ANNUAL REPORT TO NC-140
2003 DWARF APPLE ROOTSTOCK TRIAL SUMMARY
FOR THE 2012 SEASON

November 2012
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The 2003 Dwarf Rootstock Trial was established in the spring of 2003 with 15 cooperators, and six cooperators have dropped out of the trial for various reasons. Nine or the original cooperators received trees on 18 rootstocks and four of these cooperators received an additional five rootstocks. Five cooperators received a partial set of 11 rootstocks. The scion cultivar is 'Gibson golden Delicious'. Each cooperator received eight trees per rootstock for most rootstocks, but most cooperators got only seven trees of five rootstocks and three cooperators go only six trees of one rootstock.

At each location the experimental design was a generalized randomized complete block design. There were two trees (referred as "tree 1" and "tree 2") of each rootstock randomized within each block. Trees were trained to the Vertical Axis system following Terence Robinson's "simplified pruning and training plan for the Vertical Axis system".

I have received data for the first nine years of the trial from the following cooperators: BC, CHIH, IA, KY, ME, NY, PA, UT and WI.

Collection and transmission of data for the 2012 growing season.

This season (2012) is the final year for the 2003 apple rootstock trial. We typically measure some extra variables in the fifth and tenth years of our uniform rootstock trials. Below is a description of the variables I would like reported for the 2012 season, along with an example of a spread sheet.

Before sending data next year, please look at the data set to confirm that it follows the format outlined below.

1. E-mail is the preferred method of receiving data sets. Use spread sheets that can be read in Windows 2010.

2. ***Avoid the newest versions of any spreadsheet***.

3. ***Please proof data sets before sending them to me***.
   - Make sure that you have the appropriate number of blocks for each rootstock and the appropriate number of rootstocks for each block.
   - Make sure the units are correct.
   - Make sure the values seem realistic.
   - Make sure the rootstock codes are correct and in the correct column.
   - If the data are sorted in a spreadsheet, make sure *all* columns are sorted correctly.

4. If values are calculated in spreadsheets, please send only the values and not the formulas.

5. Report "tree status" as 0 = dead, 1 = living, or 2 = missing. Missing trees are those that are dead or severely injured by mechanical injury, wildlife, or herbicides. If a 0 or a 2 is recorded for status, then all other columns for that tree should have dots.

6. Include "dots" or "periods" in all cells where data are missing, but enter a zero where zero is the appropriate value.

7. When a tree died in previous years, continue to report status for that tree. Do not eliminate the tree from the data set and enter dots for all response variables except "status".

8. Please put the entire data set on one sheet. Some cooperators put data for different blocks on different sheets within an Excel notebook. This increases the time to proof and consolidate the data set.

PLEASE, PLEASE, PLEASE – Do not simply copy spread sheets from last year until you have first looked it over to make sure the rootstock codes are correct and columns are in the correct order. A few cooperators submit the same incorrect codes each year.

An example of the spreadsheet for data collected in 2012 is provided below.

STATE _____. Data for the 2003 Dwarf Rootstock Planting for the 2012 season

Additional information about your planting: Select one response per question.

1. Was irrigation provided? (yes or no)
2. Replant history: Was this planting preceded by apple trees, fruit trees other than fruit trees, no fruit trees.
3. Site preparation. This site was not fumigated before this planting, this site was fumigated before planting

1 Year	2 site	3 Block	4 Tree	5 Rootstock code	6 Status	7 TCSA	8 Fruit wt. (g)	9 Yield (Kg/tree)	10 Tree Ht. cm)	11 Tree spread (cm)	12 suckers	13 Burrkots (%)
2011	MI	1	1	JM1	1	xx.x	xxx	xx.x	xxx	xxx	xx	xx
2011	MI	1	2	JM1	1	xx.x	xxx	xx.x	xx	xx	x	x
2011	MI	2	1	JTEG	1	xx.x	xxx	xx.x	xxx	xxx	xxx	xx
2011	MI	2	2	JTEG	0	.	.	.	.	.	.	.
2011	MI	2	1	B9	1	xx.x	xxx	xx.x	xxx	xxx	xx	xx
2011	MI	2	2	B9	1	xx.x	xxx	xx.x	xxx	xxx	xx	xx
2011	MI	2	1	T337	2	.	.	.	.	.	.	.
2011	MI	2	2	T337	1	xx.x	xxx	xx.x	xxx	xxx	x	x

Column 1: year is 2012
Column 2: site should be in capital letters, use same abbreviation as in the annual report.
Column 3: Block (1, 2, 3, or 4)
Column 4: Tree number (1 or 2)
Column 5: Rootstock – use the codes listed in the **non-shaded** column in the table below ("code to report"). Use all capital letters, no periods and no spaces.
Column 6: Tree status (0=dead, 1=live, or 2=missing)
Column 7: Trunk cross-sectional area (cm^2 measured fall 2012)
Column 8: Fruit weight (grams per fruit)
Column 9: Yield (kg/tree)
Column 10: tree height (cm)
Column 11: Tree spread (cm) – average of canopy diameter measured parallel and perpendicular to the row.
Column 12: Number of rootsuckers per tree.
Column 13: Burrknots (%) – this is an estimate of the percentage of the trunk circumference of the above-ground portion of the rootstock covered by burrknots.

Preferred Format: Excel.

Use rootstock codes in the following table for the 2003 Dwarf rootstock trial. All letters must be capitalized and **there must be no spaces or periods between characters**. The shaded columns are the rootstock names. The non-shaded columns are the codes to use in your spread sheets. The reason for the codes is to shorten the names.

Code to Report	Rootstock Name		Code to Report	Rootstock Name
CG3041	CG.3041		PI5683	PiAu 56-83
CG5935	CG.5935		B9	B.9
CG6210	CG.6210		Pajam2	M.9Pajam2
JTEG	J-TE-G		M26	M.26
JTEH	J-TE-H		T337	M.9T337
JM1	JM.1		G16	G.16
JM2	JM.2		JM4	JM.4
JM7	JM.7		JM5	JM.5
JM8	JM.8		JM10	JM.10
PI5111	PiAu 51-11		PI362	PiAU 36-2
PI514	PiAU 51-4		CG5179	CG.5179
B62396	Bud.62-396			

Summary of the data collected for the first 9 years of the 2003 Dwarf Apple Rootstock trial.

Tree Survival: Tree survival was influenced more by the main effect of location than the main effect of rootstock (Table 1). All trees survived in IA and WI, whereas survival was only 70% and 77% in UT and KY, respectively. None of the rootstocks had 100% survival at all locations, but rootstocks that averaged over 95% survival included JTEH, PI 51-4 and PI 56-83. In BC and CHIH, trees on G.16 had only 62% survival. In KY, CG5935 and B.9 had only 25% and 50% survival, respectively. In UT survival was 0%, 25%, 50%, and 62% for trees on M.9 Pajam2, M.26, M.9 T337, and B.62396, respectively. Of the rootstocks not in the core group, tree survival was poor for JTEG and PI 51-11 in UT and trees on JM1 in BC.

Trunk Cross-sectional Area: KY had the largest trees and trunks at BC, CHIH, ME, and NY were about half the size of those in KY (Table 2). Trees on PI 51-4 and PI 56-83 had the largest trunks and trees on B.9 had the smallest trunks. Rootstocks with trunks similar in size to M.9 T337 were B.62396, and CG.3041. Trees on CG.5935 had trunks similar in size to M.9 Pajam2 and trees on JTEH were similar to M.26. Since there is a fairly severe location by rootstock interaction it is difficult to make general comments about the noncore rootstocks. However, at most locations, rootstocks more vigorous than M.26 included CG.6210, CG.5179, JM7, and PI 51-11. Rootstocks similar to M.9 Pajam2 included JM8 and CG.5179. The rootstock J-TE-G appears to be quite a bit less vigorous than M.9 T337 and may be too dwarfing for most commercial situations.

Cumulative Yield of surviving trees: Averaged over all rootstocks, KY had the highest yields and CHIH had the lowest yields (Table 3). Rootstocks with the highest yields included PI 51-4 and PI 56-83, probably because they were the largest trees. Trees on CG.3041 and CG.5935 had yields similar to or higher than trees on M.26 and M.9 Pajam 2. At most, but not all locations, trees on B.9 had the lowest yields, probably because it was the most dwarfing rootstock in the core group. In the noncore group trees on CG.6210 had the highest yields. Although CG.5179 was planted in just two locations, it was about as productive as trees on M.9 Pajam2. JM.7 and JM.8 were quite productive at most locations.

Cumulative Yield Based on the Number of Trees Planted. We usually estimate yield based on trees that survive the evaluation period, but this does not take into consideration that tree survival is poor for some rootstocks and this could have serious economic implications. Therefore, cumulative yield was calculated by

entering a yield of zero for the years following tree death. Then mean cumulative yield, based on the original number of trees, was calculated (Table 5). In IA, rootstocks did not differ significantly. Cumulative yields of less than 100 KG per tree were reported for CHIH and IA and yields exceeding 165kg per tree were reported for KY, NY, PA, and WI. Trees on PI 51-4 and PI 56-83 had about 200 kg/tree, and trees on B.9 produced 82 kg/tree. Trees on CG.3041 and CG.5935 were similar to or exceeded yields for trees on M.26, M.9 Pajam2 and M.9 T337.

Cumulative Yield Efficiency (CYE). CYE was only 0.5 in CHIH and exceeded 3.0 in NY and BC (Table 4). Only trees on PI 51-4 and PI 56-83 had CYEs less than 1.5 and the rootstocks with CYEs greater than 3.0 included B.9, CG.3041, and CG.5935. Of the noncore group, the rootstocks with relatively low CYEs included PI 36-2 and JM2, Jm4, and JM5. Trees on CG.5179 and J-TE-G tended to have high CYEs.

Future Data Publication: Assuming I recieve data from everyone by spring, I hope to have a manuscript ready for reviewed by our meeting next fall. Some coordinators have published two papers – one for main effects and one for interaction effects. Since all variables for all of our trials always have highly significant location x rootstock interactions, I have usually published only on the interactions. What would the group like me to do with these data?

I also plan to use these data for a repeated measures analysis to determine how rootstocks separate over time for TCA, yield and YE and this would be a separate publication.

Finally I would like to attempt a stability analysis for a third paper.

Are there other things you want me to look at?

Does anyone else want to write a paper?

Table 1. Survival (%) of 'golden Delicious' apple trees in 2011 on 23 rootstocks planted in 2003.[z]

Stock	BC	CHIH	IA	KY	ME	NY	PA	UT	WI	Mean	Slice
B62396	87	100	100	100	100	100	100	62	100	94	0.016
B9	100	100	100	50	100	100	88	100	100	93	0.001
CG3041	87	75	100	88	100	100	100	75	100	92	0.096
CG5935	100	88	100	25	100	100	100	88	100	89	0.001
G16	62	62	100	50	88	88	100	88	100	82	0.001
JTEH	100	62	100	100	100	100	100	100	100	96	0.023
M26	100	88	100	75	100	100	100	25	100	88	0.001
M9P2	100		100	88	100	100	100	0	100	83	0.001
PI 51-4	100	83	100	100	100	100	100	88	100	97	0.823
PI 56-83	88	88	100	100	100	100	100	100	100	97	0.794
T337	88	88	100	75	100	100	100	50	100	89	0.001
Mean	92	81	100	77	98	98	98	70	100		
Slice	0.001	0.003	1.00	0.001	0.99	0.99	0.99	0.001	1.00		
CG5179	---	---	80	---	---	88	---	---	---		
CG6210	86	---	50	---	100	100	100	87	---		
JM1	43	---	100	---	100	100	83	67	---		
JM2	88	---	100	---	100	100	100	100	---		
JM4	---	---	100	---	---	100	---	---	---		
JM5	---	---	100	---	---	100	---	---	---		
JM7	72	---	100	---	86	100	85	72	---		
JM8	67	---	100	---	100	84	100	67	---		
JM10	---	---	100	---	---	100	---	---	---		
J-TE-G	86	---	80	---	100	100	100	12	---		
PI36-2	---	---	100	---	---	100	---	---	---		
PI51-11	88		100		100	100	100	43	---		

[z] Lsmeans and p-values (obtained with the slice option) for location are calculated from the 11 core rootstocks.

Table 2. Trunk cross-sectional area (cm2) of 'Golden Delicious' apple trees in 2011 on 23 rootstocks planted in 2003.[z]

Stock	BC	CHIH	IA	KY	ME	NY	PA	UT	WI	Mean	Slice
B62396	33.0	50.6	69.2	79.1	47.0	39.0	63.7	57.7	72.2	56.8	0.001
B9	19.0	18.7	27.6	20.8	28.9	18.2	42.8	22.3	33.2	25.7	0.003
CG3041	40.4	57.9	57.4	80.3	39.6	39.5	52.1	49.2	47.8	51.6	0.001
CG5935	46.5	63.2	76.4	66.5	55.1	37.2	60.0	62.8	61.8	58.8	0.001
G16	36.2	51.9	52.8	91.6	42.6	30.1	63.5	53.2	52.1	52.7	0.001
JTEH	50.6	43.9	82.5	95.7	49.5	56.1	86.4	88.2	77.6	70.0	0.001
M26	48.4	54.3	64.4	86.4	55.6	48.0	98.3	105.4	112.2	74.8	0.001
M9P2	35.6	31.7	63.2	113.9	34.0	46.3	81.8	- - -	67.4	59.2	0.001
PI 51-4	113.7	93.2	116.3	220.6	73.7	122.6	152.4	203.7	147.0	143.7	0.001
PI 56-83	123.0	139.1	173.9	251.6	98.2	111.8	169.1	212.5	157.1	159.6	0.001
T337	29.8	23.5	81.0	84.2	29.7	39.2	72.2	67.1	66.7	54.8	0.001
Mean	52.4	57.1	83.1	108.2	50.3	53.5	85.7	92.2	81.4		
Slice	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001		
CG5179	---	---	65.1	---	---	43.1	---	---	---		
CG6210	50.1	---	97.1	---	59.3	63.8	86.4	78.0	---		
JM1	11.0	---	41.6	---	52.6	102.0	74.9	80.8	---		
JM2	118.2	---	137.4	---	80.4	144.9	186.8	179.6	---		
JM4	---	---	115.5	---	---	88.5	---	---	---		
JM5	---	---	157.4	---	---	136.4	---	---	---		
JM7	42.8	---	77.6	---	58.7	46.8	70.3	77.3	---		
JM8	37.0	---	22.0	---	65.0	61.1	126.6	172.7	---		
JM10	---	---	96.0	---	---	65.9	---	---	---		
J-TE-G	14.1	---	22.0	---	15.4	10.7	30.4	20.4	---		
PI36-2	---	---	148.9	---	---	118.6	---	---	---		
PI51-11	45.9	---	79.8	---	47.6	58.9	90.3	191.8	---		

[z] Lsmeans and p-values (obtained with the slice option) for location are calculated from the 11 core rootstocks.

Table 3. Cumulative yield (kg per surviving tree) of 'Golden Delicious' apple trees in 2011 on 23 rootstocks planted in 2003.[z]

Stock	BC	CHIH	IA	KY	ME	NY	PA	UT	WI	Mean	Slice
B62396	147	76	100	273	128	161	175	157	170	154	0.001
B9	95	15	74	81	79	109	124	79	129	87	0.001
CG3041	164	73	128	265	127	162	151	185	168	158	0.001
CG5935	184	67	146	251	176	167	178	227	204	178	0.001
G16	124	75	122	251	115	115	178	174	157	146	0.001
JTEH	140	49	114	287	89	185	159	236	170	159	0.001
M26	178	82	107	245	123	163	168	222	207	166	0.001
M9P2	143	41	113	294	105	183	183		183	156	0.001
PI 51-4	208	79	94	355	129	256	260	294	257	215	0.001
PI 56-83	164	134	57	368	169	244	210	280	222	205	0.001
T337	134	31	125	257	104	154	167	222	184	153	0.001
Mean	153	66	107	266	122	173	178	208	186		
Slice	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001		
CG5179	---	---	113	---	---	171	---	---	---		
CG6210	183	---	152	---	156	287	227	238	---		
JM1	41	---	88	---	137	127	163	149	---		
JM2	249	---	125	---	196	189	131	191	---		
JM4	---	---	55	---	---	174	---	---	---		
JM5	---	---	52	---	---	243	---	---	---		
JM7	165	---		---	142	187	197	227	---		
JM8	152	---	139	---	140	178	157	244	---		
JM10	---	---	78	---	---	142	---	---	---		
J-TE-G	70	---	83	---	70	62	112	107	---		
PI36-2	---	---	105	---	---	255	---	---	---		
PI51-11	133	---	103	---	99	175	157	293	---		

[z] Lsmeans and p-values (obtained with the slice option) for location are calculated from the 11 core rootstocks.

Table 4. Cumulative yield efficiency for surviving trees (kg·cm^{-2} TCA) of 'Golden Delicious' apple trees in 2011 on 23 rootstocks planted in 2003.[z]

Stock	BC	CHIH	IA	KY	ME	NY	PA	UT	WI	Mean	Slice
B62396	4.4	0.6	1.5	3.5	2.7	4.2	2.9	2.8	2.5	2.8	0.001
B9	5.6	0.2	2.7	3.8	2.7	6.0	3.1	3.5	3.9	3.5	0.001
CG3041	3.9	0.7	2.2	3.3	3.2	4.1	3.0	3.8	3.5	3.1	0.001
CG5935	4.3	0.7	1.9	3.6	3.2	4.5	3.0	3.6	3.3	3.1	0.001
G16	3.2	0.6	2.3	2.8	2.7	3.8	2.9	3.3	3.2	2.8	0.001
JTEH	2.5	0.4	1.4	3.0	1.8	3.3	1.9	2.7	2.2	2.1	0.001
M26	3.4	0.7	1.7	2.5	2.2	3.4	1.7	2.1	1.9	2.2	0.001
M9P2	3.9	0.4	1.8	2.6	3.1	4.0	2.2		2.7	2.6	0.001
PI 51-4	1.6	0.4	0.6	1.6	1.8	2.1	1.7	1.4	1.8	1.4	0.001
PI 56-83	1.3	0.7	0.3	1.5	1.7	2.2	1.2	1.3	1.4	1.3	0.001
T337	4.7	0.3	1.5	3.0	3.6	3.9	2.4	3.4	2.9	2.8	0.001
Mean	3.5	0.5	1.6	2.8	2.6	3.8	2.4	2.8	2.7		
Slice	0.001	0.400	0.001	0.001	0.001	0.001	0.001	0.001	0.001		
CG5179	---	---	1.9	---	---	4.0	---	---	---		
CG6210	3.6	---	1.5	---	2.6	4.6	2.7	2.9	---		
JM1	3.4	---	2.1	---	3.0	1.3	2.4	2.3	---		
JM2	2.1	---	0.9	---	2.4	2.2	0.7	1.1	---		
JM4	---	---	0.5	---	---	1.3	---	---	---		
JM5	---	---	0.3	---	---	2.0	---	---	---		
JM7	3.9	---	---	---	2.7	1.8	2.8	2.8	---		
JM8	3.5	---	1.7	---	2.4	4.1	1.3	1.9	---		
JM10	---	---	0.9	---	---	3.6	---	---	---		
J-TE-G	6.1	---	3.5	---	4.4	5.8	3.7	4.2	---		BC'
PI36-2	---	---	0.7	---	---	2.2	---	---	---		
PI51-11	3.4	---	1.4	---	2.1	3.0	1.7	1.5	---		

[z] Lsmeans and p-values (obtained with the slice option) for location are calculated from the 11 core rootstocks.

Table 5. Cumulative yield (kg per original tree) of 'Golden Delicious' apple trees in 2011 on 23 rootstocks planted in 2003.[z]

Stock	BC	CHIH	IA	KY	ME	NY	PA	UT	WI	Mean	Slice
B62396	135	76	98	273	123	161	175	119	170	148	0.001
B9	89	14	68	41	79	109	125	79	129	82	0.001
CG3041	156	64	108	232	125	162	151	144	168	145	0.001
CG5935	184	56	129	121	136	167	178	205	205	153	0.001
G16	108	77	95	128	114	102	178	158	157	124	0.002
JTEH	132	37	103	287	89	163	159	236	170	153	0.001
M26	152	74	99.4	199	123	163	168	91	207	142	0.001
M9P2	128	34	108	264	104	183	183	64	183	139	0.001
PI 51-4	181	69	86	355	129	256	220	228	256	198	0.001
PI 56-83	144	120	55	367	169	244	210	280	211	201	0.001
T337	103	30	105	214	101	154	167	157	184	135	0.001
Mean	138	59	96	226	118	169	174	160	186		
Slice	0.004	0.005	0.224	0.001	0.048	0.001	0.028	0.001	0.001		
CG5179	---	---		---	---		---	---	---		
CG6210		---		---					---		
JM1		---		---					---		
JM2		---		---					---		
JM4	---	---		---	---		---	---	---		
JM5	---	---		---	---		---	---	---		
JM7		---		---					---		
JM8		---		---					---		
JM10	---	---		---	---		---	---	---		
J-TE-G		---		---					---		
PI36-2	---	---		---	---		---	---	---		
PI51-11		---		---					---		

z Lsmeans and p-values (obtained with the slice option) for location are calculated from the 11 core rootstocks.