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New Jersey Agricultural Experiment Station

Improving Branching of Apple Trees

***Win* Cowgill & Rebecca Magron**

Mike Beese

Rutgers Cooperative Extension

New Jersey Agricultural Experiment Station

Terence Robinson

Cornell University

Overview

- Goal to Identify PGR programs to successfully branch apple trees in the nursery

- Identify techniques to branch whips already established in the orchard

Why Feathered Nursery Stock?

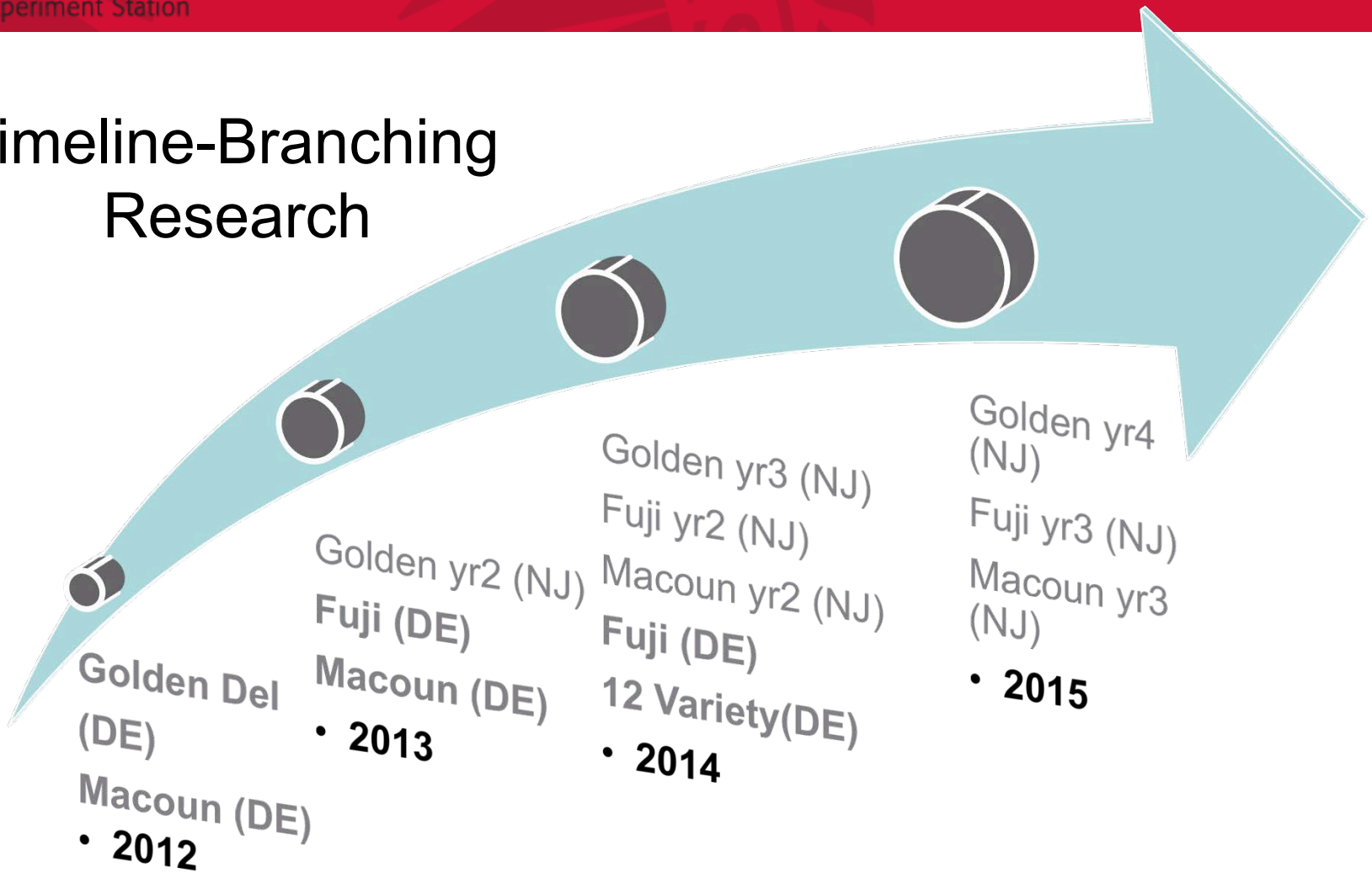
In high density systems where we are planting 1000+ trees per acre, specifically, Tall Spindle, it is essential to produce early production to cover the cost of establishment.

ACN Nursery-Delaware 2012

GRIBA Nursery-Italy-Golden D

- **Highly feathered nursery trees –** “Nursery stock will ideally have from 10-15 feathers per tree. Transplant shock caused by a high scion to root ration helps keep trees within this tight spacing. It also contributes to significant fruit bud differentiation the year of planting. Trees with scaffolds provide bearing surface for production in the second leaf. Early bearing is essential to help pay for increased tree numbers and establishment costs. “ Terence Robinson, Cornell

Timeline-Branching Research



Tall Spindle 2nd leave Goldens @ 1200 T/A

2nd Leaf Golden Delicious- 413 BU/Acre

maxCel™

INCREASING BRANCHING IN NURSERY STOCK AND YOUNG TREES

Active ingredient: 6-benzyladenine (6-BA)
Formulation: Aqueous solution
Reg. status: Submitted to EPA. State registrations anticipated in 2013
Type of label: Supplemental label

Use	Application Rate	Product / acre	Application method and timing
For increased branching of nursery stock and young trees, to improve branch angles, stimulate bud break and improve tree structure.	500 ppm spray concentration (refer to the dilution table for assistance).	128 oz / 40 gal of water	Make the first of 3 to 4 applications at 28-30 inches of growth and continue on a 5-10 day schedule.

Chemical Treatments 2012

Golden Delicious	Macoun
Tiberon: 50 and 100 ppm; 2 or 1 Applications	**Tiberon**: 50 ppm; 2 Applications
Maxcel 500 and 1,000 ppm; 2, 4 and 5 Apps.	**Maxcel** 500 and 1,000 ppm; 4 Applications
Promalin 500 ppm; 2 and 4 Apps	**Promalin** 500 ppm; 4 Applications

Chemical Treatments 2013

Fuji	Macoun
Tiberon: 50 ppm; 2 Applications	**Tiberon**: 50 ppm; 2 Applications
Maxcel 300, 400 and 500 ppm; + and – Surfactant; 3 and 4 Applications	**Maxcel** 300, 400 and 500 ppm; 3 and 4 Applications
Promalin 500 ppm; 4 Applicaitons	**Promalin** 500 ppm; 4 Applications

Feathers Starting

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Results of Chemical Treatments 2012, 2013

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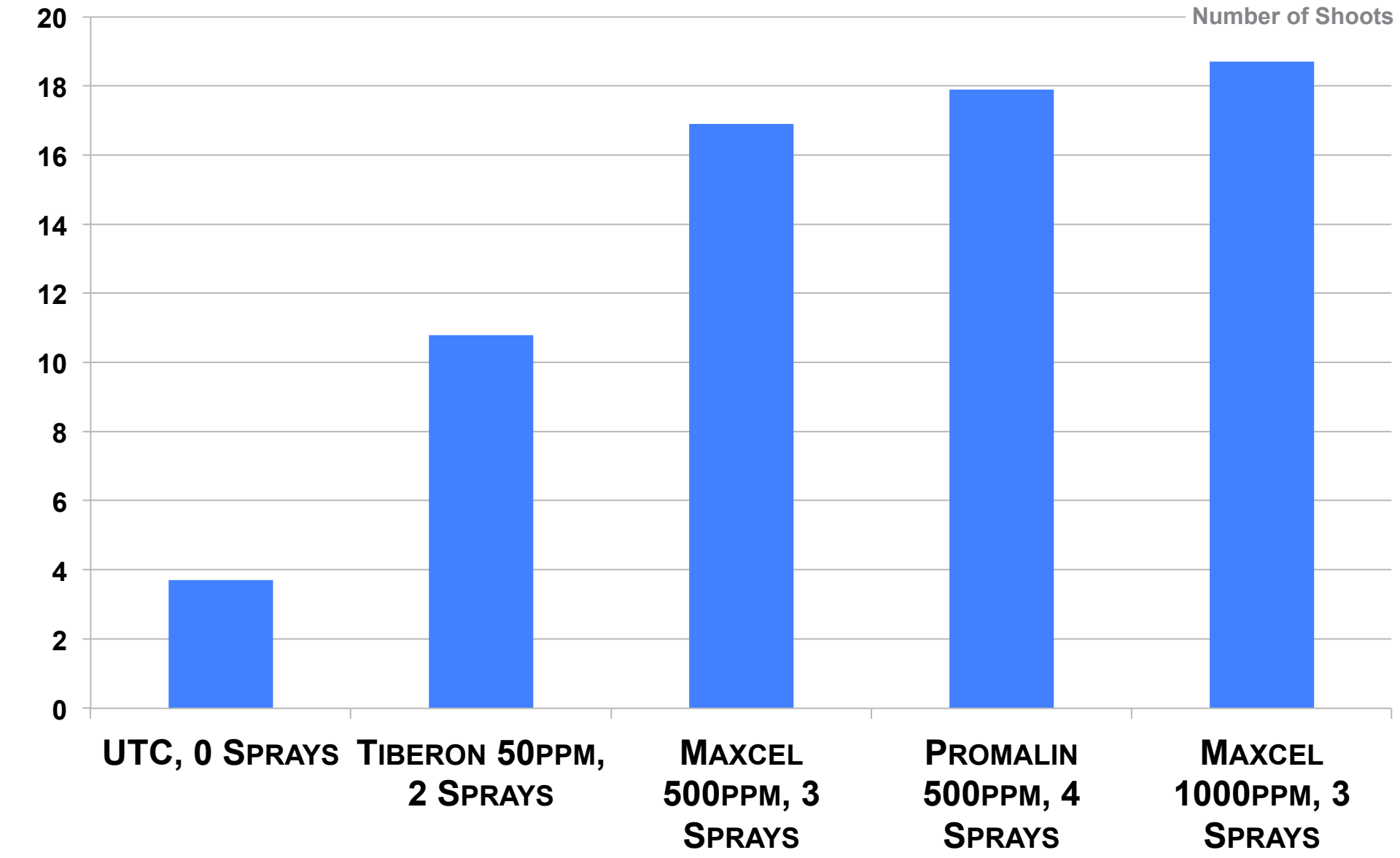
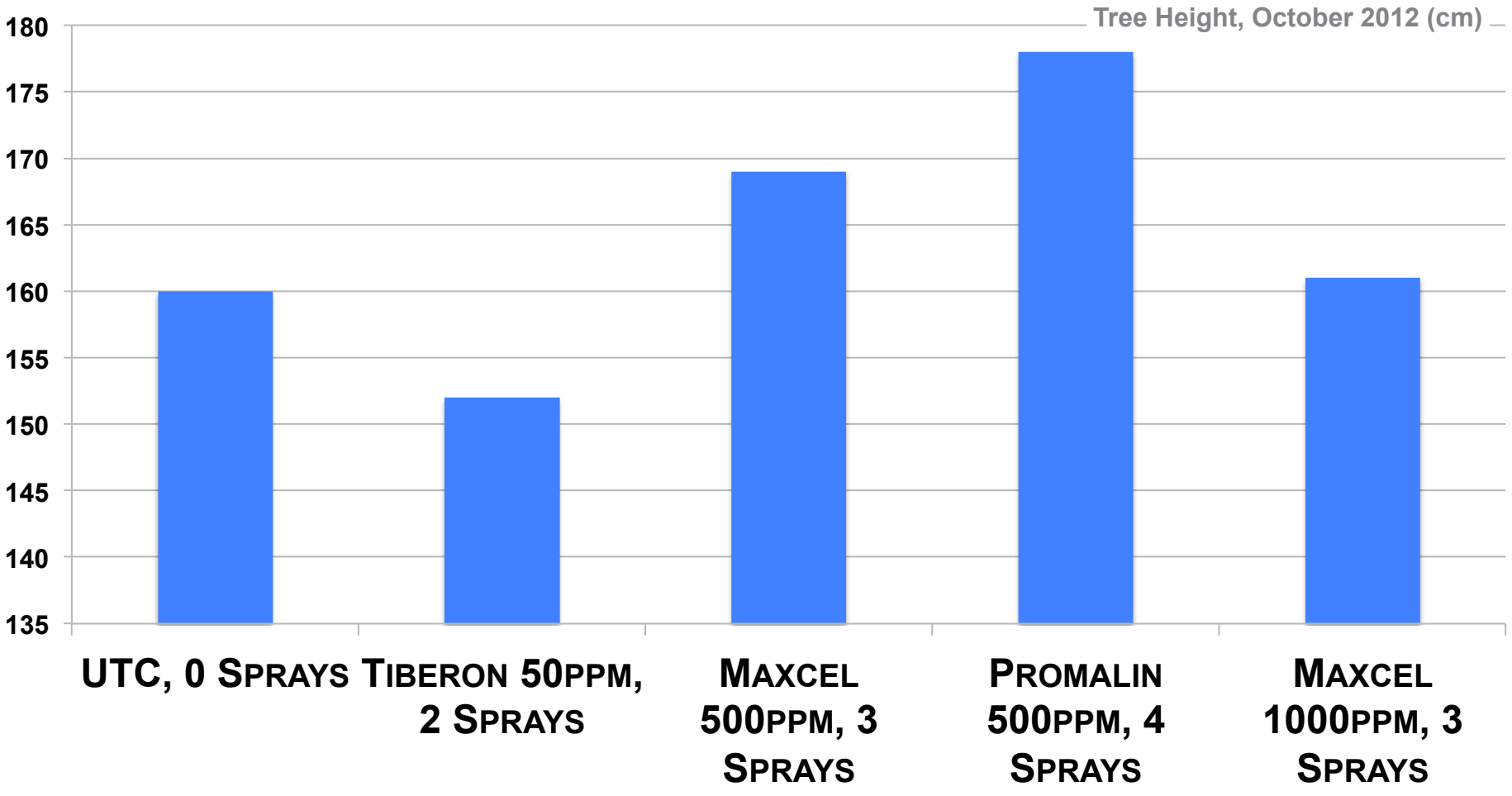
Number of Shoots on Macoun after treatment in 2012





Average tree height (cm), October 2012 of Macoun

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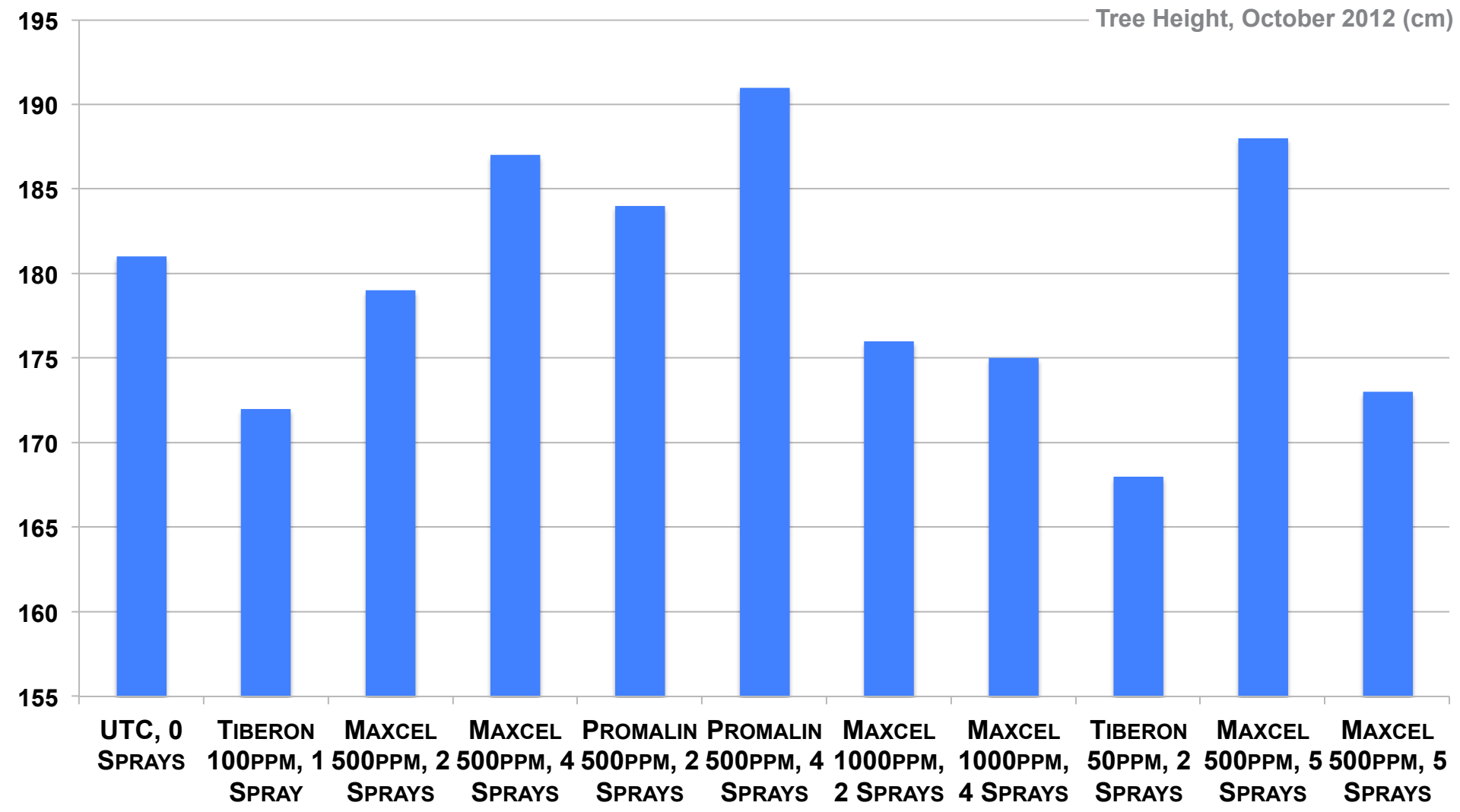
2012 ACN TRIAL DELAWARE



Average tree height (cm) of Golden Delicious during October 2012

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Golden Delicious
Treatment 4
Maxcel 500 ppm
(4 Sprays)

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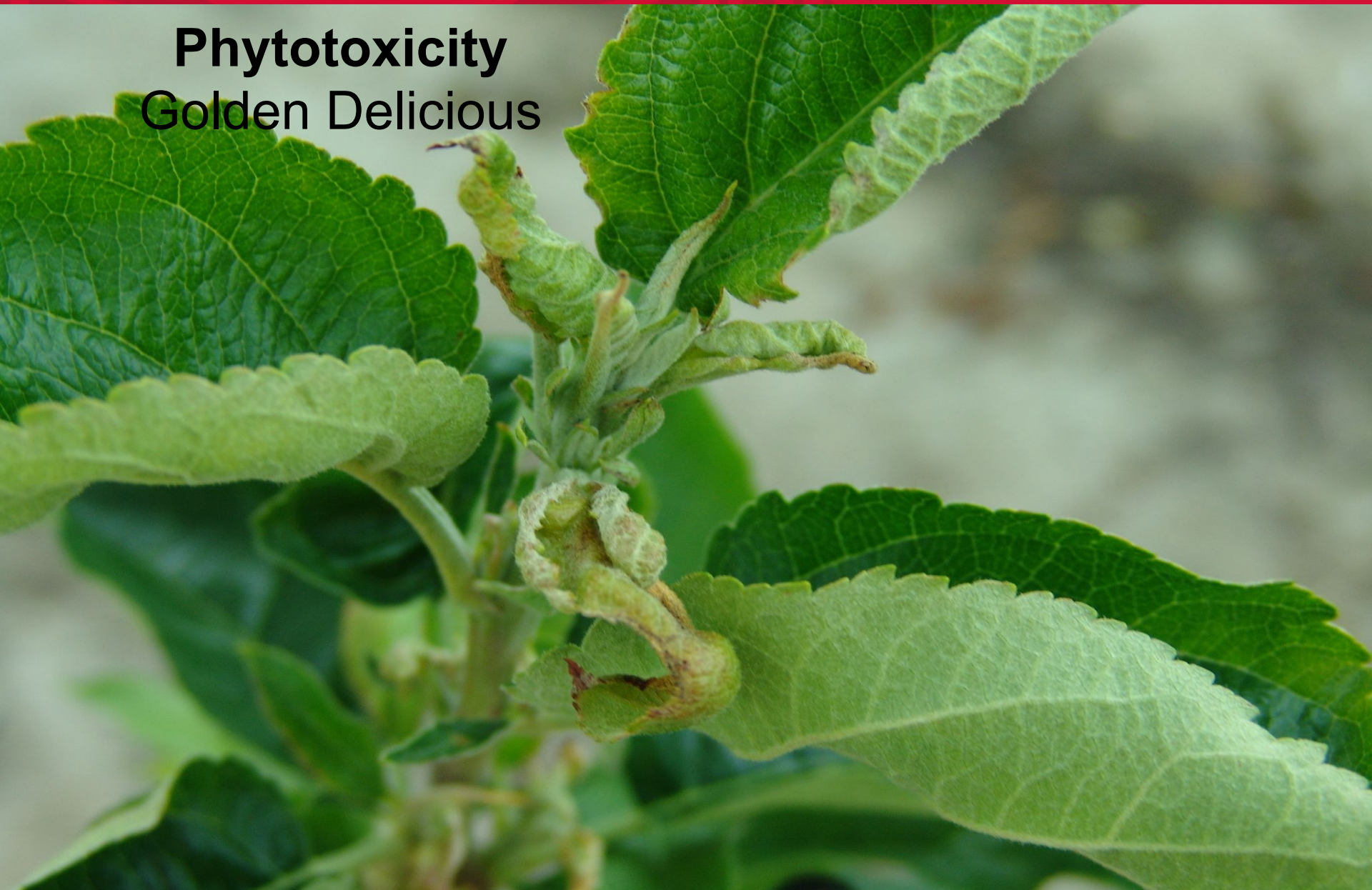
Phytotoxicity
Golden Delicious




Golden Delicious
Treatment 8
Maxcel 1,000 ppm
(4 Sprays)

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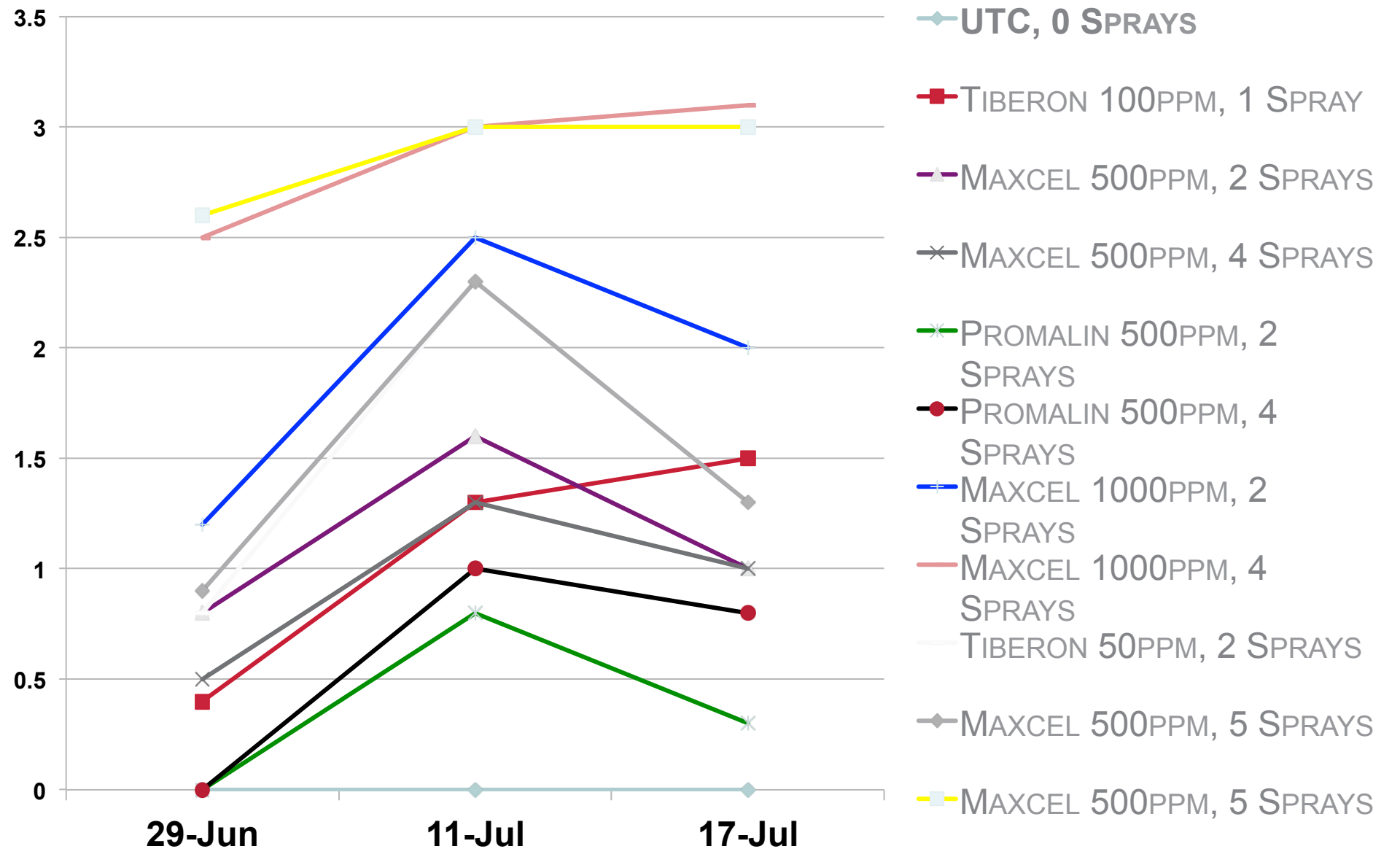
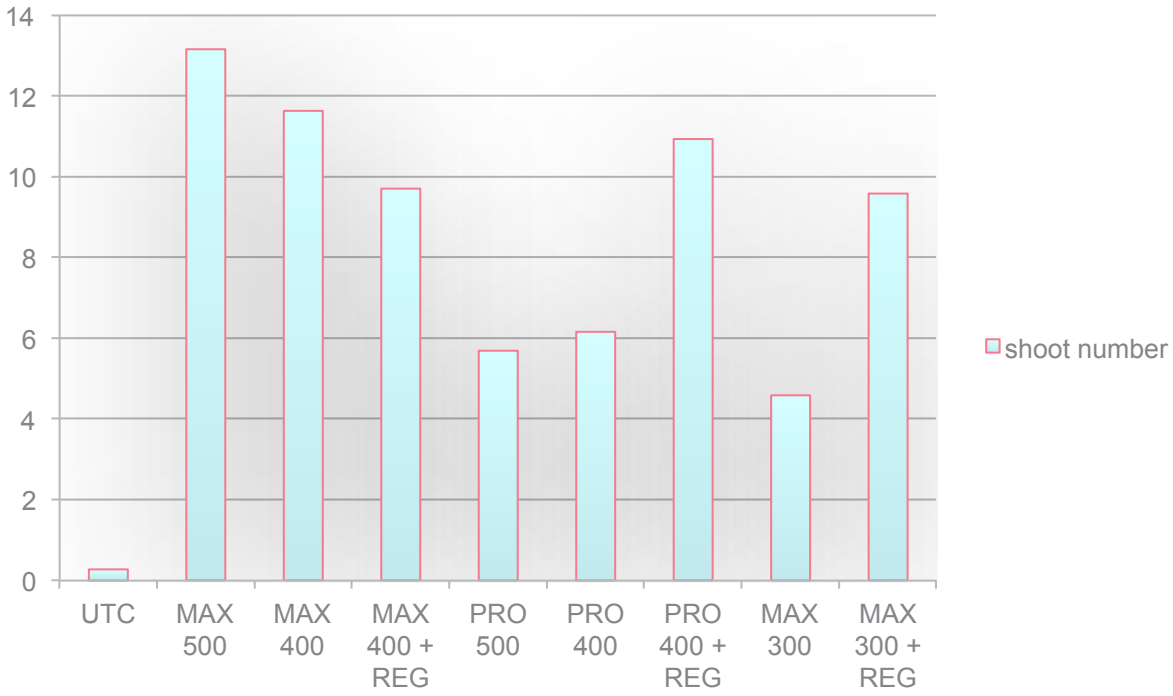
Phytotoxicity Ratings on Golden Delicious in 2012



Effects of Maxcel or Promalin on lateral shoot number (feathers) of Macoun 2013




Golden Delicious
Treatment 10
Maxcel 500 ppm
(5 Sprays)


Macoun
Treatment 5
Maxcel 1,000 ppm
(4 Sprays)

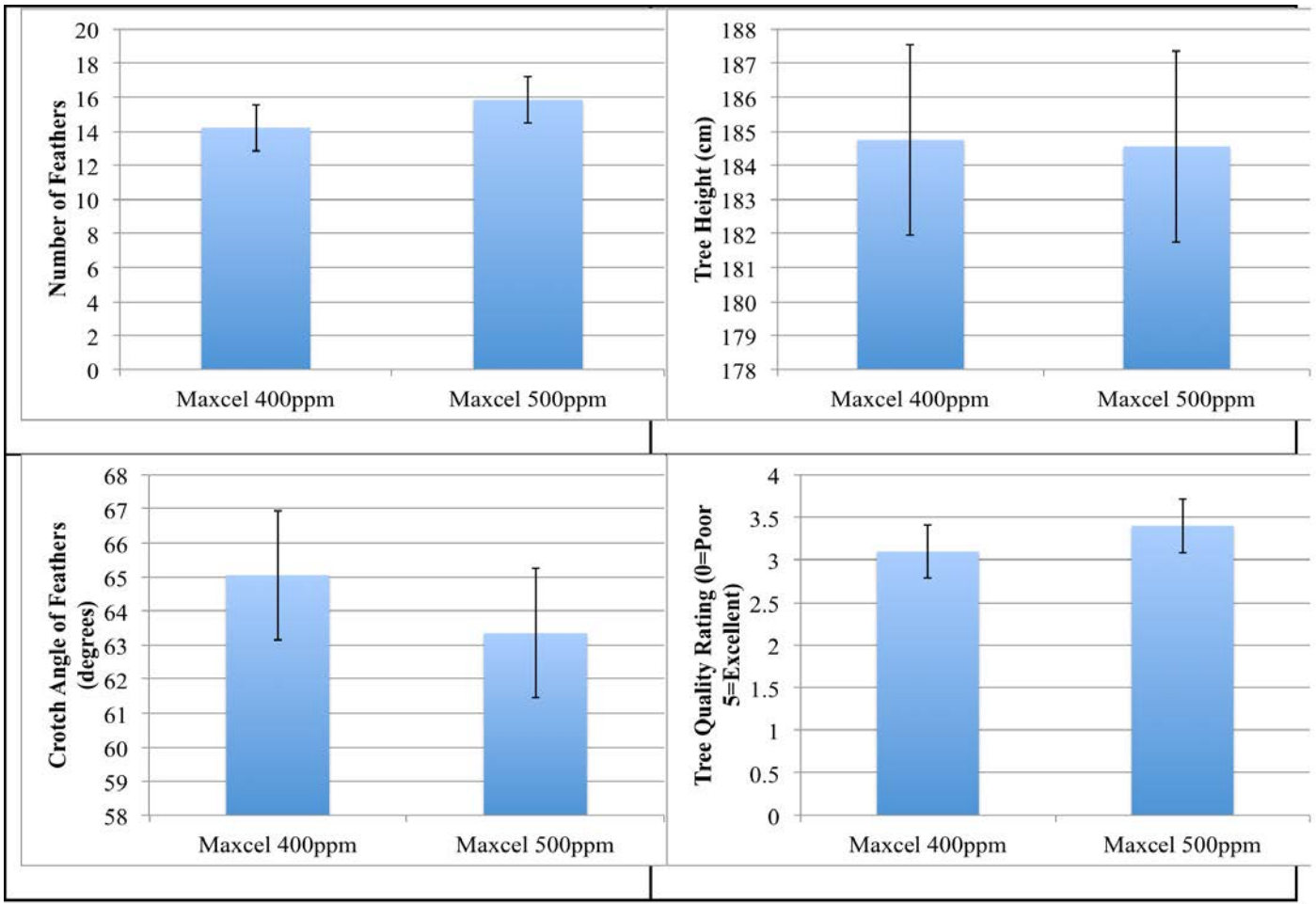
Chemical Treatments 2014

Fuji	Multiple Varieties
Maxcel: 400 and 500 ppm; 4 or 5 Applications	**Maxcel**: 400 ppm; 5 Applications
Promalin: 400 and 500 ppm; 4 and 5 Applications	**Promalin**: 400 and 500 ppm; 4 and 5 Applications
12 treatments, balanced with UTC	*4 treatments to 40 trees on multiple varieties*

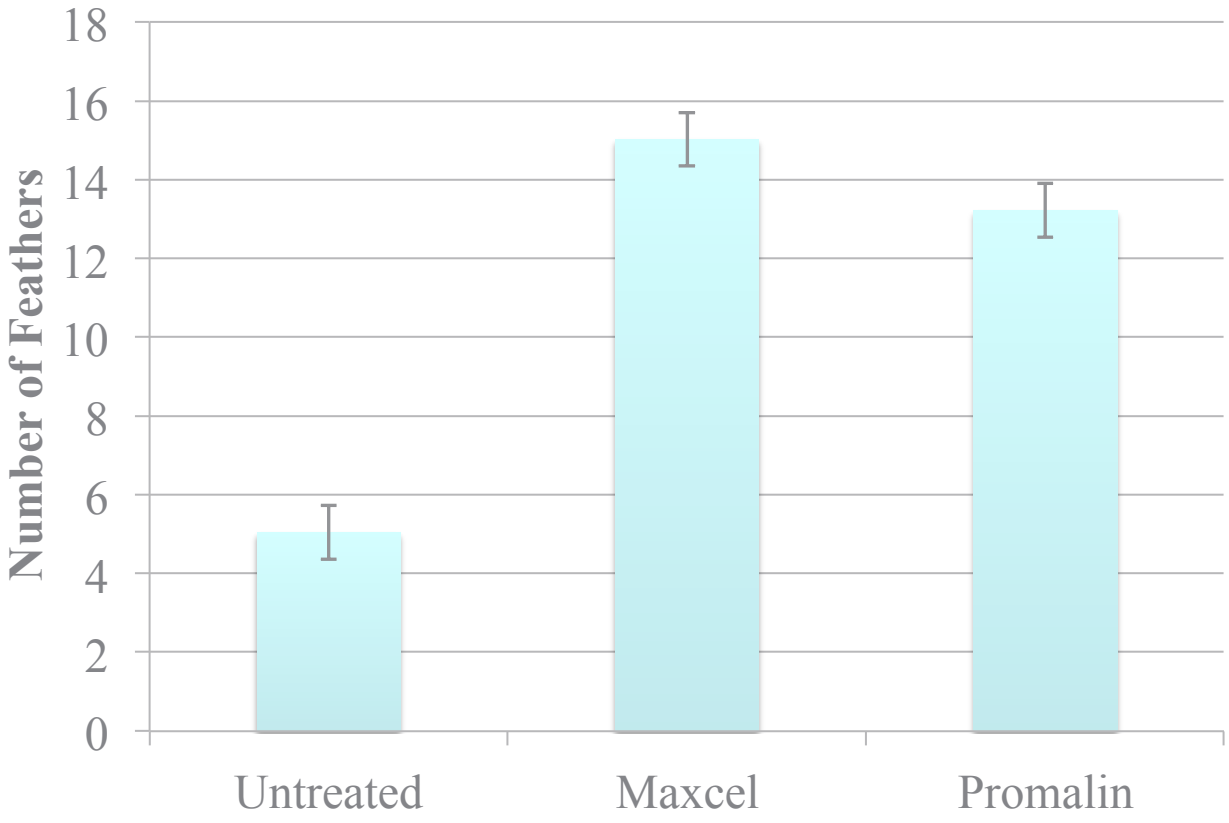
Multiple Varieties in Demonstration

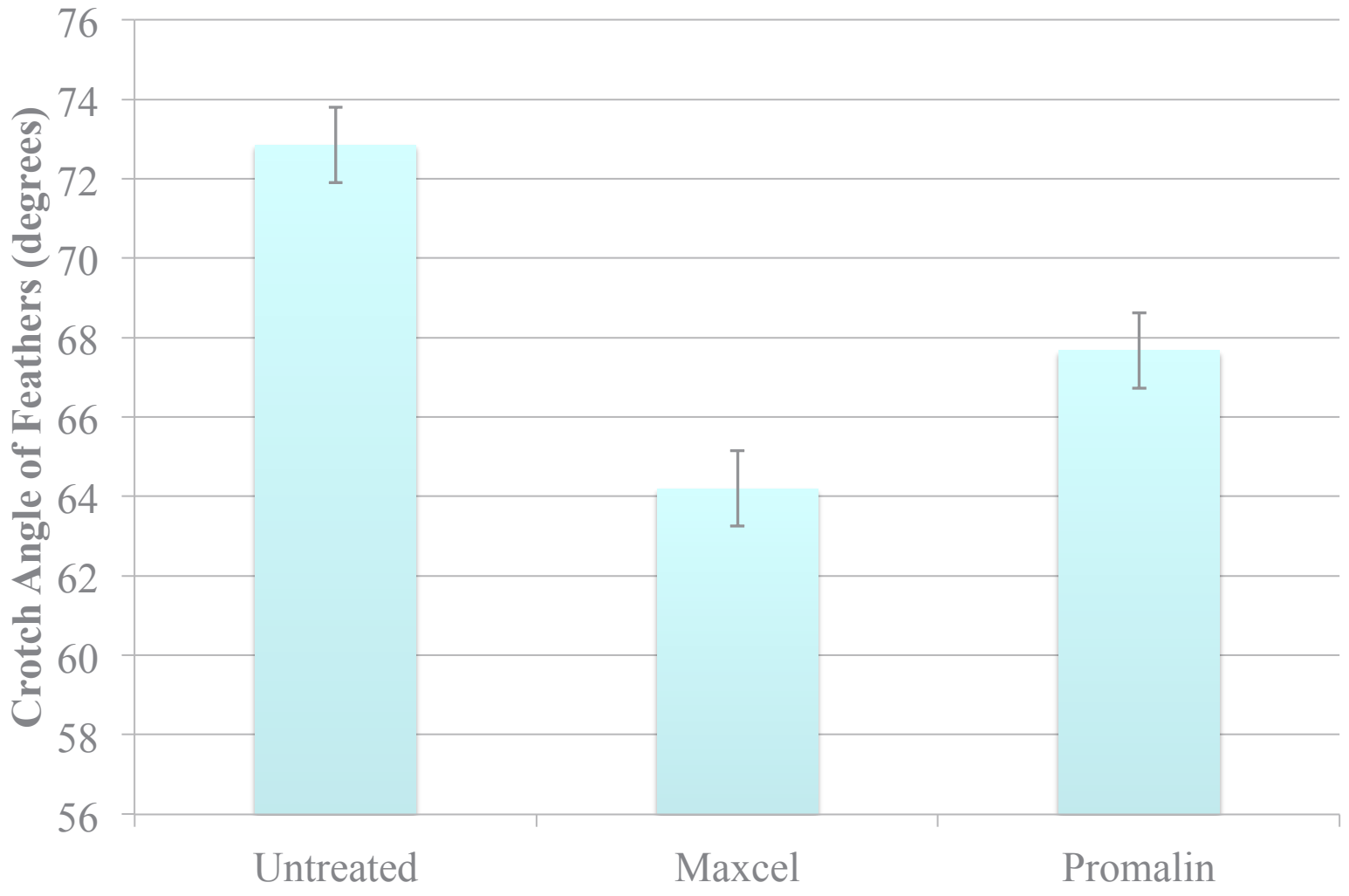
Ambrosia	Aztec Fuji
Cameo	Crimson Crisp
Empire	Enterprise
Gala	Goldrush
Honeycrisp	Pink Lady
Royal Court	Ruby Mac
Suncrisp	

Effect of rate of Maxcel on the number of feathers, tree height, branch crotch angle and overall tree quality of Daybreak Fuji/M.9



2014 Fuji Number of Feathers




Crotch Angle of Feathers (degrees)
76
74
72
70
68
66
64
62
60
58
56
Untreated
Maxcel
Promalin

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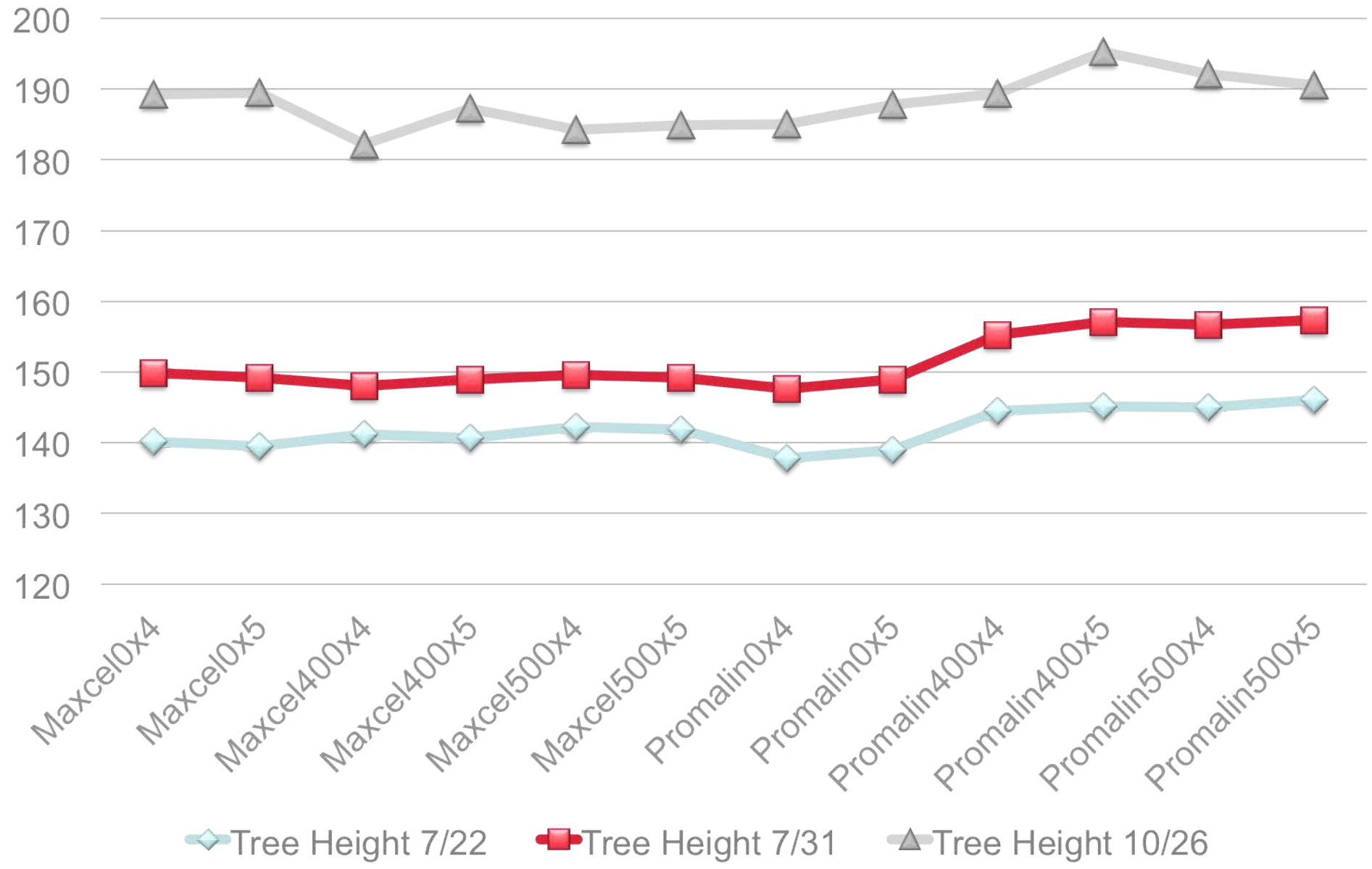
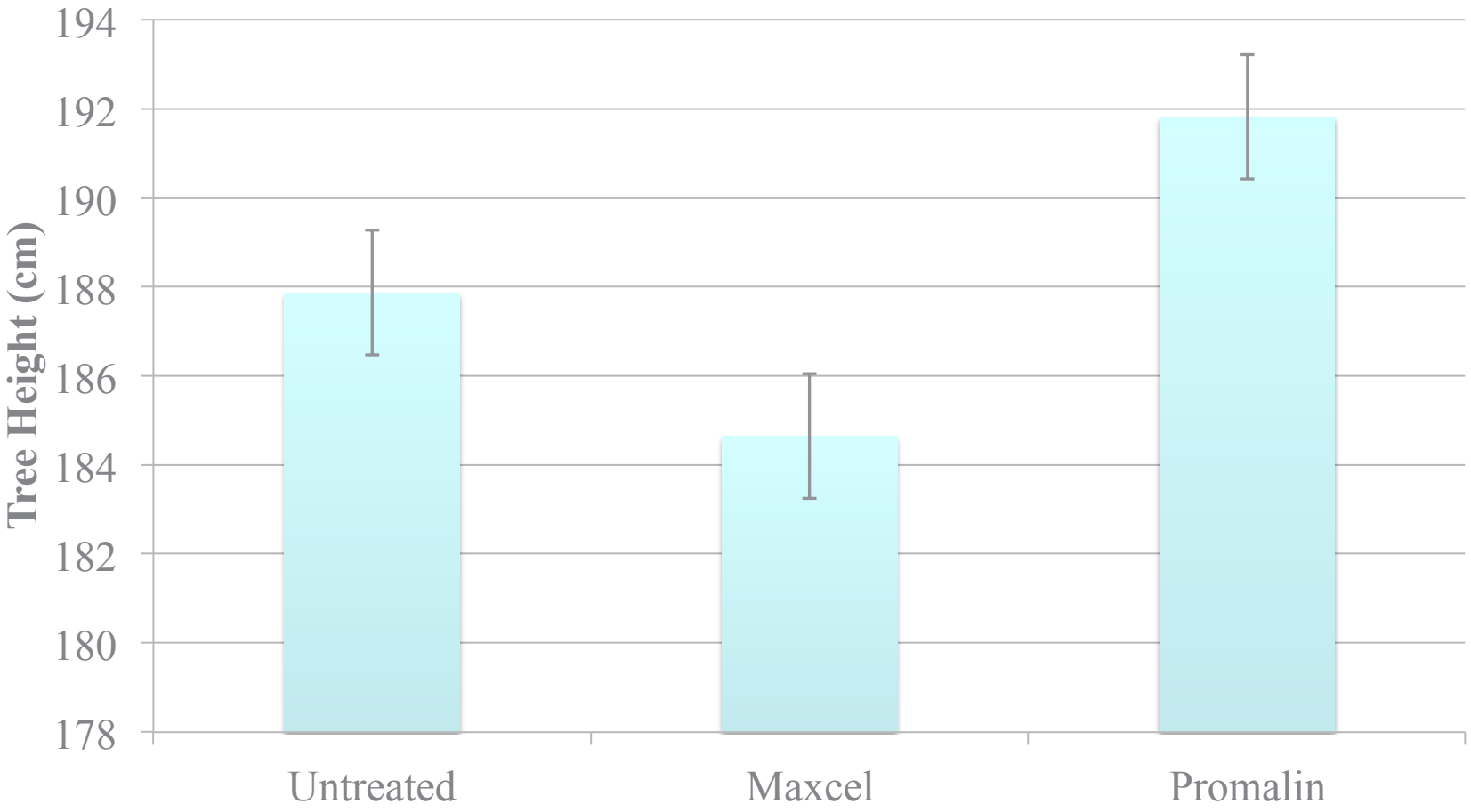
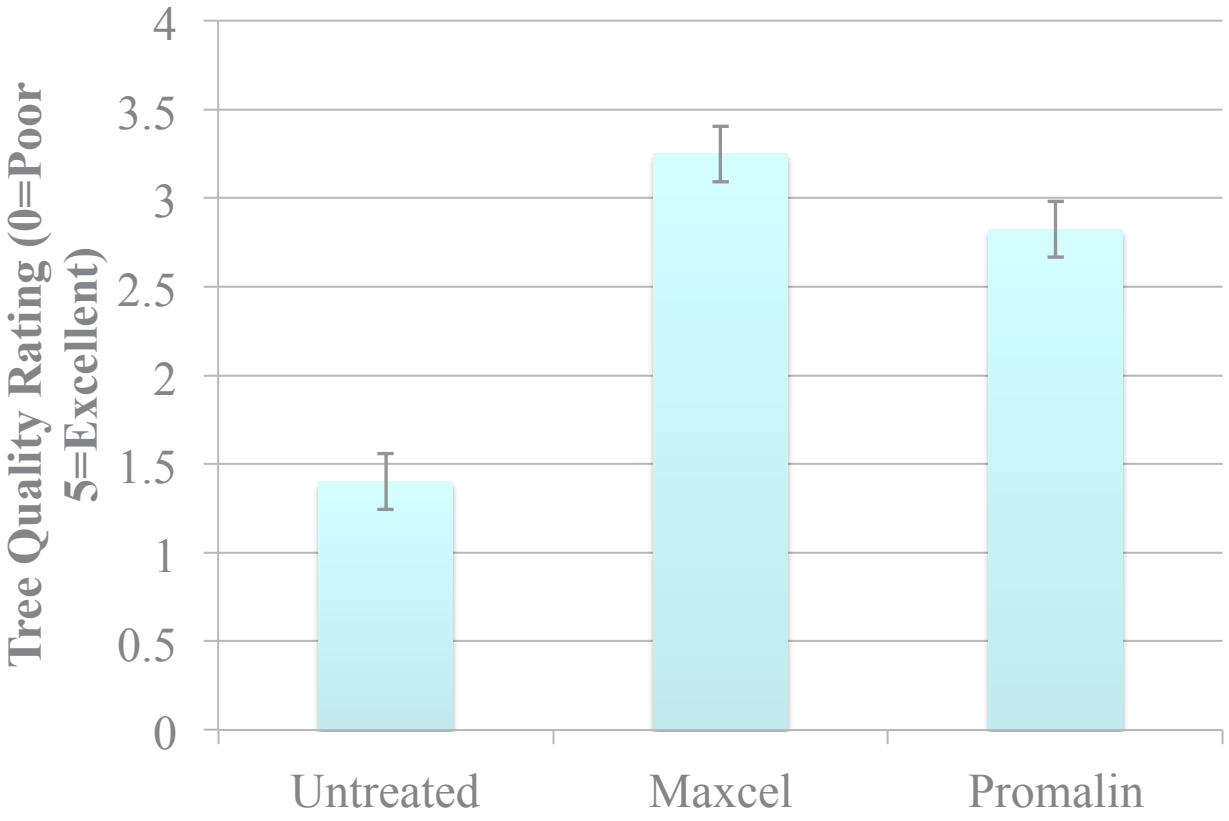
Maxcel and Promalin effects on Tree Height (cm) on Daybreak Fuji, 2014



2014 Fuji Tree Height



2014 of Tree Quality Rating of Fuji



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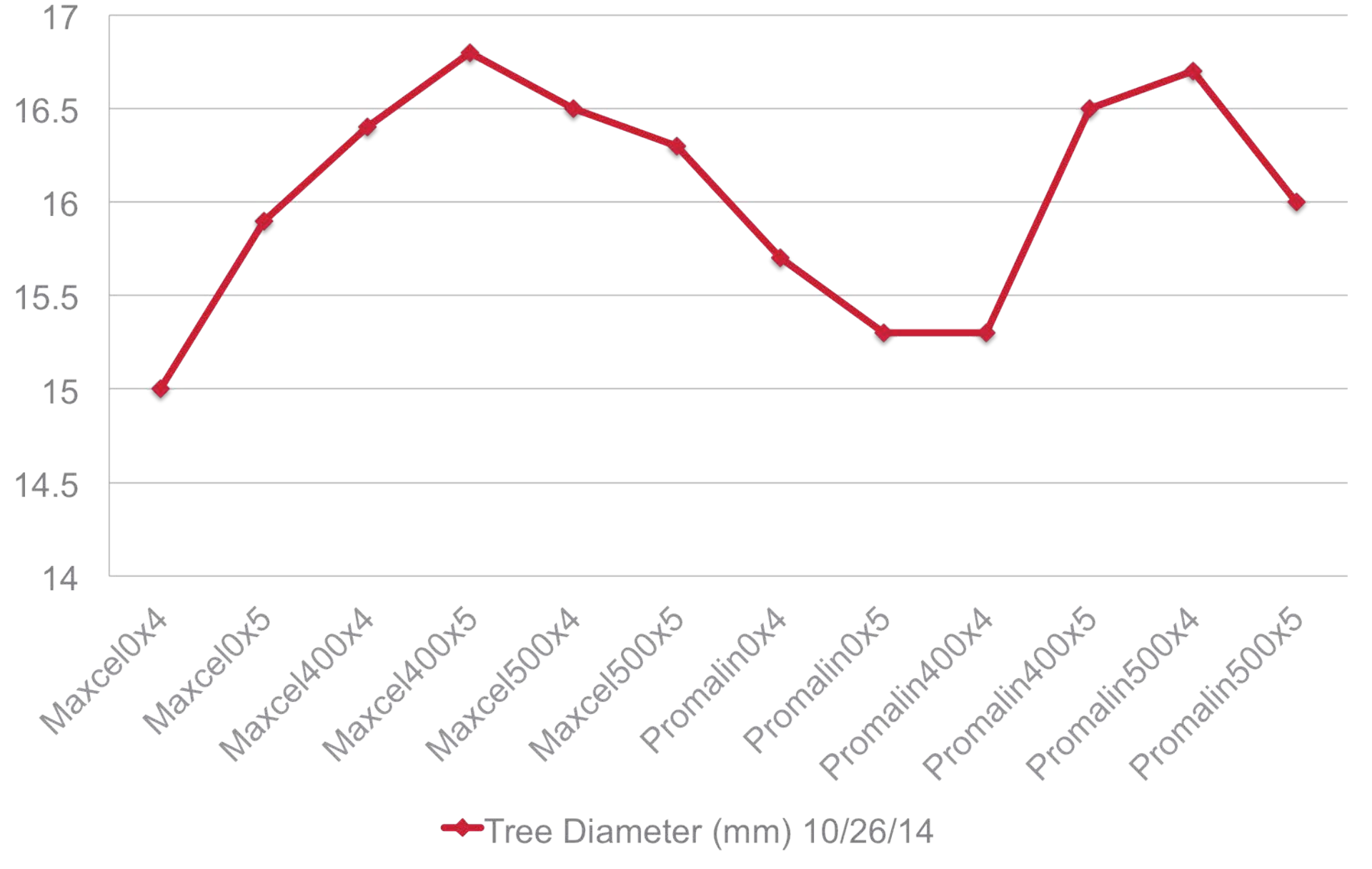
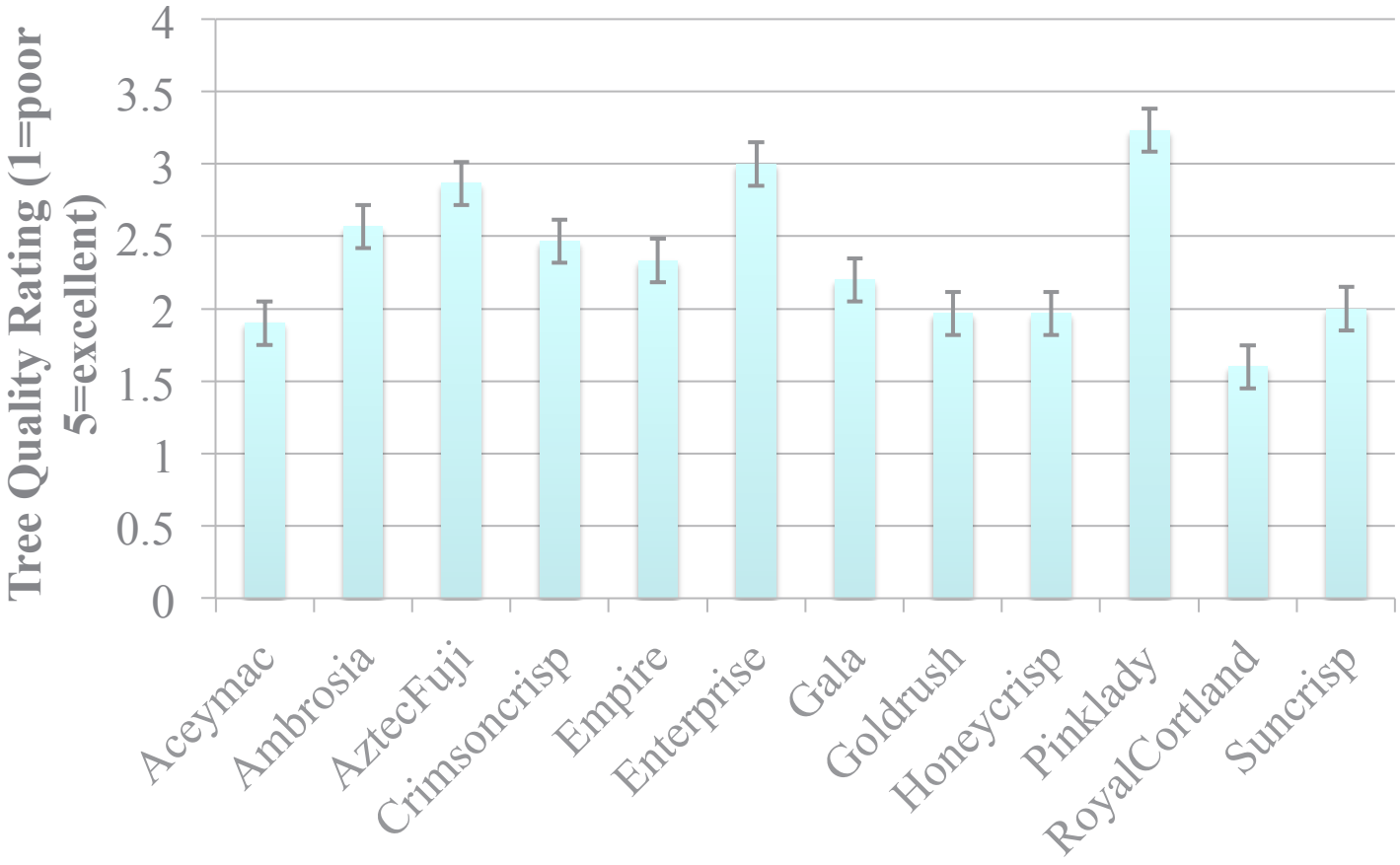
Maxcel and Promalin effects on Tree Diameter (mm) on Daybreak Fuji, 2014



2015 ACN Variety Trial Tree Quality Rating



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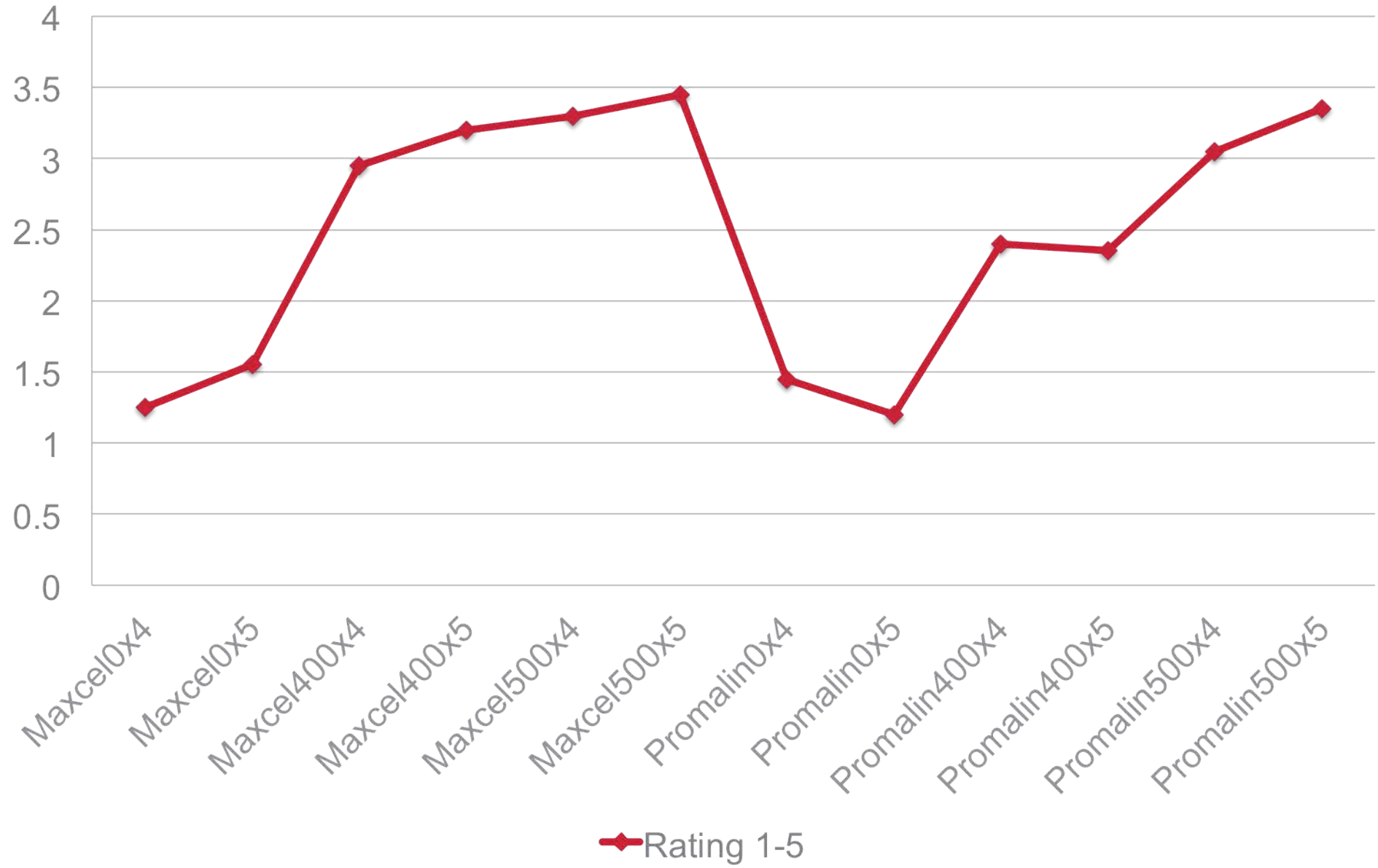
Maxcel and Promalin effects on Visual Rating (1-5) on Daybreak Fuji, 2014



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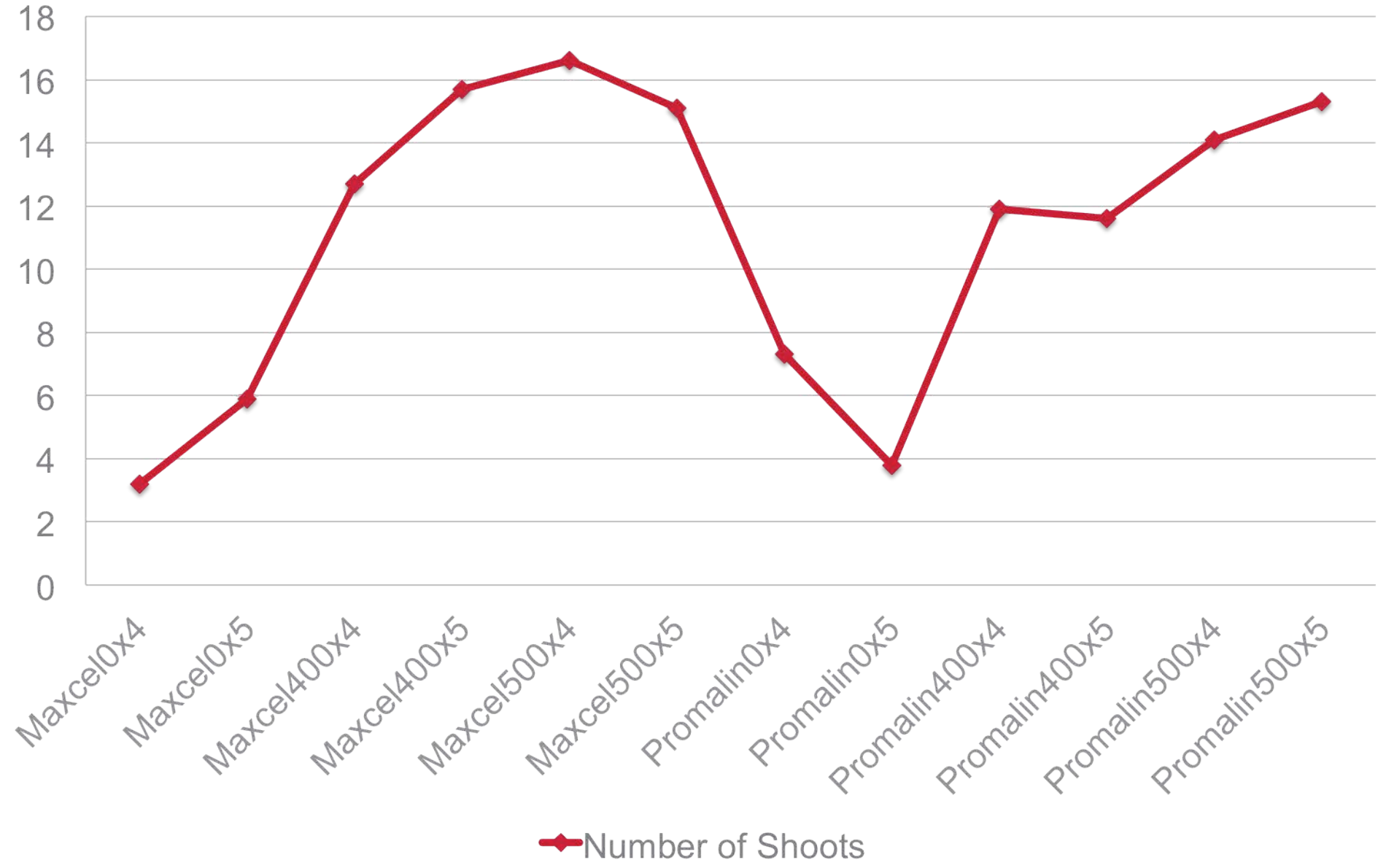
Maxcel and Promalin effects on Number of Shoots on Daybreak Fuji, 2014



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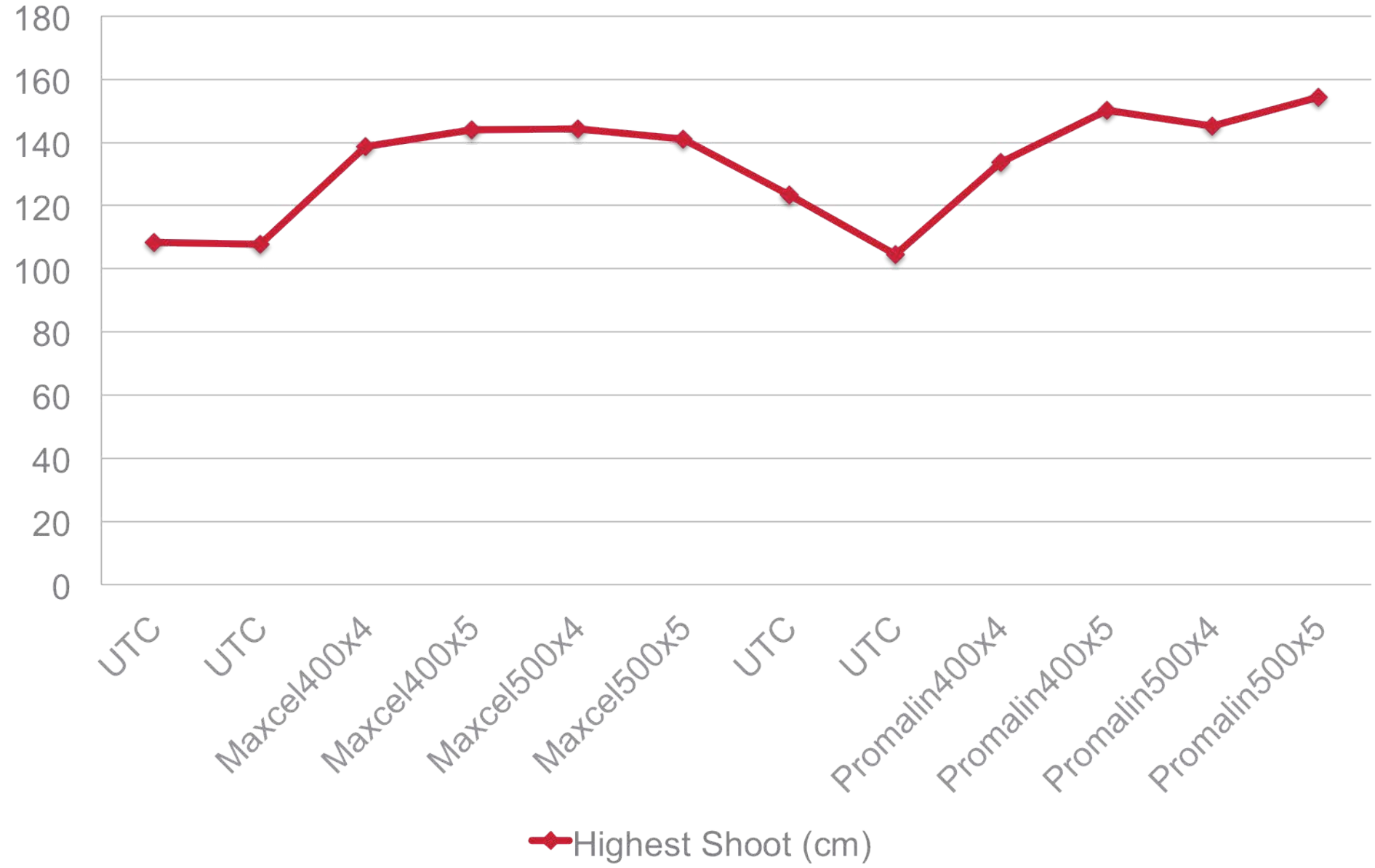
Maxcel and Promalin effects on Highest Shoot (cm) on Daybreak Fuji, 2014



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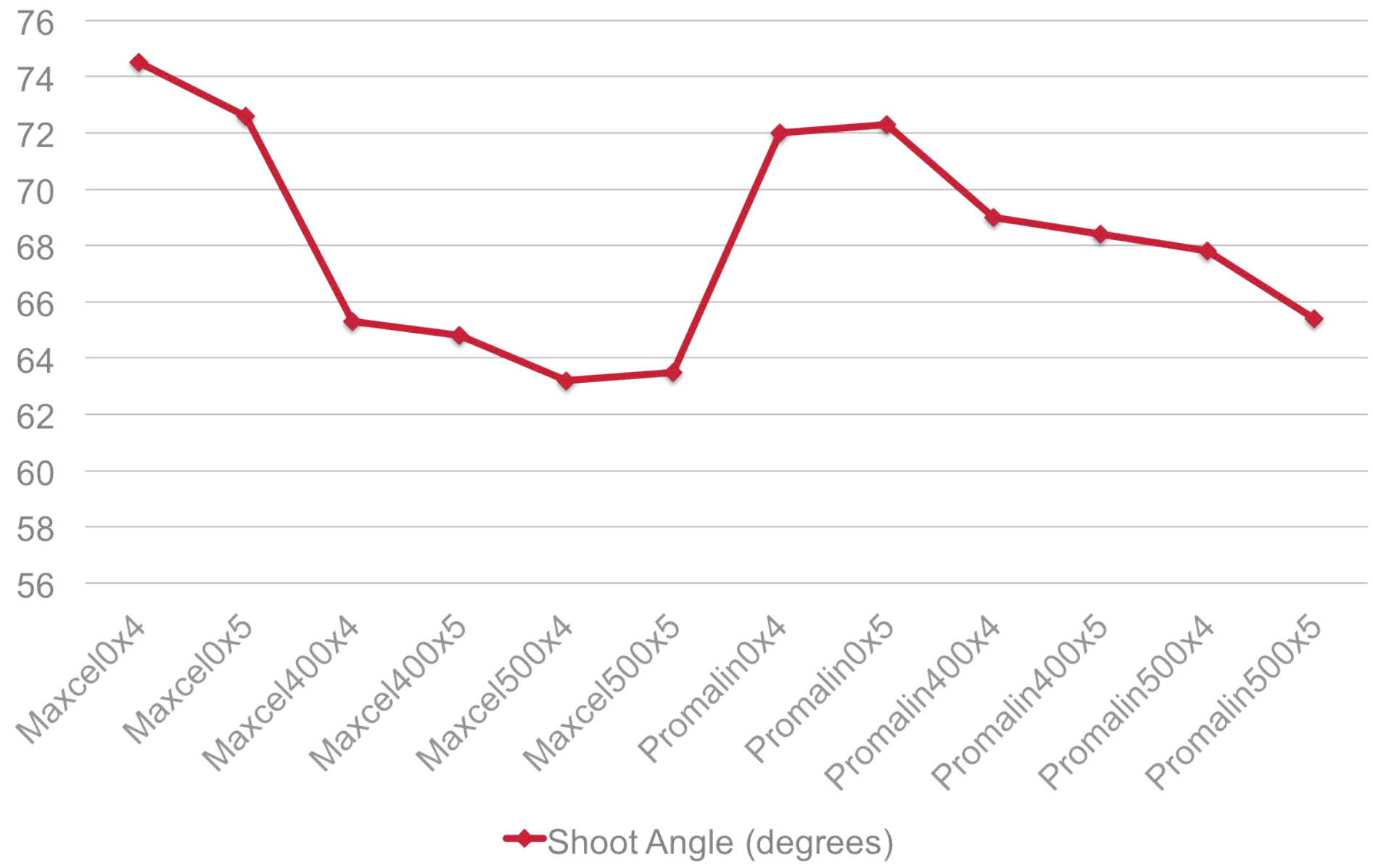
Maxcel and Promalin effects on Shoot Angle (degrees) on Daybreak Fuji, 2014



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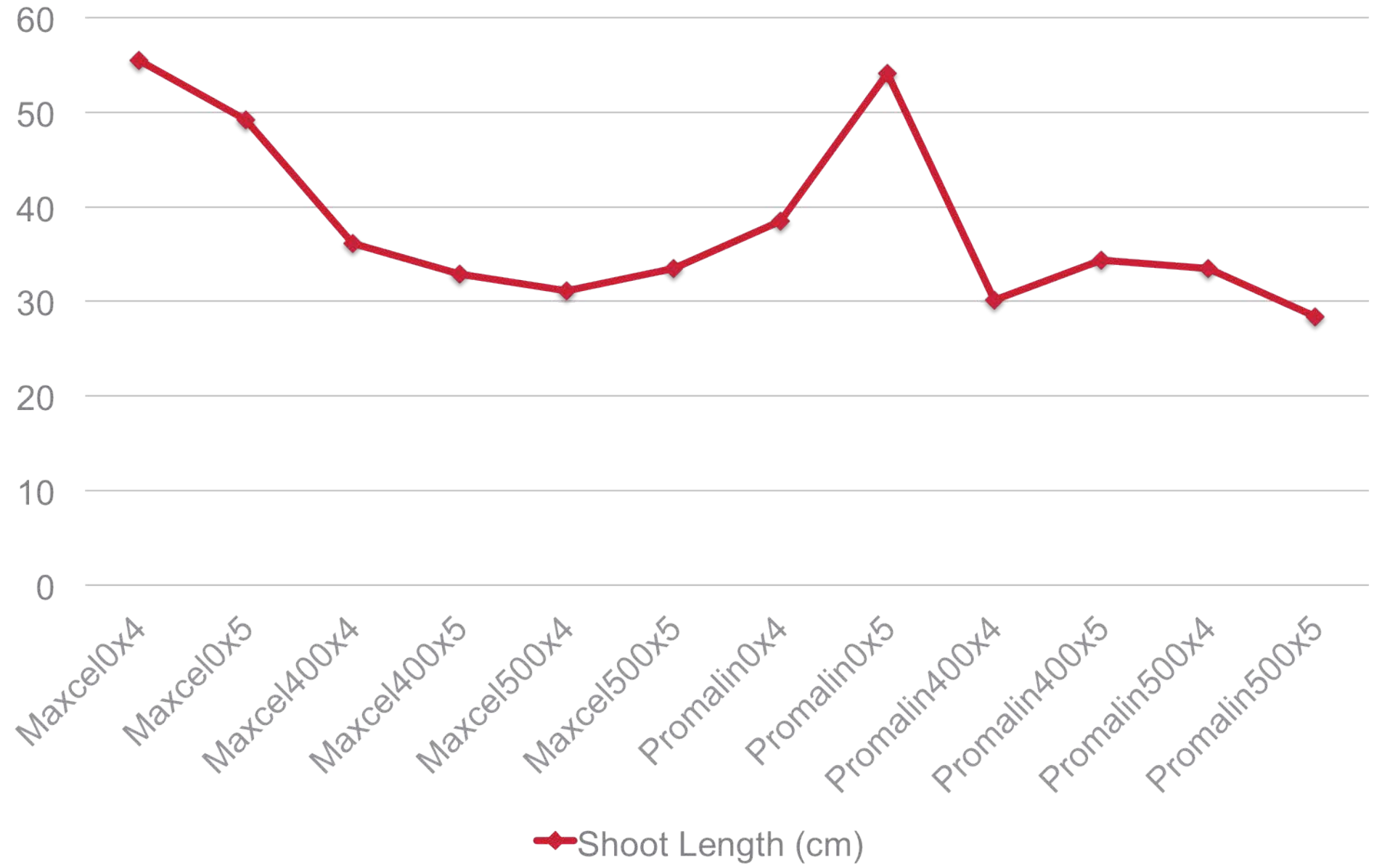
Maxcel and Promalin effects on Shoot length (cm) on Daybreak Fuji, 2014



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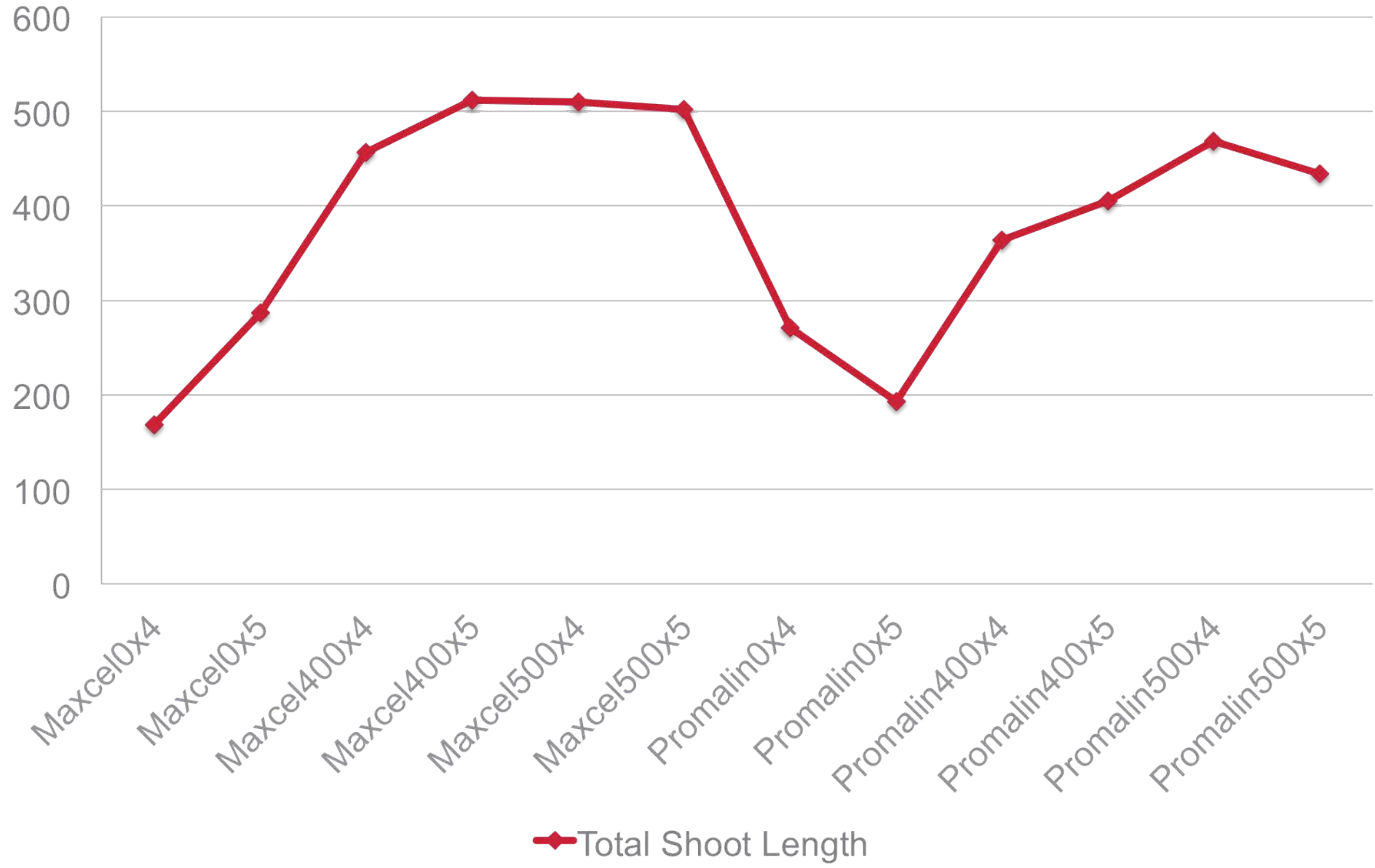
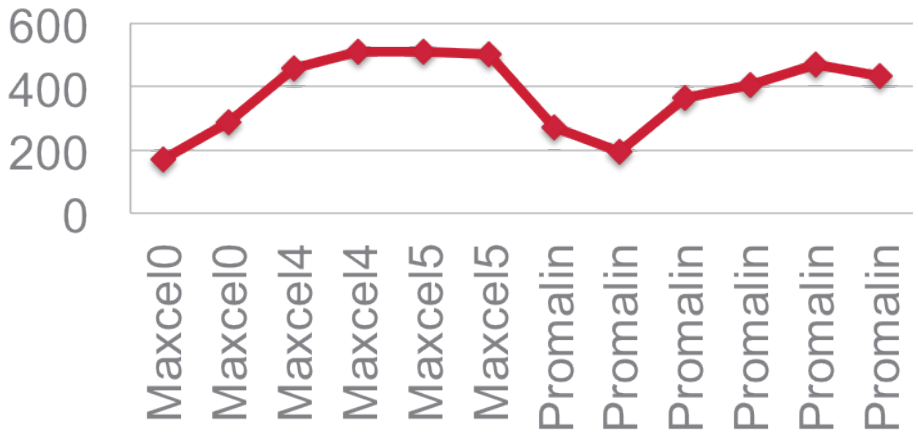
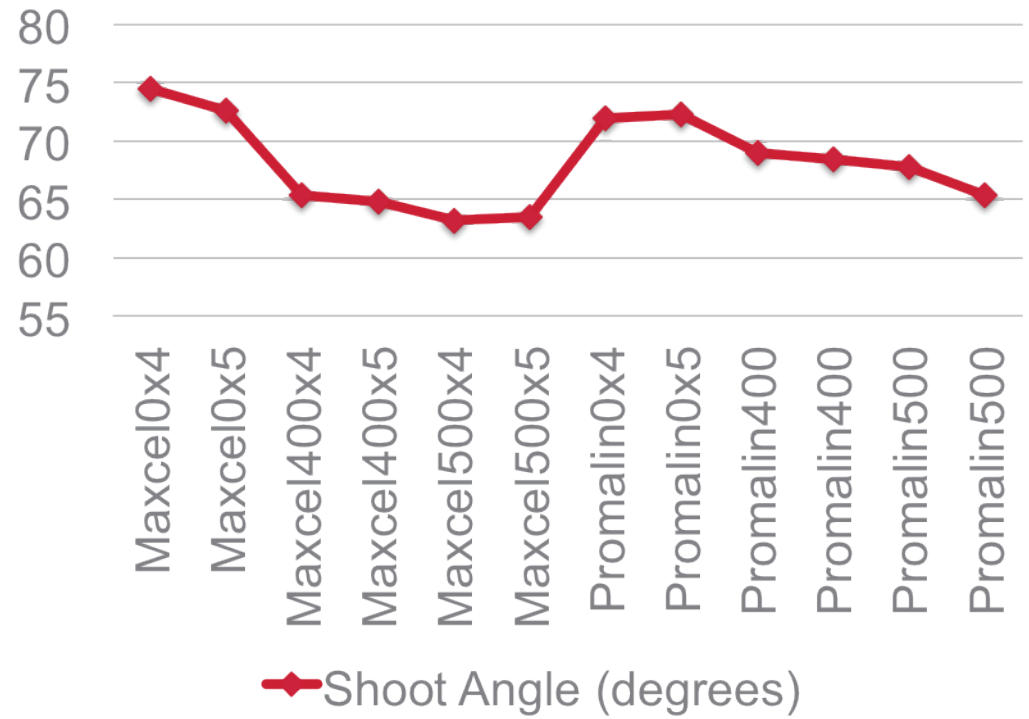
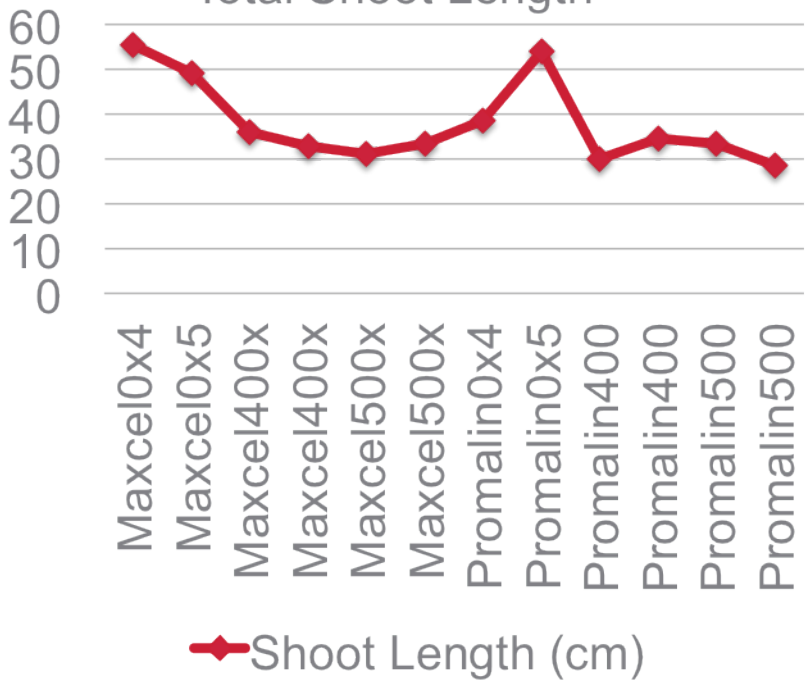
Maxcel and Promalin effects on Shoot length (cm) on Daybreak Fuji, 2014




600
400
200
0
Maxcel0
Maxcel0
Maxcel4
Maxcel4
Maxcel5
Maxcel5
Promalin
Promalin
Promalin
Promalin
Promalin
Promalin
Total Shoot Length


80
75
70
65
60
55
Maxcel0x4
Maxcel0x5
Maxcel400x4
Maxcel400x5
Maxcel500x4
Maxcel500x5
Promalin0x4
Promalin0x5
Promalin400
Promalin400
Promalin500
Promalin500
Shoot Angle (degrees)


60
50
40
30
20
10
0
Maxcel0x4
Maxcel0x5
Maxcel400x
Maxcel400x
Maxcel500x
Maxcel500x
Promalin0x4
Promalin0x5
Promalin400
Promalin400
Promalin500
Promalin500
Shoot Length (cm)

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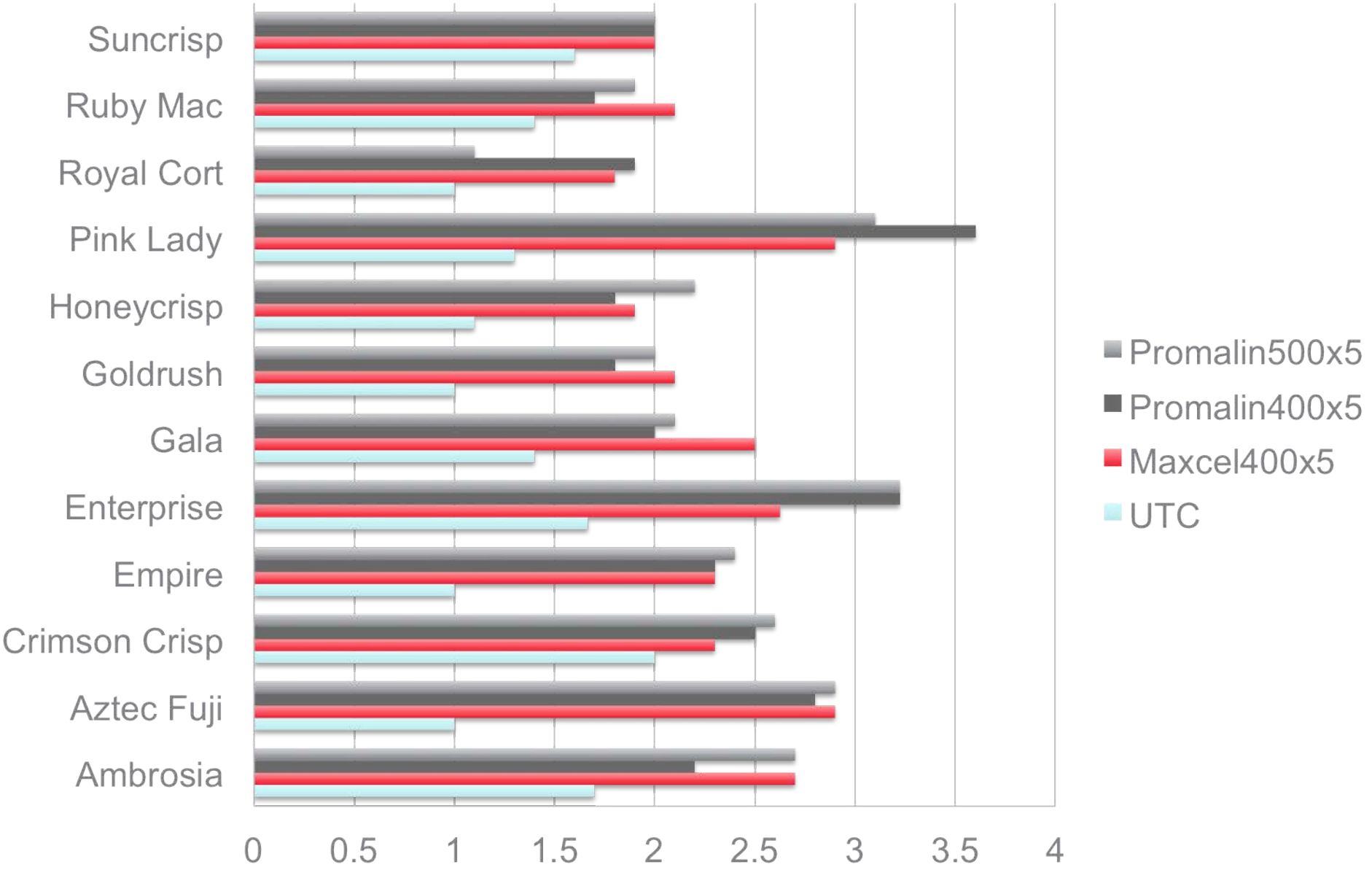
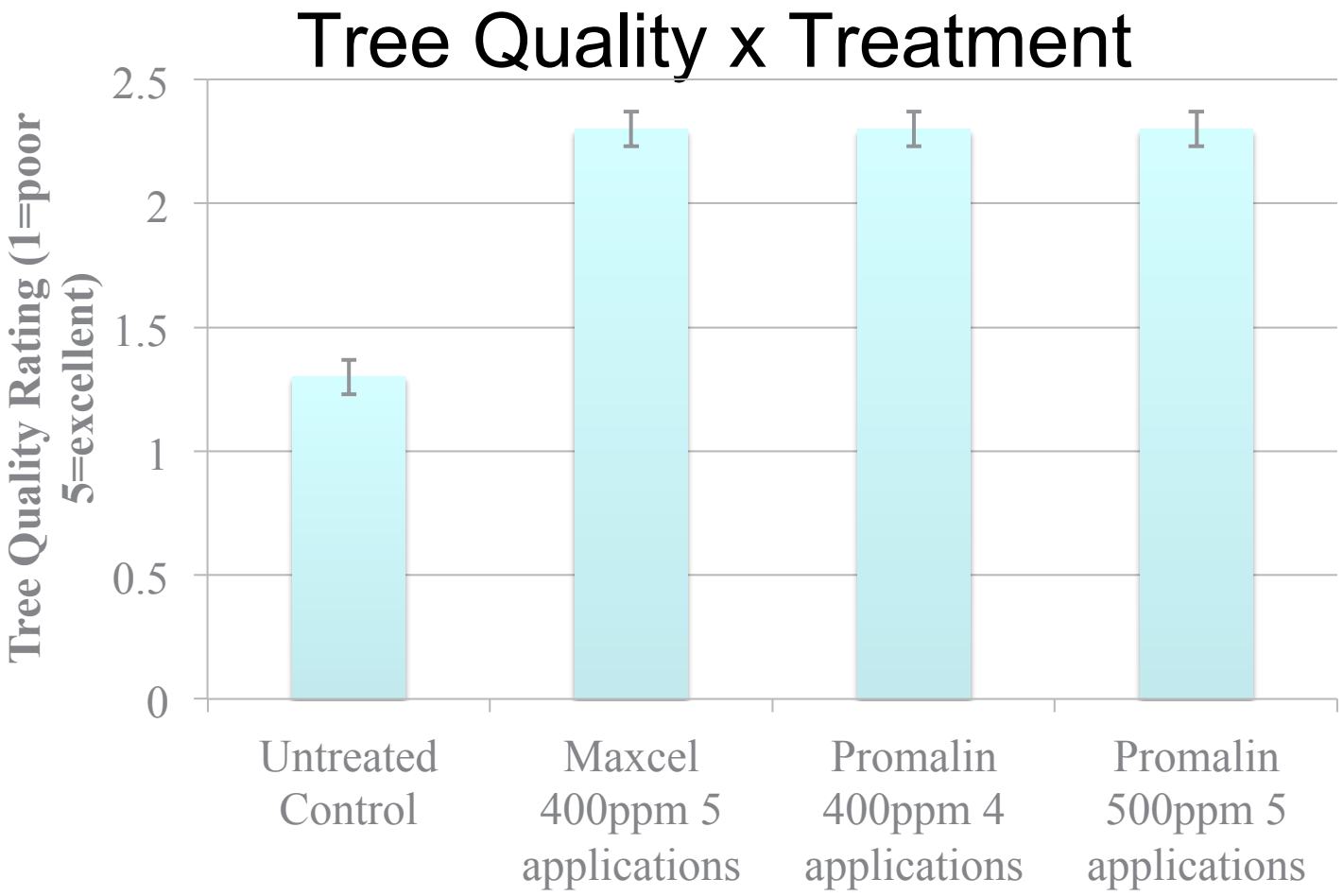
Variety Demonstrations 2014 Ratings (1-5)




Tree Quality x Treatment
Tree Quality Rating (1=poor 5=excellent)
2.5
2
1.5
1
0.5
0
Untreated Control
Maxcel 400ppm 5 applications
Promalin 400ppm 4 applications
Promalin 500ppm 5 applications

Conclusions after Three Years of Research

Best Suggested Treatments to date nursery trees

- Fuji – Maxcel 400 ppm -4 applications- 2 week intervals in Mid Atlantic
- Macoun – Promalin 400ppm + Regulaid -2 week intervals
- Golden Delicious- Maxcel 400 PPM- 2 week intervals
- **Note:** NY, NE and cooler climates may only need 3-4 applications and 500PPM Maxel or 500 PPM Promalin + Surfactant

Suggested Guidance

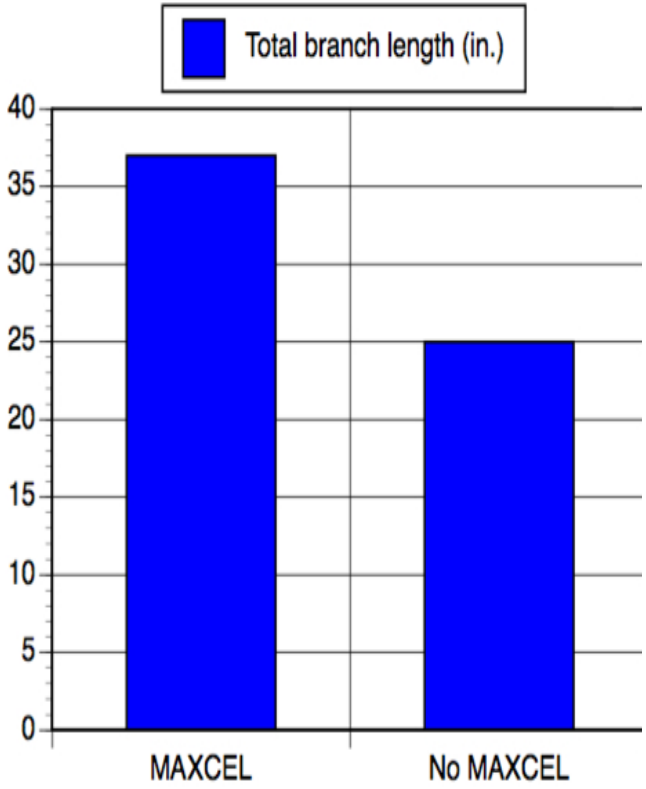
- Make Multiple applications of Maxcel or Promalin + Surfactant- 4-5 applications (no surfactant with Max) to the growing tips
- Intervals are temperature dependent, but approximately every 2 weeks
- When applications to leader stop the leader elongates with no more feathers
- Treatments are variety dependent as to material
- Enterprise, Pink Lady, Macoun, and Honeycrisp, may be better with Promalin+ Regulaid than Maxcel

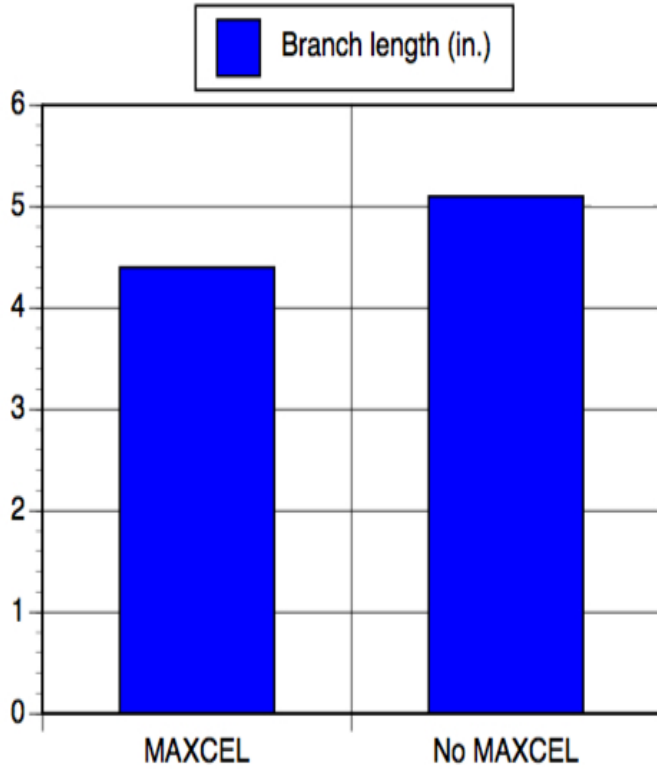
Other techniques to branch whips already established in the orchard

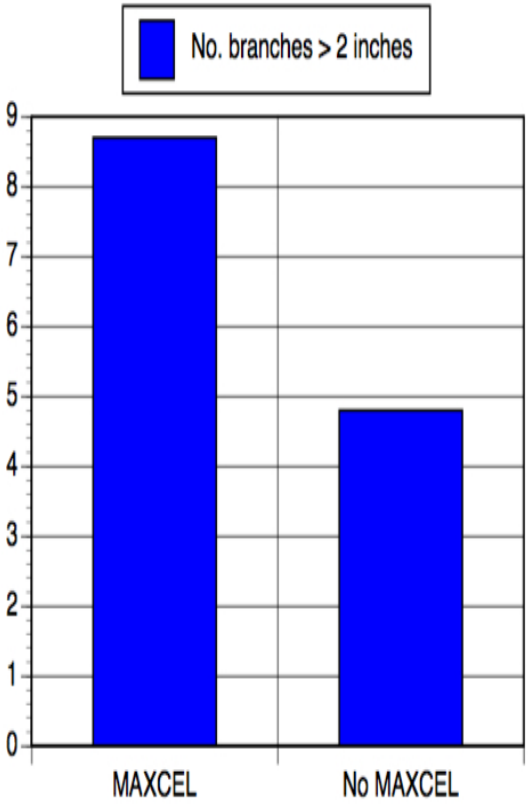
- Notching
- Painting with Promalin or Maxcel
- Spraying Trees in the Orchard with Maxcel
- Combing notching with spraying or painting Maxcel

Other Branching Studies: Clements, J. Painting with Maxcel (*in Horticultural News, Vol. 95, No. 1)*

Jon Clements, UMASS-2014







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Use of Notching, MaxCel® and Promalin® to Overcome Blind Wood in Apple Trees

Steve McArtney, Regional Apple Specialist (NCSU/UGA/UT/Clemson)

NC STATE UNIVERSITY

COLLEGE OF AGRICULTURE & LIFE SCIENCES
ACADEMICS • RESEARCH • EXTENSION

The University of Georgia 1785

THE UNIVERSITY of TENNESSEE

CLEMSON UNIVERSITY

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McArtney Notching

Treatment	Bud break (%)[z]	Buds with shoots > 1 cm (%)	Mean shoot length (cm)[y]
Control	0 a[x]	0 a	-
Notching	59 b	4 a	0.8 a
6-BA (1.5 g·L^{-1})[y]	0 a	0 a	-
Notching + 6-BA (1.5 g·L^{-1})	95 c	89 b	7.9 ab
Notching + 6-BA (1.5 g·L^{-1}), 6-BA plus GA_{4+7} (0.25 g·L^{-1})	90 c	80 b	15.5 b
Significance	***	***	*

[z]Percentage data were transformed using the arcsine function prior to analysis. Data are back-transformed mean values.
[y]1 g·L^{-1} = 1000 ppm, 1 cm = 0.3937 inch.
[x]Mean separation in columns by Waller-Duncan k-ratio test following significant F test at $P \leq 0.05$.
*, ***Significant at $P < 0.05$, and $P < 0.001$, respectively.

The Authors appreciate the financial support of Adams County Nursery, The International Fruit Tree Association, the Northwest Nursery Improvement Institute, Rutgers University, the New Jersey Agricultural Experiment Station, and Mike Beese, Dave Johnson and numerous other Rutgers Master Gardeners who assisted with hundreds of hours of data collection.

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.

Winfred P. Cowgill Jr. et al "**Studies and Recommendations for Branching Young Apple Trees**
- Horticultural News Volume 94, No.3, 1-9

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Plans for 2015

Grant from International Fruit Tree Association

Improving branching of nursery and young orchard apple trees

Rutgers University and UMASS-Amherst
Win Cowgill, Jon Clements

1. Refine the rate and choice of the PGR's Maxcel® and Promalin® (M&P)
2. Evaluate bench grafts with (M&P)
3. Induce branches in Orchard settings- 3 methods
    1. Painting
    2. Spot spraying
    3. Air blast sprayer application

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Chemical Treatments 2014

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Chemical Treatments 2014