contained the cultivars ‘Liberty’ (Block 1) and ‘McIntosh’ (Block 2) on M.26. A randomized complete block design (RCB) with interstock as the blocking variable was chosen because the former cultivar may affect growth of the top-grafted cultivars. Within block, there were multiple replications as a completely randomized (CR) design. The five cultivars grafted were ‘Ginger Gold’, ‘Honeycrisp’, ‘Liberty’, ‘Macoun’, and ‘Zestar!’. There were 6 two-tree replications of each cultivar per block. Bloom rating was recorded in May 2009. Harvest was collected in Aug. and Sep. 2009, and yield per tree was recorded. Bloom was rated on a scale of 0 to 5, with 0 representing no bloom and 5 representing greater than 90% of spurs having blossoms. Yield was recorded in kg of fruit per tree, including both fruit on the ground and fruit in the tree with one harvest per cultivar. Trees grafted in 2006 were recorded as dead or alive in May 2010. The data were analyzed as RCB design. Bloom rating and yield were analyzed using analysis of variance with the MIXED procedure, and survival results were analyzed using logit analysis with the GENMOD procedure in SAS (SAS version 9.1; SAS Institute, Cary, NC). Yield and bloom rating were analyzed with blocks separately as individual CR designs and with blocks together as an RCB design.

Results

Cultivar had a significant effect on all parameters analyzed.

•**Bloom Rating:** ‘Zestar!’, ‘Liberty,’ and ‘Ginger Gold’, had similar bloom ratings which were higher than those of ‘Macoun’ and ‘HoneyCrisp’ (Table 1).

•**Yield:** Yields for ‘Ginger Gold’ and ‘Liberty’ (23.0 and 21.2 kg , respectively) were significantly higher than the other cultivars. The cultivar ‘Macoun’, had significantly lower yields (4.8 kg) than the other four cultivars.

•**Scion Survival:** Scion cultivar had a significant effect on survival. Cultivars ‘Ginger Gold’, ‘Honeycrisp’, and ‘Liberty’ had similar survival rates, whereas cultivars ‘Macoun’, and ‘Zestar!’ had survival rates below 70%. Survival rates were not different with different interstocks.

Conclusions

Results indicate the success of top-grafting as an economical and sustainable technique to change existing apple cultivars is cultivar dependent and several years may be necessary to determine its success or failure. The cultivar ‘Ginger Gold’ is performing significantly better than ‘Macoun’ in several measured parameters such as scion survival, bloom rating, and yield. The lower survival rate of ‘Zestar!’ and ‘Macoun’ raise concerns on the viability of top-grafting technique with these cultivars.

Table 1. Bloom rating in 2009 of top-grafted apple trees in 2006.

Cultivar	Average bloom rating ^z		
	Block 1 ^y	Block 2 ^x	All trees
Ginger Gold	3.06a	3.32a	3.21ab ^w
Honeycrisp	2.13b	2.62b	2.45bc
Liberty	3.46a	3.11ab	3.18ab
Macoun	1.77b	1.74c	1.78c
Zestar!	3.79a	3.57a	3.74a

^zBloom was rated on a scale of 0 to 5, with 0 representing no bloom and 5 representing greater than 90% of spurs having blossoms.

^y‘Liberty’ interstock

^x‘McIntosh’ interstock

^wAverage ratings followed by different letters are significantly different at $\alpha=0.05$, using Tukey’s HSD.

Table 2. Fruit yield (kg) in 2009 for top-grafted apple trees in 2006.

Cultivar	Yield/tree (kg)		
	Block 1 ^z	Block 2 ^y	All trees
Ginger Gold	21.4a	24.4a	23.0a ^x
Honeycrisp	14.7b	14.3b	15.0b
Liberty	22.5a	20.5a	21.2a
Macoun	4.5c	5.7c	4.8c
Zestar!	10.3bc	13.7b	12.6b

^z‘Liberty’ interstock

^y‘McIntosh’ interstock

^wAverage ratings followed by different letters are significantly different at $\alpha=0.05$, using Tukey’s HSD.

Table 3. Tree survival of 2009 of top-grafted apple trees in 2006.

Cultivar	Survival rate (%) ^z
Ginger Gold	95a ^y
Honeycrisp	95a
Liberty	86a
Macoun	66b
Zestar!	63b

^yTrees grafted in 2006 were recorded as dead or alive in May 2010.

^zFrequencies followed by different letters are significantly different at $\alpha=0.05$.



Funding sources: USDA Integrated Organic Program, University of Vermont, University of Arkansas, University of Maine, and the VT Tree Fruit Growers’ Assoc.