

STREET TREE PERFORMANCE TESTS OF CRABAPPLE CULTIVARS: INITIAL RESULTS¹

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Abstract. Ten crabapple cultivars are being evaluated as street trees in twelve communities. Using standardized methods, cooperators in the Municipal Tree Restoration Program design plantings, plant trees, and take annual measurements in the first three growing seasons after which they are repeated triennially. Growth in height and trunk diameter varied considerably among locations, as did exposure to diseases and insects. The principal pests were gypsy moth, Japanese beetle, scab, and aphid. The large fruit of Brandywine caused problems in one community, but not in two others. All ten cultivars grew well and remained healthy at most locations, which could be expected because they had been selected for superior street tree growth habit and disease resistance. Minor differences in performance of cultivars during the first three years were not large or uniform enough to recommend one over another, though this may change as evaluations continue. Until then, selections can be based on other traits such as color of flowers or fruit, tree size, and branching habit.

The Municipal Tree Restoration Program has provided communities with cultivars of several popular tree species and is testing their performance along streets. The purposes are to increase available information needed to select the most appropriate trees for various urban sites, and to stimulate communities to improve their tree programs. Initially, only shorter species have been planted that will not interfere with overhead wires and that fit into other urban sites where space is limited. The program is supported by utility companies through the Pennsylvania Electric Energy Research Council, and by state forestry agencies in Pennsylvania and Maryland.

As part of this program, ten cultivars of *Malus* have been planted in twelve communities throughout Pennsylvania and one in Maryland. The crabapple cultivars are Brandywine, Centurion, Donald Wyman, Harvest Gold, Madonna, Red Barron, Red Jewel, Snowdrift, Spring Snow, and Sugar Tyme. The communities where these

cultivars have been planted are Dundalk, Maryland; and Dushore, Galeton, Huntingdon, New Milford, Port Allegany, Roseto, Southmont, Tidioute, Towanda, Ulysses, and West Reading, Pennsylvania.

This report summarizes research results of data gathered from 1988 through 1992. The data were collected during the first, second, and third growing seasons for most of the cultivars. Although evaluations are still at an early stage, enough information has been gathered to portray an accurate picture of the growth and health of the young trees.

Methods

With the assistance of service foresters, utility foresters, and extension urban foresters conferring with community representatives, cultivars and planting sites were chosen in each community according to site characteristics, aesthetics, and community preferences. Two cultivars were chosen for each community (three for Dundalk, MD), and both cultivars were planted together in each of 4 to 9 plots of typically 4 to 16 trees per plot. All plots were required to be under primary electric distribution lines, and in many places deteriorating old trees that conflicted with wires were removed. Both cultivars were obtained from a single nursery, and both were ordered with the same caliper, either 1.7 or 2 inches.

Since the establishment of the plantings during 1987 to 1992, both cultivars in a community have been evaluated yearly by a service forester or another trained cooperator, eleven altogether, using standardized methods at each site. After the third growing season, data will be collected at

¹ Common trade names are used in this report, some of which are cultivar names and others are trademarks.

three-year intervals. Data have been collected typically in September on height and diameter growth; health of foliage, branches, and trunk; maintenance needs; and overall quality of the individual cultivars. Causes of damage, such as insects, disease, air pollution, drought, and mechanical damage, have been recorded along with observations on the general growth habits of the trees.

An analysis of variance was conducted on each type of quantitative data to identify significant differences between the two (or three) cultivars in each community. Each location in every year was treated as a separate experiment with plots providing replication. Results were tabulated for each year of growth after planting, rather than by calendar year. These results, along with written comments of cooperators, were used to characterize the performance of the cultivars.

Results

Overall, the cultivars are doing quite well and are exhibiting the general characteristics described in the literature (1,2,3,4,5,6). Survival is excellent, ranging from 94 to 100 percent at the various locations. The few losses that have occurred are attributable to vandalism, accidents, and adverse site conditions.

Differences in height and diameter (Table 1) are due largely to the size of the trees when planted. The trees typically grew very little in the first growing season, and some even decreased in height as a result of slight dieback from transplanting.

Growth rates in the second and third years varied greatly among locations (Figs. 1 and 2, Table 1). Slow growth in height and diameter occurred at Galeton, Tidioute, and Ulysses. At all other locations the crabapples grew 1.54 to 2.55 feet in height and 0.53 to 1.34 inches in diameter in the second plus third growing seasons (Table 1). Their heights increased 15 to 27 percent and diameters 56 to 125 percent except at Galeton, Tidioute, and Ulysses.

All cultivars are growing well at the more favorable locations. At a given location, growth rates of cultivars were similar (Fig. 3 and 4). But there was substantial variation in the growth of

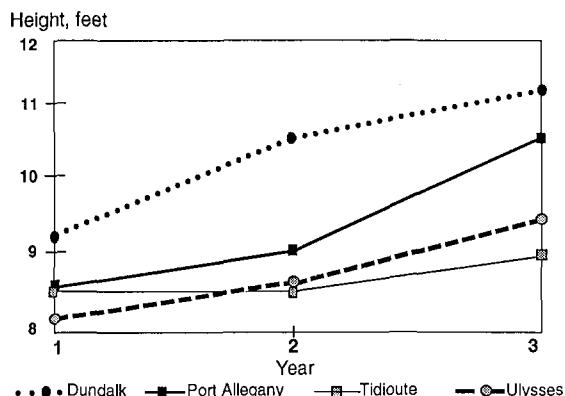


Fig. 1. Height of Sugar Tyme at four locations after the first three growing seasons.

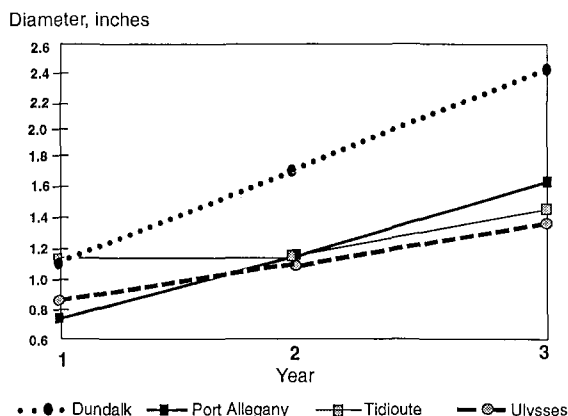


Fig. 2. Diameter of Sugar Tyme at four locations after the first three growing seasons.

any cultivar for which there were data from different locations (Table 1, Figs. 1 and 2). The growth of some cultivars (Brandywine, Centurion, Sugar Tyme) was greater in warmer hardiness zones, whereas others (Harvest Gold, Madonna) grew faster in colder zones. However, the data relating growth to hardiness zones were too limited to be conclusive, especially at this early stage of evaluation.

Growth rates are indicative of the health and vigor of trees. Because initial growth rates have been so variable, it is not possible at this time to rank the cultivars according to these criteria. All had been selected for superiority in disease resistance and branching habit so it is not surprising that all have been growing well at most locations.

Branch health has been very good with only

Table 1. Heights and diameter growth of crabapple cultivars after the first three growing seasons.

Cultivar	Location, Date planted	Average height (ft)			2-year growth	Average diameter (in)			2-yr growth
		Year 1	2	3		Year 1	2	3	
Brandywine	Galeton, 10-89	12.4*	12.5*	12.6*	.21	1.7*	1.8*	2.2*	.50
	Port Allegany, 11-87	10.2*	11.4*	12.8*	2.55	1.0*	1.3*	1.7*	.73
	West Reading, 4-89	12.1*	12.9*	13.8*	1.78	1.5*	2.2*	2.7*	1.17
Centurion	Dundalk, 4-89	9.6*	10.6*	11.2*	1.54	1.2*	1.7*	2.3*	1.10
	Huntington, 10-89	10.5	11.3	12.4	1.89	1.2	1.7	2.0	.74
	Roseto, 10-91	10.4	-	-		1.4	-	-	
	Towanda, 4-91	11.3*	12.0*	-		1.7	1.9	-	
	Ulysses, 11-87	9.3*	9.8*	10.8*	1.50	0.8	0.9	1.2	.36
Donald Wyman	Southmont, 10-90	8.5*	8.9*	-		1.1*	1.2*	-	
Harvest Gold	Huntington, 10-89	10.6	11.5	12.2	1.59	1.2	1.6	1.9	.69
	New Milford, 4-91	10.0	10.6	-		0.9	1.3	-	
	Towanda, 10-88	10.6	11.8	12.6	1.96	1.0	1.4*	1.9	.87
Madonna	Dundalk, 4-89	8.7*	10.0*	10.5*	1.81	0.7*	1.0*	1.3*	.53
	Towanda, 10-88	10.4	11.6	12.8	2.36	1.1	1.6*	2.0	.91
	West Reading, 4-89	10.4*	11.3*	12.2*	1.75	0.9*	1.2*	1.5*	.60
Red Barron	Dushore, 10-91	13.2*	-	-		1.2*	-	-	
Red Jewel	Dushore, 10-91	9.3*	-	-		0.9*	-	-	
	Tidioute, 10-90	8.4	8.7	9.1	0.73	0.9*	0.9	1.1	.19
Snowdrift	New Milford, 4-91	9.7	10.6	-		0.9	1.4	-	
	Roseto, 10-91	10.9	-	-		1.4	-	-	
	Galeton, 10-89	9.4*	10.1*	11.0*	1.62	1.0*	1.1*	1.3*	.29
Spring Snow	Southmont, 10-90	9.4*	9.6*	-		1.4*	1.5*	-	
	Towanda, 4-91	9.7*	11.4*	-		1.6	2.0	-	
	Dundalk, 4-89	9.2*	10.6*	11.3*	2.15	1.1*	1.7*	2.4*	1.34
Sugar Tyme	Port Allegany, 11-87	8.4*	9.1*	10.6*	2.23	0.7*	1.0*	1.3*	.54
	Tidoute, 4-90	8.4	8.5	9.0	.59	1.1*	1.1	1.2	.09
	Ulysses, 11-87	8.2*	8.6*	9.5*	1.37	0.8	1.0	1.2	.33

* Asterisks represent significant differences from the other cultivar(s) at the same location in the same year. For example, Brandywine was different from Spring Snow at Galeton in all three years. The significance of 2-year growth was not tested.

minor exceptions. On a scale of 1 (65 to 100% injuries) to 5 (no injuries), values ranged from 3.00 (32% injury) on Snowdrift to 4.96 (2% injury) on Madonna and Sugar Tyme (Table 3). The majority, however, fell in the interval of 4.7 to 4.96 (5% to 2% injury); only 12% of the average values fell below 4.0. Most of the significant differences found in the analyses occurred during the first year and could be attributed to transplant shock.

Branch tip dieback seemed to be the major factor influencing branch health. Fire blight, a disease commonly found on crabapples, was recognized on only two trees during the study,

both Red Jewel. According to the literature, Red Jewel is moderately to very susceptible to this disease (1,3). In 1993, however, fire blight severely infected over half of the Madonna trees in Towanda; Madonna is known to be susceptible.

The lowest branch health values were given to cultivars at West Reading and New Milford. At West Reading, Madonna was severely impacted by tip dieback, whereas Brandywine was not affected. Because insect and disease levels on the two cultivars there were equal, it is likely that Madonna suffered more serious transplanting shock than Brandywine. At New Milford, Snowdrift

was given significantly lower branch health values than Harvest Gold. Both cultivars had exhibited signs of windburn when received for planting. Snowdrift was more severely affected and the lower values carried over into the second year of growth. Harvest Gold also had relatively low branch health in the second year, which is not explained by either windburn, insects, or disease.

Trunk health was very good throughout the study, with little variation among locations or cultivars. The major causes of injury were from mechanical sources such as lawn mowers, vandalism, cars, and cat scratching, which are to be expected considering the urban locations of the plantings.

Foliage health was observed carefully because crabapples are very susceptible to several foliar pests and diseases. Overall, the foliage was very healthy (Table 2), even when examined late in the growing season. The average yearly values at various locations range on a scale from 1 (65 to 100% injuries) to 5 (no injuries), from 3.00 (32% injury) on Snowdrift to 4.96 (2% injury) on Sugar Tyme. The number of values below 3.7 declined from 11 in the first year to 5 in the second and 1 in the third year. The majority of the values were better than 3.9 (14% injury). The causes of imperfect foliage health were identified whenever there were clear signs or symptoms.

The insects and diseases found most often on the crabapples were gypsy moth, Japanese beetle, scab, and aphid. The incidence of these pests varied greatly among localities and years (Table 3), so it was possible to compare the susceptibility of cultivars only where they were exposed. For example, the cultivars planted at Port Allegany (Brandywine and Sugar Tyme) have had serious problems with Japanese beetle, gypsy moth, and scab. However, there were no significant differences in foliage health between these cultivars. The same pests at Galeton did cause significant differences in foliage health between Brandywine and Spring Snow, but rankings and severity changed from year to year.

Relatively minor differences in susceptibility to various pests were found among the cultivars. When more than one pest caused injuries, the data did not discern the amount of damage caused

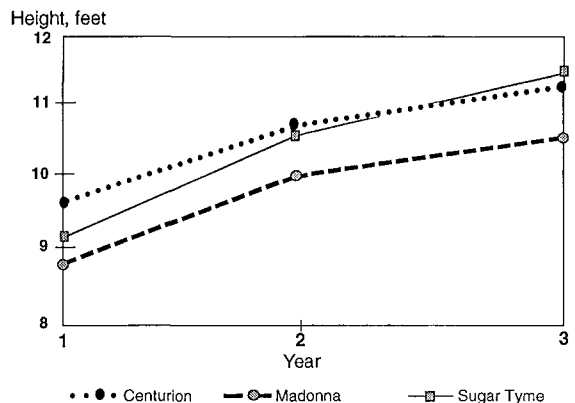


Figure 3. Heights of three cultivars at Dundalk, MD after the first three growing seasons.

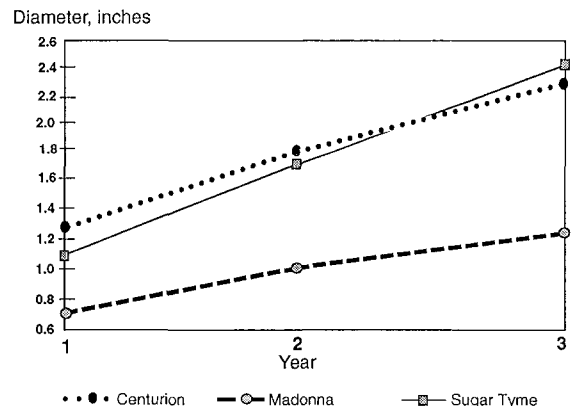


Figure 4. Diameters of three cultivars at Dundalk, MD after the first three growing seasons.

by each of them. Although none of the cultivars consistently had healthier foliage than the others, neither was any of them excessively damaged. Most trees appeared healthy when viewed from a distance.

Higher pest occurrences were observed in the more northern communities in Pennsylvania. Ulysses, Port Allegany, Galeton, and New Milford reported higher levels of insects and disease than the communities in the southern region of the state and Maryland.

The overall quality of each cultivar based on all characteristics of the trees was evaluated by the various cooperators on a scale of 1 (least desirable of any species or cultivar that is suitable for the site) to 9 (ideal for the site in adaptation, appearance, and health). Most of the ratings are

Table 2. Average yearly branch and foliage health of crabapple cultivars, late in each growing season.

Cultivar	Location	Branch health**			Foliage health***		
		Year 1	2	3	Year 1	2	3
Brandywine	Galeton	4.4	4.5	4.4	3.6*	3.3*	3.7*
	Port Allegany	4.7	4.8	4.7	3.6	4.6	3.8
	West Reading	4.5*	4.5	4.8*	3.8	3.6	4.0
Centurion	Dundalk	4.7*	4.9	4.9	4.8*	4.8*	4.8*
	Huntington	4.4*	4.6	4.5	3.7*	4.4	4.5
	Roseto	4.0	-	-	4.3*	-	-
	Towanda	4.9	4.9	-	4.1	3.7*	-
	Ulysses	4.8	4.7	4.8	3.6	3.8	3.6
Donald Wyman	Southmont	4.8	5.0	-	3.6	4.9	-
Harvest Gold	Huntington	4.7*	4.5	4.5	3.8*	4.1	4.6
	New Milford	4.2*	3.9	-	3.2	3.3*	-
	Towanda	4.0	5.0	5.0	3.9	5.0*	4.0
Madonna	Dundalk	4.7*	4.8	5.0	4.3*	4.4*	4.3*
	Towanda	4.0	5.0	4.7	3.8	4.8*	3.9
	West Reading	3.9*	3.3	3.8*	4.0	3.7	3.9
Red Barron	Dushore	4.6	-	-	3.2*	-	-
Red Jewel	Dushore	4.8	-	-	4.7*	-	-
	Tidioute	4.8	4.5*	4.3*	4.8	4.0	4.6
Snowdrift	New Milford	3.0*	3.8	-	3.0	3.8*	-
	Roseto	4.0	-	-	3.7*	-	-
Spring Snow	Galeton	4.1	4.5	4.6	3.5*	3.8*	4.4*
	Southmont	4.9	5.0	-	3.4	4.8	-
	Towanda	4.4	5.0	-	4.0	4.4*	-
Sugar Tyme	Dundalk	4.8*	5.0	5.0	4.5*	4.9	5.0*
	Port Allegany	4.7	4.8	4.8	3.6	4.6	3.9
	Tidoute	5.0	4.9*	4.6*	4.3	4.6*	4.3
	Ulysses	4.9	4.9	5.0	3.5	3.8	3.9

* Asterisks represent significant differences from the other cultivar(s) at the same location in the same year.

** Branch health was estimated according to the percentage of branches injured or damaged: 5 = no injuries, 4 = 5-20%, 3 = 25-40%, 2 = 45-60%, and 1 = 65-100%.

*** Foliage health was estimated according to the percentage of leaves injured or defoliated: 5 = no injuries, 4 = 5-20%, 3 = 25-40%, 2 = 45-60%, and 1 = 65-100%.

in the 7.8 to 9.0 range. Because determining the overall quality of the cultivars was rather subjective, most of the differences in ratings presumably are due to differences in the cooperators' opinions of what are desirable characteristics.

Although all cultivars were highly rated at most of the locations, five received lower ratings at certain locations. Brandywine received low ratings at West Reading because the large fruits on

sidewalks became a nuisance to residents and were used as projectiles by children. The fruits were not considered a problem, however, at the two other locations. Red Jewel and Sugar Tyme were given high ratings the first year at Tidioute, but declined dramatically the following two years because of slow growth, branch dieback, chlorotic leaves that were smaller than normal, and basal sprouting, a common occurrence with crabapples.

Table 3. Average occurrence of gypsy moth, Japanese beetle, aphids, all insects, scab and other parasitic diseases on crabapple cultivars during the first three growing seasons.

Cultivar	Location	Gypsy moth	Jap. beetle	Aphids	Insects*	Scab	Diseases**
Brandywine	Galeton	67	74	7	100	26	26
	Port Allegany	67	67	13	96	83	92
	West Reading	0	0	0	94	0	100
Centurion	Dundalk	0	0	0	56	0	22
	Huntington	33	0	0	33	28	28
	Roseto	0	17	0	89	0	22
	Towanda	0	58	0	67	50	75
	Ulysses	67	67	13	100	33	33
Donald Wyman	Southmont	0	50	20	70	0	0
Harvest Gold	Huntington	33	0	0	45	28	28
	New Milford	50	7	43	100	50	50
	Towanda	7	73	0	73	0	0
Madonna	Dundalk	0	0	0	44	0	67
	Towanda	33	100	0	100	87	87
	West Reading	0	0	0	100	0	89
Red Barron	Dushore	100	0	0	100	67	83
Red Jewel	Dushore	83	17	0	83	0	0
	Tidioute	6	0	0	50	22	28
	New Milford	50	0	43	100	28	28
Snowdrift	Roseto	0	11	0	78	0	100
	Galeton	67	82	11	96	33	37
	Southmont	0	60	20	80	0	0
	Towanda	0	42	0	50	25	59
Sugar Tyme	Dundalk	0	0	0	33	0	11
	Port Allegany	54	63	21	100	92	92
	Tidoute	6	0	0	61	22	28
	Ulysses	67	67	20	100	33	33

* "Insects" refers to all types of insect damage reported in each community, and includes unidentified insects reported in some communities.

** "Diseases" refers to both scab and unidentified parasitic diseases reported in each community.

Madonna also had a problem with basal sprouts along with scab at Towanda in the first year, but improved subsequently. At Galeton, Spring Snow was branched low when planted and difficult to maintain in a single stem form and, therefore, required more pruning.

Conclusions

All of the cultivars are doing very well at most locations. No reasons were found to eliminate any as a desirable, smaller type of tree adapted to confined urban spaces. Brandywine may be one

exception, if its large fruit is considered a problem; furthermore, Brandywine has been reported to be susceptible to scab and cedar-apple rust. The serious damage to Madonna by fire blight at one location also is ominous.

Most of the ten cultivars, which had been chosen according to their known disease resistance and street tree form, have retained healthy foliage and branches throughout the growing season and have exhibited good height and diameter growth. Insect and disease levels so far appear to be more site-dependent rather than cultivar-dependent,

with the greater damage occurring largely in several northern communities. Despite exposures to several pests at various occasions, most of the cultivars have withstood their attacks. Gypsy moth, which is a relatively new threat to crabapples, has been identified at about half of the locations and nearly as frequently as Japanese beetle. Judging by the consistently high foliage and branch health values, however, these two insects have not been an overwhelming problem to the cultivars. Scab appears to be affecting the cultivars in varying degrees, but the foliage has remained healthy throughout most of the growing season.

The first few years after transplanting are crucial to the growth and vigor of a tree, because that is the period when the tree is becoming established and insect and disease attacks could be more damaging. As the study continues and additional data are accumulated, a more complete picture of the performance of the crabapples will emerge.

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Résumé. Dix cultivars d'aubépines ont été évalués comme arbre de rue dans 12 villes différentes. En utilisant des méthodes standardisées, les participants au *Programme de rétablissement de l'arbre dans les municipalités* (Municipal Tree Restoration Program) ont établi les plans de plantation, planté les arbres et pris annuellement les mesures nécessaires durant les trois premières années; les mesures étant prises aux trois ans après cette période. La croissance en diamètre pour le tronc et celle en hauteur variaient considérablement entre les divers endroits tout comme la sensibilité aux insectes et aux maladies. Les principaux parasites retrouvés étaient la spongieuse, le coléoptère japonais, la tavelure et les pucerons. Les 10 cultivars présentaient un bon taux de croissance et étaient en bonne santé dans la plupart des villes, ce qui pouvait être normalement espéré vu qu'ils avaient été sélectionnés comme arbre de rue pour leur croissance supérieure et leur meilleure résistance aux maladies. Les petites différences de performance entre les différents cultivars n'étaient pas suffisamment importantes les trois premières années pour permettre de recommander une espèce plutôt qu'une autre.

Zusammenfassung. Zehn Holzapfel-Kultivare werden gerade in zwölf Gemeinden als Strassenbäume bewertet. Die Mitarbeiter des städtischen Baum-Restaurationsprogrammes entwickeln Pflanzpläne, pflanzen Bäume und nehmen jährliche meßungen in den ersten drei Wachstumsperioden nach der Pflanzung. Das wird dreijährlich wiederholt. Das Höhenwachstum und der Stammdurchmesser variieren erheblich an den unterschiedlichen Standorten, ebenso wie die Anfälligkeit für Krankheiten und Insektenbefall. Die grundsätzlichen Schädlinge waren Schwammspinner, Jap. Käfer, Schorf und Blaffläuse. Alle zehn Kultivare wuchsen gut und blieben an den meisten Standorten gesund, was zu erwarten war, da sie besonders für Wachstumsbedingungen in der Straße und für Krankheitsresistenz ausgewählt wurden. Geringe Unterschiede im Wuchsbild der Kultivare während der ersten drei Jahre waren nicht groß oder einheitlich genug, um den einer vor dem anderen zu empfehlen.