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Fifth Year Performance of Honeycrisp Grafted on 31 Dwarfing Rootstocks of the NC-140 2010 Regional Apple Rootstock Trial

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Abstract
Dwarfing rootstocks have the potential to increase profitability of tree-fruit growers by providing smaller trees suitable for highdensity plantings. Although the initial installation cost can be 10 to 30 times greater than lower-density plantings, the long-range returns can far exceed the traditional plantings. However, to be viable as a commercial rootstock, dwarfing rootstocks must be adapted to a range of agro-climatic conditions, moderately disease resistant, high yielding, and produce quality fruit.

Keywords
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Introduction

Dwarfing rootstocks have the potential to increase profitability of tree-fruit growers by providing smaller trees suitable for high-density plantings. Although the initial installation cost can be 10 to 30 times greater than lower-density plantings, the long-range returns can far exceed the traditional plantings. However, to be viable as a commercial rootstock, dwarfing rootstocks must be adapted to a range of agro-climatic conditions, moderately disease resistant, high yielding, and produce quality fruit.

To evaluate the adaptability and performance of new and promising apple rootstocks in the dwarfing size-control category, an NC-140 regional rootstock trial was established in 2010 at 11 sites in the United States (CO, IA, IL, MA, MI, MN, NJ, NY, OH, UT, WI), two sites in Canada (BC, NS), and one site in Mexico (CH) with Honeycrisp apples serving as the test cultivar. Iowa's project is located at the ISU Horticulture Research Station, Ames, Iowa, where 31 dwarfing rootstocks are currently being evaluated: new selections from the Cornell-Geneva breeding program (G., CG.), Russia (B.), and Germany (PiAu, Supp.), with M.26 EMLA, M.9 Pajam2, and M.9 T337 serving as industry standards. Tissue cultured propagated (TC) rootstocks of G.41, G.202, and G.935 were included for comparison with normal (N) stool bed propagated rootstocks. This report summarizes the performance of the Iowa planting during the 2014 growing season.

Materials and Methods

The trees were planted at a 4 × 14 ft spacing with 1 to 3 trees/plot in a randomized block design replicated four times. Gala/B. 9 trees were planted between each block and at the ends of the rows as pollinators, and Auvil Early Fuji/Bud 9 trees were inserted as replacements for trees broken off by wind in 2010. Trees were trained to the tall spindle system using a 3/4-in. metal conduit for support. Supplemental water was provided through trickle irrigation.

Results and Discussion

Iowa had record low temperatures across the state during the 2013-2014 winter. At the ISU Horticulture Research Station, soil temperature dropped below 10.4°F on several occasions. Air temperature ranged from -10°F to -20°F throughout the winter season. As a result, several trees exhibited moderate to severe decline, most likely due to cold temperatures. PiAu 9-90 had the highest injury rating; whereas, Honeycrisp apples grafted on all B rootstocks had the least injury, with the exception of Honeycrisp apples grafted on B.9 and B.71-7-2.

At the end of the 2014 growing season, B.67-5-32, B.70-20-20, B.70-6-8, B.7-20-21, B.7-3-150, CG.4814, G.202N, and PiAu51-11 were the largest trees, and the smallest trees were B.71-7-22 and B.9. Honeycrisp apples grafted on B.71-7-2 and CG.4004 had high yield efficiency (> 1.0) the previous year and high blossom densities in 2014 (current season). Conversely, trees on B.70-20-20 had a very low crop load in 2013 and a very low blossom density in 2014. CG.4214 rootstocks had the greatest yield efficiency compared with B.70-6-8 G.935N, B.70-20-20, G.935TC, and PiAu9-90. Subsequently, PiAu9-90 had the highest zonal chlorosis rating and the lowest yield efficiency. Similar to injury rating, Honeycrisp apple grafted on all B rootstocks had the least zonal chlorosis with the exception of B.9 and B.7-20-2.

Acknowledgements

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Table 1. Performance of Honeycrisp apple trees grafted on 31 rootstocks at the ISU Horticulture Research Station.

Rootstock	Trees (no.)	2013 Yield efficiency (lb·in.$^{-2}$)	Blossom clusters (no.)	Tree vigor rating[z]	Suckers per tree (no.)	Trunk CSA (in.^{2})[y]	2014 Yield efficiency (lb·in.$^{-2}$)	Avg. fruit weight (lb)	Cumulative efficiency (lb)[x]	Zonal chlorosis (%)
B.10	9	2.32	81.4	1.3	0.0	1.4	10.0	0.4	3.40	11.1
B.64-194	7	1.30	104.6	1.3	0.1	2.7	5.8	0.5	2.02	22.9
B.67-5-32	10	1.42	69.6	1.2	0.1	3.2	4.6	0.4	1.71	24.5
B.70-20-20	12	0.32	34.2	1.0	1.1	3.4	1.8	0.5	0.55	21.7
B.70-6-8	11	1.98	33.8	1.0	0.1	3.1	2.9	0.4	1.75	19.2
B.71-7-22	4	3.07	30.3	2.8	0.5	0.5	10.3	0.4	4.02	26.3
B.7-20-21	12	1.86	36.8	1.4	0.1	2.9	3.4	0.4	1.89	39.2
B.7-3-150	10	1.90	38.2	1.0	0.3	3.2	3.4	0.5	3.24	15.0
B.9	8	3.79	7.8	2.2	1.2	0.9	3.2	0.4	3.54	64.6
CG.2034	4	3.30	18.8	2.6	0.4	1.2	4.3	0.4	3.12	58.0
CG.3001	2	2.85	36.0	1.5	0.0	2.7	6.1	0.5	3.14	27.5
CG.4003	3	3.45	29.7	3.7	0.3	1.2	6.8	0.4	4.03	46.7
CG.4004	4	2.64	99.5	2.0	0.5	2.1	12.3	0.4	4.04	48.3
CG.4013	3	1.95	38.7	1.0	7.0	2.5	3.6	0.6	1.87	41.7
CG.4214	8	2.09	123.1	2.4	6.1	1.7	12.5	0.4	3.64	52.5
CG.4814	4	1.40	67.8	1.5	2.5	2.8	7.0	0.5	2.25	56.3
CG.5087	3	2.93	24.7	2.3	0.3	1.9	3.5	0.5	2.90	83.3
G.11	8	3.94	27.3	1.3	0.1	1.7	3.5	0.5	3.45	54.5
G.202N	3	1.24	145.3	1.3	1.3	3.0	6.8	0.3	1.87	43.3
G.202TC	4	3.50	48.8	2.3	1.8	1.7	6.8	0.4	3.73	17.5
G.41N	8	2.99	68.3	1.6	0.0	1.5	11.2	0.4	4.04	28.8
G.41TC	2	2.61	28.7	1.3	0.3	1.6	10.9	0.5	3.73	31.7
G.935N	9	3.24	9.8	2.5	5.0	1.7	2.6	0.4	3.03	70.5
G.935TC	3	3.72	4.3	3.0	4.3	1.2	1.6	0.4	3.02	55.0
M.26EMLA	4	3.10	28.0	1.5	0.5	2.0	4.9	0.4	3.02	30.0
M.9Pajam2	10	2.48	29.1	1.9	3.0	1.9	3.5	0.4	2.34	54.6
M.9T337	11	3.12	23.0	2.1	1.2	1.5	3.6	0.4	3.03	59.6
PiAu51-11	11	1.22	59.5	1.5	0.5	2.8	6.5	0.4	1.95	19.6
PiAu9-90	3	1.25	17.5	3.8	0.5	1.9	1.3	0.4	1.19	93.2
Supp.3	2	0.59	69.0	2.0	1.5	1.6	7.2	0.4	1.56	75.0
HSD	-	2.01	109.8	2.3	6.3	1.9	10.0	0.2	3.22	61.7
Auvil	28	-	53.2	2.4	1.1	1.4	8.0	0.3	-	0.0
GalaB.9	40	2.16	178.6	2.1	2.0	1.5	11.5	0.3	3.97	0.0

[z]Tree vigor rating on a 1 to 6 scale: 1 = healthy, 3 = moderate decline, 6 = dead.
[y]Trunk CSA: trunk cross-sectional area $\{[(\text{trunk circumference} \div \pi) \div 2]^2 \times \pi\}$.
[x]Cumulative efficiency: (2013 yield lb + 2014 yield lb)/CSA2014.