The OrganicA Project - Multi-Year Research Results on Tree Growth, Productivity, and Fruit Quality in Two Certified Organic Apple Production Systems

Lorraine P. Berkett[1], Renae E. Moran[2] , M. Elena Garcia[3], Heather M. Darby[1], Robert L. Parsons[1], Terence L. Bradshaw[1], Sarah L. Kingsley-Richards[1], and Morgan C. Griffith[1]

[1]University of Vermont, [2]University of Maine, [3]University of Arkansas Contact address: Lorraine.Berkett@uvm.edu

After extensive grower input, the multi-state, multi-disciplinary OrganicA Project was initiated in 2006 through a USDA OREI grant to holistically examine the opportunities and challenges of organic production within two major orchard systems growers are using to change to new cultivars and with five of the top apple cultivars that growers identified as important to the future of the industry in New England. Growers want to know what the potential is for sustainable and profitable organic production with the newer apple cultivars that are being planted in the region. The orchard systems are: (i) a new orchard planted with young trees purchased from a nursery and (ii) a "top-grafted" orchard, i.e., an established, older orchard onto which new cultivars are grafted.

Two apple orchards, located at the University of Vermont Horticultural Research Center in South Burlington, Vermont, USA, are involved in this research project. Orchard 1 is an orchard planted in April 2006 with 'Ginger Gold', 'Liberty', and 'Macoun', and 'Zestar!' on Bud. 9 rootstock and 'Honeycrisp' on M.26; cultivars are arranged in a completely randomized design with three-tree replications. Orchard 2 was an existing orchard planted in 1988 with 'McIntosh' and 'Liberty' trees on M.26 rootstock which was 'top-grafted' in April 2006 to the same five cultivars. Since the original cultivar (i.e., original 'McIntosh' or 'Liberty' interstem) may affect growth of the new 'top-grafted' scion, a randomized complete block experimental design, with two-tree replications, was used to block any effect on new scion growth. For most parameters measured, there was no significant effect from the interstem.

Orchards have been managed organically since 2006, with organic certification received in 2008. The orchards began to produce significant crops of fruit in 2009, with results from 2009 – 2011 presented here. Arthropod and disease management included the use of organically-acceptable insecticides and fungicides, applied based on IPM models, across the whole orchard. In 2009-2010, a nested study assessing the effect of kelp-extract biostimulant materials was also conducted in Orchard 1, with very few significant effects from kelp-extract treatments found for most measured parameters.

Orchard 1, 2006

Orchard 1, 2011

Orchard 2, 2006

Orchard 2, 2011

Funding sources:
USDA Organic Agriculture Research & Extension Initiative, University of Vermont, University of Arkansas, University of Maine, USDA NIFA Integrated Pest Management Program, and the Vermont Tree Fruit Growers' Association

For additional and more specific research results, please visit the OrganicA project website:
http://www.uvm.edu/organica/

In Orchard 1, Ginger Gold trees grew best of all cultivars, with the greatest terminal shoot length, tree height, and tree width measured in 2011. Liberty had the lowest tree growth measurements. Most trees in Orchard 1 are smaller than desired for the planting system and age of the orchard. Trees in Orchard 2 are similar in height across cultivars. Macoun trees had greater shoot length but narrower canopies in 2011. Health ratings of top-grafted trees in Orchard 2 did not show statistically significant differences, but Macoun and Zestar! trees ranked lowest in the proportion of trees deemed healthy in the planting.

Ginger Gold and Honeycrisp generally had greater cumulative yield than other cultivars from 2009-2011. In Orchard 2, Ginger Gold had the greatest yield in all years, and cumulative yield was well above any other cultivar. Fruit weight was good for most cultivars in most years, with 140 grams the minimum for the highest grade of fruit in the study. Liberty consistently had the lowest fruit weight in both orchards and all study years.

Ginger Gold

Honeycrisp

Liberty

Macoun

Zestar!

2011 Tree growth measurements, Orchard 1[x]

cultivar	terminal length (cm)	height (m)	avg* width (m)
Ginger Gold	20.9a	2.5a	1.8a
Honeycrisp	17.7ab	2.2b	1.5b
Liberty	16.2b	1.9c	1.4bc
Macoun	17.6ab	2.3b	1.3cd
Zestar!	17.7ab	2.4ab	1.2d

2011 Tree growth measurements, Orchard 2[x]

cultivar	terminal length (cm)	height (m)	avg* width (m)	proportion 'healthy' trees[y]
Ginger Gold	35.0ab	4.1	3.3a	0.95
Honeycrisp	29.2b	3.9	3.3a	0.92
Liberty	29.5b	3.8	3.2a	0.76
Macoun	39.9a	4.3	2.5b	0.63
Zestar!	27.7b	4.0	2.8ab	0.63

Net yield (kg) of harvested fruit, Orchard 1[x]

cultivar	2009	2010[z]	2011	Cumulative 09-11
Ginger Gold	2.8b	2.2a	6.1a	11.1b
Honeycrisp	5.0a	0.9b	7.3a	13.4a
Liberty	4.0a	0.6b	3.4b	7.9c
Macoun	2.0bc	0.9b	3.7b	6.6cd
Zestar!	1.4c	1.2b	3.0b	5.6d

Net yield (kg) of harvested fruit, Orchard 2[x]

cultivar	2009	2010[z]	2011	Cumulative 09-11
Ginger Gold	18.1a	16.3a	35.0a	70.1a
Honeycrisp	13.9b	8.2bc	24.2abc	45.0b
Liberty	18.9a	10.6b	13.1c	44.2b
Macoun	3.2d	3.5c	17.2bc	25.4c
Zestar!	9.3c	14.1ab	27.4ab	52.7b

Mean individual weight of harvested fruit (g), Orchard 1[x]

cultivar	2009	2010	2011
Ginger Gold	179.6b	178.9a	120.5bc
Honeycrisp	154.0c	155.4bc	131.7b
Liberty	103.4d	143.8c	109.0c
Macoun	164.3bc	143.9c	120.6bc
Zestar!	201.2a	167.3ab	173.8a

Mean individual weight of harvested fruit (g), Orchard 2[x]

cultivar	2009	2010	2011
Ginger Gold	221.8	216.3a	181.3ab
Honeycrisp	260.1	217.1a	210.5a
Liberty	182.6	173.2b	148.5b
Macoun	177.9	178.6ab	152.1b
Zestar!	210.4	178.3ab	164.9b

[x]Different letters within columns indicate significant differences at $P \leq 0.05$ (Tukey's test)
[y]Trees were assigned a 'health rating' where 0= dead, 1= poor health, 2= healthy but less than full vigor, and 3= healthy and fully vigorous
[z]Crop yield in 2010 was depressed due to frosty events which occurred during and after bloom