

"The new Geneva apple rootstocks -- which ones work for Michigan"

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The Cornell–Geneva apple rootstock breeding program has developed a number of rootstocks for commercial propagation. The breeding program was established in 1968 by Dr. Jim Cummins, NYAES. After retiring, Dr. Cummins was replaced with a USDA research geneticist, Dr. Gennaro Fazio, who has carried on the program. The goals of the program have remained the same in developing apple rootstocks which offer resistance to North American maladies (such as Phytophthora, Fireblight and Woolly Apple aphids) with improved orchard performance. Current information about the program can be gained on the web site,

<http://www.nysaes.cornell.edu/hort/breeders/appleroots/appleroostocks.html>

In trying to organize a large group of rootstock candidates for evaluation, the breeders at Geneva developed a code system. Each clone during test-phases retains a number (first number in the code) which estimates approximate vigor influence compared to established standard stocks such as the Malling series. For example, among code numbers used in testing such as CG.3041 CG.4013, CG.5030, CG.6210, the first numbers in the code such as 3 in 3041, 4 in 4013, etc., are defined size class numbers. The suggested size classes, are associated with standard stock of equivalent vigor class in parentheses: defined as 1, super dwarf (M.27), 3, (M.9), 4, (M.26), 5, (between M.26 and M.7), 6, (M.7), 7, (MM.106), 8, (MM.111) and 10, (Seedling). Once the breeder decides to release a rootstock for commercial propagation, the letter C (Cornell) and the first number (size class) is dropped, ie CG.5030 to G.30.

Stocks Under Evaluation in Michigan

As noted above, we first began evaluating CG rootstocks in 1982. The initial study included some 60 elite or first field-test clones (CG Elites) (Perry and Cummins, 1988). These stocks preceded the national testing program known as NC-140 (multiple sites), which limited the evaluation to only clones which performed well in initial trials (CG Elites) such as in NY, MI and WA. Additionally, Michigan has hosted plot trials in NC-140 where the most promising CG stocks were included in trials and compared to clonal rootstocks from other breeding programs from around the world. We have limited testing to two sites in Michigan, northern Michigan at the Northwest Hort. Research Station (NHRS) and southern or mid Michigan, at the Clarksville Hort. Experiment Station (CHES). After consultation with Dr. Fazio, a new plot was established in 2004 with a grower-cooperator near Belding, Wittenbach Orchards. We have found over the years that performance of stocks at Clarksville in the heavier Kalamazoo soils, is comparable to performance in commercial orchards in Belding/Grand Rapids, Southwest (including SWMREC) and Southeast Michigan. The northern site is necessary due to the impact of the coarse sandy soils and shorter growing season. In this latter area, vigor for trees in this region is more challenging. For example, M.7 in southern Michigan sites, including

CHES, approaches M.26 in vigor in northern Michigan sites. Knowing this, we have purposely restricted testing of stocks in northern Michigan to clones which are expected to be in a vigor class 4 (M.26) or above and stocks in southern Michigan to clones between class 3 to 5 (M.9-M.7). We have found that most stocks equivalent in vigor class to M.9 clones, struggle to achieve adequate vigor in northern Michigan. The only exception to this rule would be if a grower chose to manage trees in the Super Slender Spindle system where trees are planted at 1 foot spacing down the tree rows. Accordingly, most trials at CHES are supported (Vertical Axe system) due to many of the stocks being more dwarfing and precocious. Trials at NHRS are not supported (Central Leader). Many commercial apple orchards in northern Michigan are not supported and managed in the traditional Central Leader system. Secondly, we are given the opportunity to determine if support is needed for any of the more vigorous stocks. All plots are irrigated using trickle irrigation. Currently, we are testing a number of CG stocks either in CG Elite or NC-140 trials (Table 1.).

Table 1. CG rootstocks currently under trial in plots in Michigan

CHES*		NHRS	
Released	Unreleased	Released	Unreleased
G.11	CG.4002	G.11	CG.4814
G.16	CG.4003	G.16	CG.5012
G.30	CG.4011	G.30	CG.5046
G.41	CG.4202	G.202	CG.5087
G.202	CG.4210	G.935	CG.5179
G.935	CG.4213		CG.5257
	CG.4247		CG.5463
	CG.4814		CG.5757
	CG.5012		CG.5890
	CG.5046		CG.6001
	CG.5087		CG.6006
	CG.5179		CG.6143
	CG.5206		CG.6210
	CG.5257		CG.6253
	CG.5463		CG.6589
	CG.5701		CG.6874
	CG.5757		CG.6879
	CG.5890		CG.6969
			CG.7480
			CG.7707
			CG.8534

* CG Elite plot planted at Wittenbach's Orchard, Belding in 2004

Performance in Michigan Trials

Most of the rootstock trials in Michigan have been conducted at CHES. We began evaluating rootstocks for northern Michigan at NHRS in 1998. A single scion is selected

for each plot for testing. Due to limited availability of candidate rootstocks, we usually have only 6-10 trees per rootstock to test and we strategically set trees in arrangements which yield the most accurate and reliable data over a 8-10 period of evaluation (usually 1 tree per replication, 6-10 replications and randomized). Most semi dwarf plantings are managed in the Central Leader (CL) system and dwarf rootstocks in the Vertical Axe (VA) system. Summaries follow for individual plots, not including the youngest plantings where cropping has not begun.

1992 NC-140 Dwarf Trial-CHES. ‘Liberty’ was established on 9 rootstocks in a VA system in 1992. After 8 years we found, that ‘Liberty’ had been most productive on M.9 EMLA, CG.5202 and Bemali, and least productive on G.65 and G.5A. Both CG. 4013 and CG. 5202 were expected to be similar to M.26 in size, these stocks surpassed M.26 by more than 50 %.

1992 NC-140 Semi Dwarf Trial-CHES. A companion trial to the dwarf trial was established on more vigorous rootstocks in 1992. Trees were not supported and after 8 years, among 9 rootstocks, we found that highest survival rate of ‘Liberty’ was found on MM.106 and CG.7707. Some of the CG rootstocks broke at the union and were lost by the third growing season on a relatively windy site. One tree of 6 succumbed on G.30, which has been reported as having a brittle union (T. Robinson, personal communication). G.30, CG.6210 and CG.5179 were found to be the most yield efficient. Surprisingly, CG.7707, which is considered a semi-vigorous rootstock, was quite productive.

1994 NC-140 Semi Dwarf Rootstock Trial – CHES. After 10 years, Gala was most productive on G.30 evaluated in a single wire Vertical Axe system since establishment but cumulative yields are not significantly different between this treatment and that of V.2 and P.1. The least productive treatment was on M.26. G.30 was smaller than G.30 (Fig. 1).

1998 NC-140 Trial-CHES. Trees of ‘Gala’ and ‘Jonagold’ were established at the CHES in 1998 on G.16 and G.41 compared to M.9. Over the years, there is no difference in cumulative yield among rootstocks. There is no significant difference in tree vigor among trees of ‘Gala’ on the 3 stocks, but ‘Jonagold’ is smaller on G.41.

1999 NC-140 Trial-NHRS and CHES

Trees of ‘MacIntosh’ were established on an array of rootstocks according to NC-140 protocol at two sites in Michigan in 1999. The semi dwarf planting (non-supported) was established at the NHRS near Traverse City on eight rootstock treatments. **Semi-Dwarf Trial.** ‘MacIntosh’ was established without support on eight rootstock treatments (G.30 N, G.30 T, CG 210, CG 707, CG 814, M.26, M.7, and Supporter 4) in 1999 at the NHRS near Traverse City. Trees on G.30T (derived from tissue culture) and G.30N (derived from stool beds) are the most productive thus far with cumulative yields greater than 50% over all other treatments including standard M.7. Trees M.26 are weakest and trees on M.7 and G.30T strongest. Guard trees of ‘Gala’ on CG.5087, is very productive and

needs further trial evaluation. Productivity on this rootstock has been equivalent if not superior to M.9 and other precocious rootstocks, but with M.7 vigor. Differences in growth and production between G.30 T and N are not showing at this time (Fig. 2). **Dwarf Trial.** Twelve rootstock treatments were established with support and trained to the Vertical Axe system are being evaluated at CHES: CG.4013, CG.5202, M 26, CG.5935, G.16 T, M 9 NAKB 337, CG.5179, G.16 N, Supporter 2, Supporter 1, CG.3041, and Supporter 3. The most vigorous trees in the planting are on CG.4013 and CG.5202 and weakest are on the Supporter series and CG.3041. There is no significant difference in cumulative cropping among 9 of 12 rootstock treatments in this plot at 95 % confidence level. Cropping has been greatest on CG.4013, CG.5202, and CG 5935.

2002 Cornell-Geneva Elites Rootstock Trial-NHRS

‘Golden Delicious’ was established without support on fifteen semi dwarf rootstock treatments (CG 5087, CG 5890, CG 6006, CG 6143, CG 6210, CG 6874, CG 6879, CG 6969, CG 8534, G.16, M.26, M.7, M9, and MM.111) in 2002 at NHRS near Traverse City. The first crop was harvested in 2004. Some CG series stocks such as CG.6874, CG.6879, and G.16 averaged 8-11 pounds per tree. Several may require support due to cropping and canopy weight (Fig. 3).

Summary

The Malling rootstocks have been the foundation to change from low to high density apple orchards in America since the late sixties. Overall, the CG rootstock series promises to offer major improvement to Michigan growers over these British standards. These stocks are cold hardy, Phytophthora resistant, precocious and productive. Most importantly to Michigan, they offer a level of resistance to fireblight from moderate to immune, depending on the clone. This has been a major problem for susceptible M.9 and M.26. CG Stocks such as G.65, G.16, G.41, G.202, G.935 and G.30 have been tested for more than several years in Michigan with promising results. Cornell has released these and other rootstocks for commercial sale; Geneva®65 (1991) M.27 size, Geneva®30 (1994) M.26-M.7 size, Geneva®16 (1998) M.9 EMLA size, Geneva®11(1999) M.26 size, Geneva®202 (2004) M.26 size, Geneva® 41 (2004) M.9 NAKB 337 size and Geneva® 935 (2004) M.26 size (Personal communication, T. Robinson). The super dwarf, G.65, the earliest release, has little application in today’s Michigan orchards. G.30, the next release has received little support in the nursery industry due to it’s problems in producing layers with spines and poor transplanting in the nursery row. Trees have been lost in trials and orchards due to weak graft unions with brittle varieties. We recommend a 2-wire trellis to support ‘Gala’, ‘Greening’, and ‘Honeycrisp’. Additionally, we have found at CHES and NHRS that spur-type Red Delicious, ‘MacIntosh’ and other precocious varieties, need at least a single wire support due to the weight of crop (Fig. 1) (Perry, et.al., 2002). However, many orchardists remain impressed with G.30 and its productivity and tree size. This rootstock appears to resist replant disease in New York (Merwin, personal communication) and has adapted well in northern Michigan where tree size approaches size class 4 (5 in southern Michigan). In the same vigor range as G.30, Cornell recently released G.935 (CG.5935) and G.202

(CG.5202). 'MacIntosh' after 6 years has cropped best on these two stocks at CHES. G.935 has been a top performer over several years and trials in New York (Robinson, 2003) and has little to no nursery problems as found with G.30 (T. Robinson, personal communication). G.16 is a very promising rootstock which will replace the more vigorous M.9 clones such as RN.29, EMLA and Pajam 2 where growers are concerned with fireblight. Growers are warned to use virus free scion wood in propagating onto G.16. The latent viruses that this stock is sensitive to are restricted to transmission by grafting, which does not appear to be a problem in the long term in the orchard (T. Robinson, personal communication). G.41 is precocious and productive and will fit well into plantings on fertile soils or where a weaker rootstock is needed. While G.11 was recently released, we can not comment on this stock (M.26 size) since our oldest trees were planted in 2003. New candidates such as CG.5087 and other 5000 and 6000 series show promise in early trials. Rootstock tissue resistance to fireblight in the CG stocks is reliable but resistance is not transferred to a susceptible scion variety. It is possible for scion tissue to be infected but stop at the union on a CG stock (as experienced in Southwest Michigan in 2000). In contrast, Budagovsky 9 rootstock tissue has been found to be moderately susceptible to fireblight infection. However, many orchardists and researchers have noted that in a typical fireblight infection scenario in the orchard, shoot infection and spread of this disease is localized or inhibited on B.9.

There is no doubt that the CG rootstocks offer improvement over the standard Malling rootstock series in every size category. Therefore, Michigan growers need to begin searching for these stocks and begin giving them a try. We hope that our rootstock trials will help growers determine which of these stocks have the most merit.

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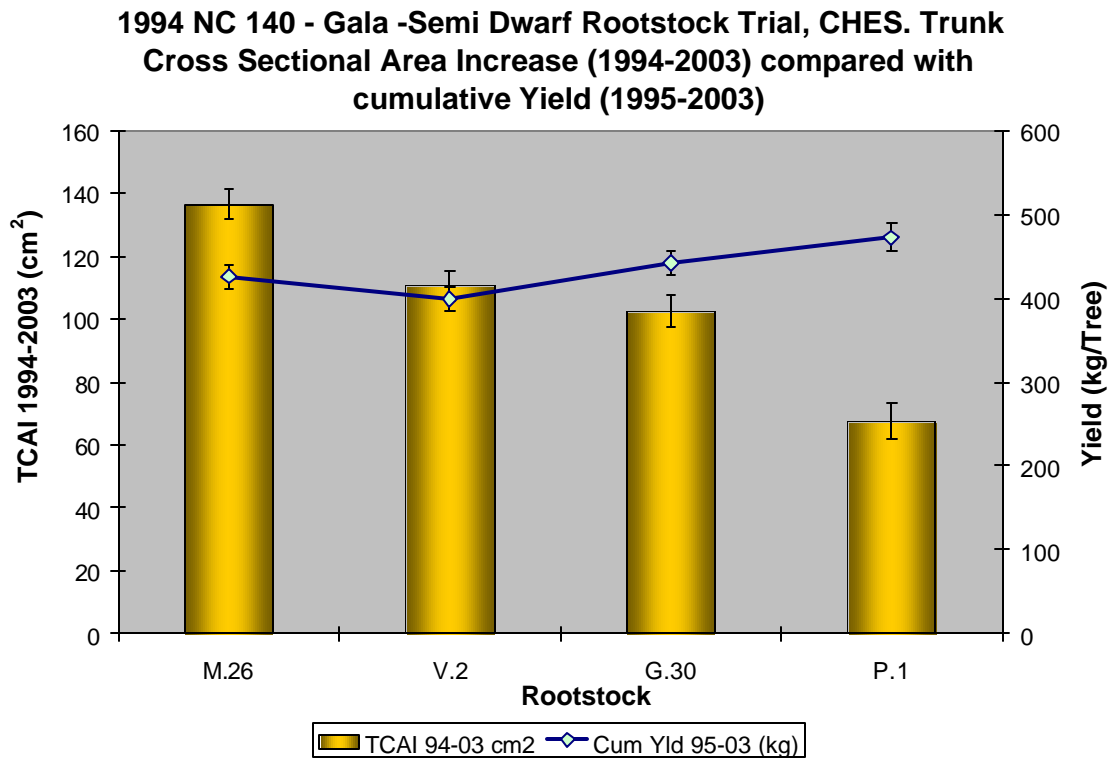


Fig. 1. Performance of Gala on 4 rootstocks in the 1994 NC-140 rootstock trial.



A

B

Fig. 2 MacIntosh after 6 years on A. G.30 and B. M.26 at NHRS.



Fig. 3. Gibson Golden Delicious on CG.6789 at NHRS after 3 years. A stake was added this past summer to augment crop load support.