Pomology Research at the Vineland Research Station

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Program Overview

The primary objectives of the pomology program are to investigate factors that determine yield and fruit quality of tree fruit crops, as well as environmental issues surrounding tree fruit production. Experiments include investigating the use of new, dwarfing peach and cherry rootstocks, irrigation scheduling, plant bio-regulators, and new methods to thin peaches, We are also interested in understanding the physiological basis for rain-Induced cracking of sweet

Project Objectives

1. Science-based performance of various rootstock/scion combinations under different orchard, environment and management systems.
2. Orchard management practices to improve production efficiency, profitability, and fruit quality
3. Use and physiology of plant bioregulators to regulate cropping, improve production efficiency and fruit quality
4. Mineral nutrition and soil management effects on fruit quality and tree growth
5. Beneficial use of organic and inorganic amendments for reducing soil-borne disease and herbicides and improving fruit quality and plant health
6. Fruit tree water relations, crop response to micro irrigation, and water conservation measures

Synchronizing Nitrogen Fertilization with Plant Demand in High Density Apple and Peach Orchards to Mitigate Nitrogen Losses through Leaching

Rationale and Background

In 2004, the Ontario government was implementing nutrient management legislation to regulate the use of synthetic and organic fertilizers by farmers. This legislation would require all livestock, field crop, and horticultural operations to implement plans to deal with fertilizer inputs and waste disposal on the warm. Significant changes to OMAF recommendations were conceivable if the basis for determining fertilizer application rates were determined on the amount of nutrients removed by a crop in a single year. The horticultural industry, in particular perennial tree fruits, is unique in comparison with annual crops, since a significant portion of nutrients are stored in the tree roots and structural wood. The objectives of the project were to:

- Establish optimum N fertilization rates for high density apple and peach orchards in Ontario.
- quantify rates of N leaching (concentration and amount) in a typical Ontario orchard in relation to N fertilization practices and time of year
- determine the annual amount of stored N in various components of apple and peach trees (used to establish sound Nutrient Management Practices)
- estimate the seasonal quantity of water percolation through a typical orchard soil profile into tile drains

Plant Material:

Peach: ‘Harrow Beauty', ‘Harson’ and ‘Harrow Diamond’ on ‘Bailey’ rootstock planted in 2004
Apple: ’Royal Gala’, ‘Ambrosia’ and ‘Honeycrisp’ on ‘M.9’ rootstock planted in 2004

Spacing: 2.5 m x 5.0 m (8.2' x 16.4'; 800 trees/ha; 324 trees/acre).

Experimental Design: Randomized complete block with 7 treatments and 4 replications

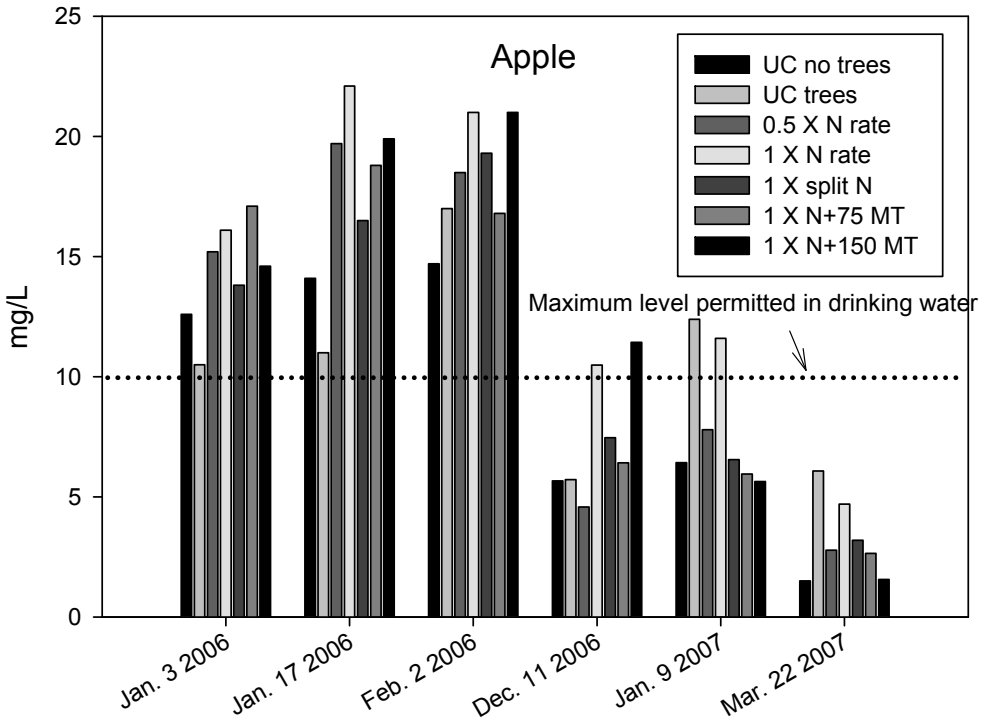
Treatments (apples and peaches):

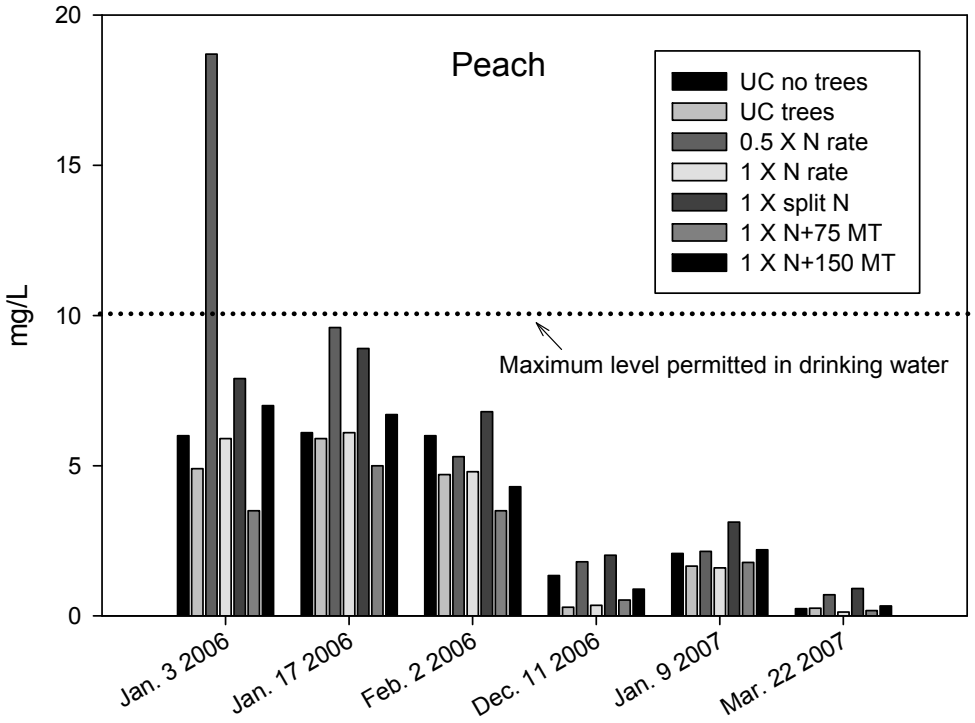
1. 0 kg N (Untreated) , no trees
2. 0 Untreated, trees
3. 0.5 X Nitrogen
4. 1.0X N Fertilizer †
5. 1.0X N Fertilizer – Split (30% pre-bloom, 40% mid June, 30% mid-late August)
6. 1.0X N Fertilizer + 75 MT Paper Mill Biosolids
7. 1.0X N Fertilizer +150 MT Paper Mill Biosolids

† In 2005, 40 g N/tree (84 lbs Ammonium Nitrate/acre; 29 lbs N/acre) was applied
† In 2006, 120 g N/tree (250 lbs Ammonium Nitrate/acre; 84 lbs N/acre) was applied

Results

1. Ground water effluent flow from drainage tiles occurs almost exclusively during the winter, during periods following snowfall and when air temperatures exceed 0 ^{o}C.
2. Approximately 70-80% of precipitation that has fallen as rainfall has been accounted for in the tile drainage effluent leaving the orchard.
3. Soil nitrate levels have been extremely variable and levels appear to be unrelated to nitrogen fertilizer rates applied in the orchard.
4. Nitrate levels are significantly lower in effluent discharge from the peach orchard in comparison with the apple orchard.
5. Tree growth and yield of both peaches and apples has been exceptional in this experiment.


Apple
UC no trees
UC trees
0.5 X N rate
1 X N rate
1 X split N
1 X N+75 MT
1 X N+150 MT
Maximum level permitted in drinking water
mg/L
25
20
15
10
5
0
Jan. 3 2006
Jan. 17 2006
Feb. 2 2006
Dec. 11 2006
Jan. 9 2007
Mar. 22 2007


Peach
UC no trees
UC trees
0.5 X N rate
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1 X split N
1 X N+75 MT
1 X N+150 MT
Maximum level permitted in drinking water
mg/L
20
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0
Jan. 3 2006
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Jan. 9 2007
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Table 1. Effect of various nitrogen fertilizer and paper mill biosolid treatment on Yield and Tree Growth of 'Royal Gala'/M.9 and 'Harrow Beauty'/Bailey trees.

	Yield (kg/tree)	Fruit number/ tree	Tree volume (m^3)	Trunk cross-sectional area (cm^2)	Mean fruit weight (kg)	Yield efficiency (kg/TCSA)	Crop denisty (fruit #/TCSA)
Apple (cv. Royal Gala)							
Untreated, no trees	.	.	.	.	.		
Untreated, trees	1.6	8.6	0.94	8.4	0.19	0.25	1.34
0.5X N Fertilizer	2.2	10.3	1.09	7.7	0.26	0.27	1.28
1.0X N Fertilizer	1.6	7.9	1.04	11.2	0.20	0.22	1.12
1.0X N Fertilizer - Split	2.1	10.6	1.05	7.2	0.20	0.30	1.54
1.0X N Fertilizer + 75 MT PMB	1.3	7.1	1.08	8.2	0.18	0.15	0.87
1.0X N Fertilizer +150 MT PME	1.7	9.0	1.07	7.6	0.19	0.22	1.13
Significance[z]	*	ns	ns	ns	ns	**	*
LSD (p=0.05)	1.5518	3.0226	0.1366	5.0444	0.0686	0.071	0.39
P value	0.03	0.24	0.39	0.65	0.18	0.0037	0.0328
Peach (cv. Harrow Beauty)							
Untreated, no trees	.	.	.	.	.	.	.
Untreated, trees	2.8	14.8	2.81	23.6	0.21	0.12	0.62
0.5X N Fertilizer	3.5	19.8	3.55	22.8	0.25	0.16	0.86
1.5X N Fertilizer	3.9	23.5	2.77	25.5	0.19	0.17	1.05
1.0X N Fertilizer - Split	2.7	14.5	5.98	22.5	0.28	0.13	0.66
1.0X N Fertilizer + 75 MT PMB	1.4	7.0	3.08	26.6	0.22	0.05	0.25
1.0X N Fertilizer + 150 MT PM	2.9	20.2	2.99	23.3	0.21	0.12	0.90
Significance[z]	*	ns	ns	ns	ns	ns	ns
LSD (p=0.05)	1.1010	8.9366	3.7175	2.2600	0.1612	0.0585	0.4366
P value	0.02	0.06	0.44	0.41	0.84	0.04	0.09

[z] ns, *, **, ***Nonsignificant or significant at $p \leq 0.05$, 0.01, or 0.001, respectively.

[y] Means followed by the same letter are not significantly different at $p \leq 0.05$.