# Rootstock and Interstem Effects on Pome Fruit Trees

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## Introduction

Although apple is the principal tree fruit grown in Kentucky, the hot and humid summers and heavy clay soils make apple production more difficult for Kentucky growers than for growers in other apple-producing regions with more favorable conditions. The hot and humid summers are also a factor in high disease and insect pressure on Kentucky orchards.

In spite of these challenges, productive orchards are high-value enterprises, suitable for rolling hills and upland soil. Furthermore, orchards in these sites have less soil erosion potential. Still, Kentucky imports more apples than it produces.

Identification of improved rootstocks and cultivars is fundamental for advancing the Kentucky apple industry. For this reason, Kentucky cooperates with 39 other states and three Canadian provinces in the Cooperative Regional NC-140 Project titled, "Rootstocks and Interstem Effects on Pome Fruit."

The NC-140 trials are critical to Kentucky growers, allowing them to gain access to and test new rootstocks from around the world. The detailed and objective evaluations allow growers to select the most appropriate rootstocks for Kentucky, when they become commercially available.

The 1994 and 1999 apple rootstock trials were designed to compare the adaptability of the slender-spindle and the French vertical-axe systems in orchards on our soils. In addition, the semi-dwarf rootstocks in the 1999 apple rootstock trial will evaluate the rootstocks' abilities to support trees without a trellis. The 2002 apple rootstock trial will provide information on performance differences among rootstock clones. The 2003 apple rootstock trial will evaluate the adaptability of some new rootstocks to Kentucky climates and soils. The physiology trial will primarily evaluate the relationship between different environment sites and crop load and fruit size. A secondary objective is to evaluate the influence of rootstock on those relationships.

The NC-140 orchard trials are used as demonstration plots for visiting fruit growers, Extension personnel, and research scientists. The data collected from these trials will help establish base-line production and economic records for the various orchard system/rootstock combinations that can be used later by Kentucky fruit growers.

## Materials and Methods

Scions of known cultivars on various rootstocks were produced by nurseries and distributed to cooperators for each planting. The University of Kentucky has four NC-140 rootstock plantings at the UK Research and Education Center at Princeton (UKREC):

I. The 1994 apple rootstock trial consists of 'Red Gala' on six rootstocks and 10 replications per rootstock. Trees are spaced 13 ft. apart within rows 18 ft. apart. Trickle irrigation was installed, and a trellis system was constructed in 1995.

II. The 1999 dwarf and semi-dwarf apple rootstock trial consists of two groups:
   i) 11 dwarfing rootstocks with six replications per rootstock. Trees are planted on a 10 ft. by 16 ft. spacing.
   ii) 6 semi-dwarfing rootstocks with six replications per rootstock. Trees are planted on a 13 ft. by 20 ft. spacing.

III. The 2002 apple rootstock trial consists of 'Buckeye Gala' on nine rootstocks with seven replications per rootstock. Trees are spaced 8 ft. apart within rows 15 ft. apart.

IV. The 2003 apple rootstock and 2003 apple physiology trials consist of two groups:
   i) 11 rootstocks with four replications with two of each rootstock per replication. Trees are planted on an 8 ft. by 15 ft. spacing.
   ii) five rootstocks with six replications per rootstock. Trees are planted on an 8 ft. by 15 ft. spacing.

All trials are laid out as a randomized block design, except for the 2003 apple rootstock/physiology trial, which is laid out in a completely randomized design. Orchard floor management consisted of a 6.5-ft. herbicide strip with mowed sod alleyways.

Trees were fertilized and sprayed with pesticides according to local recommendations (1, 2). Trunk circumference and number of root suckers were measured for all of the rootstock trials. Yield was measured for the 1994 and 1999 apple rootstock trials, and maturity indices were measured for the 1994 trial only.

## Results and Discussion

The winter of 2002 was mild, followed by a wet spring and normal rainfall from June through August. Summer temperatures were generally about normal. Rainfall was moderate to above normal throughout the remainder of the growing season.

### *I. 1994 Apple Semi-Dwarf Rootstock Trial*

This is the first orchard trained to the French vertical-axe system at this station. It includes a number of new rootstocks, along with others that have performed well in previous trials here.

Survival of trees on M.26 EMLA rootstock (10% survival) differed significantly from trees on the other three rootstocks (90% survival), namely CG.30, B.9, and V.2. Cumulative yield, 2003 yield, trunk cross-sectional area, flesh firmness, and number of root suckers varied significantly among rootstocks (Table 1). No significant differences were observed for fruit size or percent soluble solids (data not shown). Trees on CG.30 and V.2 rootstocks have been the most productive in this trial. On the other hand, trees on B.9 rootstocks have been the least productive.

**Table 1.** Results of the year 2002 for the NC-140 1994 apple semi-dwarf rootstock trial, UKREC, Princeton, Kentucky.

| Rootstock* | Cumulative Yield (lb/tree) | 2003 Yield (lb/ tree) | Fruit Size (oz/fruit) | Flesh Firmness (lb) | Trunk Cross-Sectional Area (in$^2$) | Tree Height (in.) | Tree Width (in.) | Number of Root Suckers |
|---|---|---|---|---|---|---|---|---|
| CG.30 | 995 | 268 | 6.2 | 15.4 | 13.2 | 152 | 137 | 4 |
| V.2 | 795 | 190 | 6.5 | 16.9 | 13.8 | 136 | 144 | 2 |
| M.26 EMLA | 568 | 116 | 5.6 | 18.3 | 8.0 | 82 | 80 | 0 |
| B.9 | 356 | 65 | 5.6 | 17.5 | 4.5 | 84 | 99 | 1 |
| Mean | 696 | 172 | 6.1 | 16.7 | 10.4 | 122 | 125 | 3 |
| LSD (5%) | 257 | 79 | 1.2 | 2.5 | 5.5 | 27 | 43 | 4 |

* Arranged in descending order by cumulative yield.

## *II. 1999 Dwarf and Semi-Dwarf Apple Rootstock Trial*

This trial consists of two groups of apple rootstocks, a dwarfing group with 11 rootstocks, and a semi-dwarfing one with six rootstocks. Eight of the dwarfing and three of the semi-dwarfing rootstocks had not been tested previously at UK Research and Education Center. At planting time, we received 90 trees of a possible 102 for this trial because 12 trees were not available for our site (one each of G.16N, CG.4814, and CG.5202, two CG.4013, three CG.3041, and four CG.30N). Furthermore, three trees never leafed out after planting (one G.16T, one G.16N, and one CG.3041).

For both groups significant differences were observed for cumulative yield and tree height (Table 2). The number of root suckers, trunk cross-sectional area, and tree width varied significantly among the dwarf rootstocks. Yield in 2003 varied significantly only among the semi-dwarf group. Average fruit weight did not vary significantly by rootstock for either the dwarf or semi-dwarf group.

## *III. 2002 Apple Rootstock Trial*

This trial compares nine rootstocks consisting of three clones of M.9, two clones each of B.9 and M.26, and one clone each of Supporter 4 and of P.14. Sixty-three trees of 'Buckeye Gala', nine different rootstocks and seven replications per rootstock, were planted in a randomized complete block design. The planting has seven rows with a pollenizer tree at the ends of each row. A trellis was constructed and trickle irrigation installed a month after planting. To date, all trees are alive and growing vigorously, except for one on M.9 Burg 756, which apparently succumbed to fire blight.

**Table 2.** Results of the year 2003 for the NC-140 1999 apple dwarf and semi-dwarf rootstock trial, UKREC, Princeton, Kentucky.

| Rootstock | Cumulative Yield (lb/tree) | 2003 Yield (lb/tree) | Fruit Size (oz/fruit) | Trunk Cross-Sectional Area (in.$^2$) | Number of Root Suckers | Tree Height (in.) | Tree Width (in.) |
|---|---|---|---|---|---|---|---|
| **Dwarfing*** | | | | | | | |
| CG.4013 | 166 | 79 | 5.7 | 8.3 | 19.3 | 112 | 140 |
| CG.3041 | 152 | 116 | 6.9 | 4.5 | 3.0 | 107 | 126 |
| G.16N | 151 | 89 | 5.8 | 5.6 | 2.0 | 102 | 132 |
| G.16T | 142 | 64 | 6.7 | 5.9 | 2.2 | 110 | 131 |
| Supporter 3 | 138 | 90 | 5.2 | 3.4 | 1.0 | 100 | 113 |
| Supporter 1 | 124 | 79 | 5.2 | 3.5 | 2.5 | 98 | 114 |
| Supporter 2 | 112 | 60 | 5.5 | 4.4 | 0.0 | 101 | 122 |
| CG.5202 | 98 | 25 | 3.1 | 5.8 | 5.3 | 124 | 139 |
| CG.5179 | 83 | 38 | 4.9 | 4.6 | 3.4 | 121 | 128 |
| M.9 NAKBT 337 | 69 | 7 | 3.2 | 5.5 | 1.5 | 114 | 124 |
| M.26 EMLA | 66 | 16 | 5.0 | 4.6 | 0.5 | 118 | 119 |
| Mean | 117 | 59 | 5.2 | 5.0 | 3.3 | 109 | 125 |
| LSD (5%) | 66 | NS | NS | 1.3 | 11.1 | 12 | 17 |
| **Semi-Dwarfing*** | | | | | | | |
| CG.30N | 171 | 109 | 7.8 | 7.0 | 3.5 | 108 | 140 |
| CG.7707 | 107 | 89 | 7.7 | 7.5 | 2.3 | 111 | 137 |
| M.7 EMLA | 100 | 75 | 6.6 | 6.4 | 22.2 | 112 | 101 |
| CG.4814 | 90 | 32 | 4.9 | 6.3 | 10.3 | 114 | 129 |
| M.26 EMLA | 80 | 49 | 6.6 | 4.8 | 0.2 | 96 | 118 |
| Supporter 4 | 77 | 52 | 6.2 | 2.7 | 10.0 | 80 | 128 |
| Mean | 100 | 66 | 6.6 | 6.0 | 9.2 | 106 | 122 |
| LSD (5%) | 50 | 45 | NS | NS | NS | 21 | NS |

* Within groups, arranged in descending order by cumulative yield.

Significant differences were observed for both fall trunk cross-sectional area and number of flower clusters, but no difference was observed in number of root suckers (Table 3).

**Table 3.** Results of the year 2003 for the 2002 NC-140 apple rootstock trial, UKREC, Princeton, Kentucky.

| Rootstock[1] | Fall Trunk Cross-Sectional Area (in.$^2$) | Number of Flower Clusters | Number of Suckers |
|---|---|---|---|
| P.14 | 1.92 | 27 | 0.0 |
| M.26 NAKB | 1.89 | 99 | 0.1 |
| M.26 EMLA | 1.88 | 87 | 0.3 |
| Supporter 4 | 1.54 | 42 | 0.9 |
| M.9 T337 | 1.39 | 58 | 0.4 |
| M.9 Nic29 | 1.37 | 59 | 1.6 |
| M.9 Burg 756 | 1.32 | 43 | 0.2 |
| B.9 Treco | 1.23 | 61 | 0.0 |
| B.9 Europe | 0.96 | 70 | 0.9 |
| Mean | 1.50 | 61 | 0.5 |
| LSD (5%) | 0.29 | 36 | NS |

[1] The numbers within the columns are arranged in descending order of trunk cross-sectional area.

**Table 4.** Results of the year 2003 for the 2003 NC-140 apple rootstock trial, UKREC, Princeton, Kentucky.

| Rootstock[1] | Spring Trunk Cross-Sectional Area (in.$^2$) | Fall Trunk Cross-Sectional Area (in.$^2$) | Growth[2] (in.$^2$) |
|---|---|---|---|
| PiAu56-83 | 0.39 | 0.69 | 0.30 |
| PiAu51-4 | 0.43 | 0.64 | 0.22 |
| J-TE-H | 0.34 | 0.54 | 0.20 |
| Bud.62-3 | 0.29 | 0.50 | 0.21 |
| CG.5935 | 0.30 | 0.46 | 0.16 |
| CG.3041 | 0.32 | 0.46 | 0.14 |
| M.9Pajam | 0.31 | 0.44 | 0.13 |
| M.9T337 | 0.31 | 0.43 | 0.12 |
| M.26 | 0.18 | 0.30 | 0.12 |
| G.16 | 0.18 | 0.29 | 0.11 |
| B.9 | 0.14 | 0.19 | 0.06 |
| Mean | 0.29 | 0.45 | 0.16 |
| LSD (5%) | 0.05 | 0.08 | 0.06 |

[1] Arranged in descending order by fall of trunk cross-sectional area.
[2] Difference in trunk cross-sectional area from spring to fall, 2003.

### *IV. 2003 Apple Rootstock and Physiology Trials*

Fall trunk cross-sectional area varied significantly for both the 2003 rootstock and the 2003 physiology trials (Tables 4 and 5, respectively). Spring trunk cross-sectional area and growth varied significantly among rootstocks only in the rootstock trial. Trees on PiAu56-83 grew the most and are the biggest trees in the rootstock trial. Root sucker growth was not observed in either planting.

**Table 5.** Results of the year 2003 for the 2003 NC-140 apple physiology trial, UKREC, Princeton, Kentucky.

| Rootstock[1] | Spring Trunk Cross-Sectional Area (in.$^2$) | Fall Trunk Cross-Sectional Area (in.$^2$) | Growth[2] (in.$^2$) |
|---|---|---|---|
| G.16 | 0.25 | 0.36 | 0.12 |
| M.9 T337 | 0.20 | 0.29 | 0.09 |
| M.26 | 0.20 | 0.29 | 0.09 |
| Mean | 0.21 | 0.31 | 0.10 |
| LSD (5%) | 0.04 | 0.06 | 0.03 |

[1] Arranged in descending order by fall of trunk cross-sectional area.
[2] Difference in trunk cross-sectional area from spring to fall, 2003.

## Literature Cited


1. Brown, G.R., R.T. Jones, J.G. Strang, L.A. Lester, J.R. Hartman, D.E. Hershman, R.T. Bessin. 1998 Commercial Tree Fruit Spray Guide. University of Kentucky College of Agriculture Cooperative Extension Service, Publication ID-98.
2. Midwest Tree Fruit Handbook. University of Kentucky College of Agriculture Cooperative Extension Service, Publication ID-93.


# Late Season Weed Control in Apple and Peach

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## Introduction

In the continuing efforts to serve the Kentucky State Horticultural Society, two weed control experiments were conducted in 2003 to test labeled and experimental herbicides in apple and peach orchards. The experimental herbicide (Chateau 51WDG) is not yet labeled on apple and peach. The purpose of testing this herbicide is to collect data to support its registration, if it proves to be effective.

The experiments were conducted at the University of Kentucky Research and Education Center (UKREC) in Princeton, Kentucky. The purpose of these experiments was to test the effectiveness of preemergence herbicides in apple and peach orchards and observe how their performance was enhanced with the addition of a new, non-labeled, preemergence herbicide.

## Materials and Methods

The experimental design used for both experiments was a randomized complete block design with three replications.

### *Apple*

The variety in this experiment was Golden Delicious on M.9 rootstock, planted in 1997. Trees were spaced 8 ft. within rows 16 ft. apart. At the time of herbicide application, trees were of mature age, in good overall condition, and had been bearing for three to four years. Each replication consisted of three trees for a total of 24 ft. of row per treatment. Herbicide treatments were applied using a four 8002-nozzle boom backpack sprayer set at 30 psi and 20 GPA with a 5.3 ft. spray swath width. Sprays were applied on both sides of the trees for a total width of about 10 ft. per treatment. Whenever possible, sprays were meant to completely cover the plots, and no effort was made to avoid spraying tree trunks. Sprays were applied on May 16, 2003. By this date, spring weeds had already germinated. Therefore, the orchard was mowed the day prior to herbicide application to remove as many weeds as possible. In addition, Roundup WeatherMax (1 lb ai/A) was tank-mixed with all treatments to further control existing weeds. The untreated control consisted of a one-time application of Roundup WeatherMax.

### *Peach*

The variety in this experiment was Redhaven on a number of rootstocks planted in 1994. Trees were spaced 16 ft. within rows 18 ft. apart. At the time of herbicide application, trees were of mature age, in good overall condition, and had been bearing for at least five to six years. Each replication consisted of two trees for a total of 32 ft. of row per treatment. Herbicide treatments were applied as above. Sprays were applied on both sides of the trees for a total width of about 10 ft. per treatment. Whenever possible, sprays were meant to completely cover the plots, and no effort was made to avoid spraying the tree trunks. Sprays were applied on May 21, 2003. As with the apple experiment, mowing and tank-mixing Roundup WeatherMax with all treatments was necessary to control existing weeds. The untreated control treatment consisted of a one-time application of Roundup WeatherMax.

The same herbicide treatments were used for both the apple and peach experiments. The only difference is the higher rate of Sinbar in treatment 3 in peach than in apple (1 lb ai/A in peach and 0.75 lb ai/A in apple).

Valent currently labels the experimental herbicide, Chateau 51 WDG, for the preemergence and postemergence control of certain weeds in peanut and soybean. It has shown significant weed control and a long period of activity, which is why it was included in this experiment.

For both experiments, weed control effectiveness was determined by a visual injury rating using a scale of 1 to 10, with 1 representing no injury or similar to the control plot and 10 representing complete kill or no weeds present.

**Table 1.** Weed control ratings 32 days after treatments in Golden Delicious apple orchard.

| Treatment[1] | | Rate (lb ai/A) | Weed Control Rating 32 Days after Treatment | | |
|---|---|---|---|---|---|
| | | | WHCL[2] | MATE | LACG |
| 1 | Control | | 6 | 6 | 5 |
| 2 | Sinbar | 1 | 9 | 9 | 10 |
| | Karmex | 2 | | | |
| 3 | Sinbar | 0.75 | 9 | 7 | 8 |
| | Devrinol | 2 | | | |
| 4 | Chateau | 0.38 | 9 | 9 | 9 |
| | Princep | 2 | | | |
| 5 | Chateau | 0.38 | 8 | 10 | 9 |
| | Devrinol | 2 | | | |
| 6 | Chateau | 0.38 | 8 | 10 | 10 |
| | Surflan | 2 | | | |
| 7 | Chateau | 0.38 | 8 | 7 | 10 |
| | Solicam | 2 | | | |
| 8 | Chateau | 0.75 | 10 | 10 | 10 |
| | Princep | 2 | | | |
| 9 | Chateau | 0.75 | 8 | 8 | 9 |
| | Devrinol | 2 | | | |
| 10 | Chateau | 0.75 | 9 | 9 | 9 |
| | Surflan | 2 | | | |
| 11 | Chateau | 0.75 | 9 | 10 | 9 |
| | Solicam | 2 | | | |
| 12 | Gramoxone Extra[3] | 2 | 5 | 7 | 4 |
| | LSD | | 1.7 | 4.0 | 3.0 |
| | Standard Deviation | | 1.0 | 2.4 | 1.8 |
| | CV | | 12.1 | 28.1 | 20.9 |

[1] Roundup WeatherMax 1 lb ai/A was included with all treatments to control existing weeds.
[2] WHCL = white clover; MATE = mares tail; LACG = large crabgrass.
[3] Gramoxone Extra was applied twice, once at preemergent stage and 30 days later to control late emerging weeds.

## Results and Discussion

### *Apple*

Table 1 shows the weed control ratings, at 32 days after treatment, of three weeds found in the Golden Delicious apple block. No honeyvine milkweed or ivy leaf morning glory vines were present in this experiment, even in untreated plots. Table 1 shows that all herbicide treatments that included a preemergence herbicide had better weed control than those plots treated with the non-selective contact herbicide Gramoxone Extra plus Roundup Ultra.

All plots treated with both low and high rates of Chateau had no weeds re-germinating. On the other hand, plots of treatments 2 or 3 showed a flush of newly germinated seedlings, similar to those of the control plots. The majority of the weeds germinating were chickweed, pigweed, and large crabgrass. No significant differences were observed in the performance of Chateau when applied at low (0.38 lb ai/A) or high (0.75 lb ai/A) rates.

### *Peach*

Weed control results in peach mirrored those observed in apple. Weed regrowth was not observed in any plots treated with either low or high rates of Chateau. In general, weed control at

26 days after treatment was generally better for most weeds in treatments that included Chateau. Dandelion control was about 30 to 40% better when treated with a Chateau and Devrinol mix compared to a Sinbar and Devrinol mix. This difference in effectiveness was less evident for other weeds rated in this experiment.

Honeyvine milkweed vines were present in this peach block. There were not enough vines in the control plots to allow for data collection. Instead, plots were rated for the presence (or lack) of this weed. All plots treated with Chateau had no re-germinating honeyvine milkweed vines. The only exception is one replication of treatment 5, which included Chateau (low rate) and Devrinol, where some re-germination was observed.

On 13 July 2003 a commercial apple IPM meeting was held at UKREC in Princeton. Attendees had a chance to visit the orchard and compare the results of the apple and peach weed control experiments. At this date, 73 days after treatments, few weeds were observed in the plots treated with Chateau in the spray mix. Next in long-term residual control were the plots treated with the Sinbar and Karmex mix (treatment 2). Plots treated with Sinbar and Devrinol had the highest number of newly germinated weeds.

## Acknowledgments

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**Table 2.** Weed control ratings taken 26 days after treatments in Redhaven peach orchard.

| Treatment[1] | | Rate (lb ai/A) | Weed Control Rating 26 Days after Treatment | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | DAND[2] | COCO | WHCL | HONE | LACG | NLPL |
| 1 | Control | | 1 | 5 | 6 | 10 | 1 | 7 |
| 2 | Sinbar | 1 | 6 | 10 | 10 | 10 | 10 | 10 |
| | Karmex | 2 | | | | | | |
| 3 | Sinbar | 1 | 5 | 10 | 9 | 10 | 10 | 10 |
| | Devrinol | 2 | | | | | | |
| 4 | Chateau | 0.38 | 8 | 9 | 8 | 9 | 10 | 10 |
| | Princep | 2 | | | | | | |
| 5 | Chateau | 0.38 | 9 | 10 | 7 | 7 | 10 | 10 |
| | Devrinol | 2 | | | | | | |
| 6 | Chateau | 0.38 | 8 | 10 | 8 | 8 | 9 | 10 |
| | Surflan | 2 | | | | | | |
| 7 | Chateau | 0.38 | 8 | 10 | 8 | 10 | 10 | 10 |
| | Solicam | 2 | | | | | | |
| 8 | Chateau | 0.75 | 9 | 10 | 8 | 10 | 10 | 10 |
| | Princep | 2 | | | | | | |
| 9 | Chateau | 0.75 | 9 | 9 | 8 | 10 | 10 | 10 |
| | Devrinol | 2 | | | | | | |
| 10 | Chateau | 0.75 | 9 | 10 | 9 | 10 | 10 | 10 |
| | Surflan | 2 | | | | | | |
| 11 | Chateau | 0.75 | 8 | 7 | 9 | 10 | 10 | 10 |
| | Solicam | 2 | | | | | | |
| 12 | Gramoxone Extra[3] | 2 | 1 | 10 | 6 | 7 | 2 | 8 |
| | LSD | | 2.9 | 2.6 | 1.8 | 3.1 | 1.4 | 2.1 |
| | Standard Deviation | | 1.7 | 1.5 | 1.1 | 1.9 | 0.8 | 1.2 |
| | CV | | 24.9 | 16.8 | 13.3 | 20.0 | 9.6 | 13.0 |

[1] Roundup WeatherMax 1lb ai/A was included with all treatments to control existing weeds.
[2] DAND = dandelion; COCO = common cocklebur; WHCL = white clover; HONE = horse nettle; LACG = large crabgrass; NLPL = narrowleaf plantain.
[3] Gramoxone Extra was applied twice, once at preemergent stage and 30 days later to control late emerging weeds.