

**Improving Branching of Apple Trees from Nursery to Orchard
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Introduction

With the rapid adoption of the Tall Spindle Apple production system for apple production, growers need to utilize very high quality feathered trees to ensure production in the second leaf and help cover the significant increased costs of establishment. Feathered trees are the critical component of most high-density apple planting systems including the Tall Spindle. As the benefits of highly feathered trees were discovered, it became necessary to develop nursery management techniques to stimulate lateral branch development. (Robinson, Black, Cowgill, 2014) so that apple nurseries can produce the well feathered tree that growers demand for these systems. Promalin was shown to branch apple trees as early as 1983. (Green, 1983)

In the spring of 2009 a new branching chemical, Tiberon, was registered, and was used commercially in the Northwest of the US. Its use significantly improved the quality of apple nursery trees. For Currently the future use of Tiberon is in doubt since Bayer Corp. has withdrawn the product (Robinson, Black, Cowgill, 2014). In 2010-2013 Robinson et al conducted branching experiments in NY, Washington, Chile, with Maxcel and Promalin. Beginning in 2012 Cowgill and Robinson did additional apple branching research at a nursery location in Delaware.

Abstract of Experiments for Branching Apple Trees in the Nursery

Apple tree liners produced in nurseries worldwide typically do not form adequate branches (feathers) in their growth cycle to suit the demand of commercial orchardists utilizing high density production systems of 1100 trees per acre or more. Feathered nursery trees are a critical component of most high-density apple planting systems including the Tall Spindle. Six plant growth regulator research trials were conducted from 2012-2014 in consecutive years at a commercial nursery in the state of Delaware, USA, to identify plant growth regulator (PGR) materials and their application techniques to induce apple tree branching in the nursery. Various rates and timings of Maxcel® (6-Benzyladenine 1.8%) and Promalin® (6-Benzyladenine 1.8%) + Gibberellin A4 and Gibberellin A7) as compared to Tiberon™ (Cyclanilide (2.8%); 1,2-Propanediol were evaluated in 2012. Cultivars treated included Golden Delicious, cv 'Gibson' and Macoun. In 2013 an experiment was conducted on Fuji cv 'Daybreak' and Macoun to evaluate different rates and number of applications of Maxcel® or Promalin®. Our results in these

4 experiments indicate that both 4-5 applications of Maxcel[®] or Promalin[®] at 400-500 ppm significantly improve branching over Tiberon[™] or the untreated control liners; with 10-17 branches on the Maxcel[®] and Promalin[®] liners vs 0-5 branches in the untreated control (UTC) or Tiberon[™] liners. In 2014 two additional experiments were conducted to determine the effect of the number of Maxcel[®] or Promalin[®] sprays on branching of Fuji cv 'Daybreak' apple nursery liners and to screen wide range of additional varieties (12) for the best treatment, Maxcel[®] or Promalin[®]. In the 2014 Fuji experiment both Maxcel[®] and Promalin[®] induced a significant increase in the number of feathery trees compared to the untreated controls. Maxcel[®] treated trees had an average of 15 feathery trees while Promalin[®] treated trees had an average of 13 feathery trees and the untreated trees had 5 feathery trees. For the variety screening experiment we selected the best two treatments from our work in 2012 and 2013, Maxcel[®] @400 ppm and Promalin[®] @ 400 ppm + Surfactant (Regulaid[®] @1 pint/100gal). We also added treatment Promalin[®] @500 ppm + Surfactant. Among varieties, Cripps Pink (Pink Lady) and Enterprise had the highest tree quality ratings when treated with either Maxcel[®] or Promalin[®]. Aztec Fuji and Ambrosia had the next highest quality ratings followed by Crimson Crisp, Empire, Gala, Golden Delicious, Honeycrisp and Suncrisp. Royal Cortland, Ruby Mac had the least response to Maxcel[®] or Promalin[®]. There was no significant difference in tree quality (number of feathery trees and height) between those treated with Maxcel[®] or Promalin[®] when averaged over all 12 varieties. Standard recommendations for east coast USA nurseries are being developed from this work for the use of Maxcel[®] and/or Promalin[®] to allow for well-feathered apple liners in the nursery.

Branching Experiment at Rutgers Snyder Farm

Following the Delaware ACN nursery treatments in 2012, the trees were dug in November and the experimental trees were planted at Rutgers Snyder Farm. Data was collected annually to track the effect of the branching treatments on the trees in the orchard. **In 2014 Maxcel 500 PPM significantly increased the yield per tree over the other treatments and the untreated control. The yield per acre of all treatments was 413 Bushels per acre in the second leaf on this tall spindle block.**

Table 1 -2014 -Golden Delicious Data for ACNursery trees planted 12/2/12 at Rutgers Snyder Farm, NJ. Data includes 2012 # of feathers, 2014 yield per tree, 2014 Return Bloom, 2014 number of fruit per tree and pruning/training times in 2013 and 2014.

Treatment Chemical, PPM, # of Applications	2012 Number of Feathers/Tree	2014 Yield KG/Tree	2014 Return Bloom Clusters/Tree	2014 Number of Fruit/Tree	2013 Time	2014 Time
Maxcel 500 x 2	13 bcd	6.5 ab	334 ab	28 ab	78.2	51.8
Maxcel 500 x 4	17 abc	6.9 ab	284 ab	28 ab	68.2	54.5
Maxcel 500 x 5	21 a	7.9 a	372 a	33 a	63.5	52.5
Promalin 500 x 2	13 cd	5.6 bc	291 ab	23 bc	72.5	38
Promalin 500 x 4	17 abc	6.1 abc	317 ab	25 ab	57.7	44.8
Tiberon 100 x 1	11 d	5.6 bc	288 ab	23 bc	78.2	46.3
Tiberon 500 x 2	10 d	4.4 c	232 b	19 c	60.4	39
UTC	9 d	5.3 bc	245 ab	22 bc	73.8	39.4

Levels not connected by same letter are significantly different.
LS Means Difference Tukey HSD $\alpha = .05$

2014 Return Bloom was significantly different ($p=.05$);
2014 Number of Fruit was significantly different ($p=.001$)
2014 Yield (Kg) was significantly different ($p=.0003$)

Recommendations for the New England orchards/nurseries

For most varieties my best recommendation is Maxcel @ 500ppm with no added surfactant, 3-4 applications begging at 35 inches of tree height and repeated at 10-14 day intervals (5-6 inches of new growth).

For Macoun Promalin at 500ppm + Regulaid @ 1 pint/100 is the treatment of choice. Make 3-4 applications begging at 35 inches of tree height and repeated at 10-14 day intervals (5-6 inches of new growth).

New England and Cooler Climates- as you move north the temperatures are cooler and the growth rate slower. 3-4 applications may be enough made at 5-6' of growth intervals. The Maxcel 500ppm rate will be more appropriate under cooler conditions. IN NJ and mid-Atlantic we are recommending 5 applications at 5 inches of new growth.

Orchard Recommendations

Even if growers' plant whips, Maxcel can be used in the orchard to induce branching. We have had good results with Maxcel sprayed at 500ppm to the un-branched leader from the tip down the existing branches or to 24 inches above the soil line (on one year old trees) at 10-14 days after bud break, to green tissue (Miranda and Robinson, unpublished).

On older trees in the orchard that need branching, one to three year trees planted in a tall spindle, we have seen good results treating with Maxcel at 200ppm in an airblast sprayer. (Cowgill, un

published) targeted at the parts of the tree that need branching. Green at UMASS also has had good results with branching apple in an orchard situation with Maxcel at 200ppm in airblast or a back pack sprayer.

Inducing Branching in the field before bud break with Maxcel or Notching

See the following articles by Clements, Cowgill, Autio:

Using a Heading Cut vs. Notching vs. BA Application
to Induce Branching in 'Non-Feathered' 1st-Leaf Orchard Nursery Trees

<http://extension.umass.edu/fruitadvisor/fruit-notes/fruit-notes-summer-2010-vol-75-no-3>

https://hrt.msu.edu/glfw/GLFW_2009_Abstracts/2009_28.pdf

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Terence L. Robinson, Brent Black, Win Cowgill, 2014. Use of Multiple Applications of maxcel and Promalin to Produce Feathered Trees. Compact Fruit Tree, Volume 47, No.1, 23-28.

Duane W. Green, 1983. Use of Promalin to Increase Branching of Young Trees. Fruit Notes, vol. 48, No. 20-22.