‘Elliott’ Pecan

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History

The original ‘Elliott’ pecan tree was a seedling in the lawn of a house in Milton, Fla., purchased by Henry Elliot in 1912. This tree, with a trunk diameter of 0.76 m, was resistant to scab and produced up to 114 kg of high quality nuts in good years (6). Mr. Elliot gave some of the nuts to Harlan Farms Nursery, Paxton, Fla. Mr. Harlan was impressed and Mr. Elliot gave him bud wood which he used to establish a 15-acre orchard in 1919. Mr. Harlan sold the orchard to Lee and Otis Mathis and the original ‘Elliot’ planting remained in the Mathis family. ‘Elliott’s resistance to scab and excellent quality nuts were responsible for the Georgia Extension Service recommending it for orchard planting in that state in the early 1960s (ref?). ‘Elliott’ is widely planted in small acreages in Georgia, with the greatest concentration in the Fort Valley-Perry area. Although the Elliot family spells their name with one “t”, the pecan industry usually spells the cultivar name with two “t’s” (6, 10).

Tree characteristics

‘Elliott’ has a low chilling requirement (21) and is well suited to areas with mild winters. ‘Elliott’ has an early budbreak (11, 26, 39, 48, 53) and is not recommended for planting in areas subject to late spring freezes (50, 48). The leaf is relatively small, very dark green, and glossy. The veins are raised to an unusual degree which is one of ‘Elliott’s’ most distinguishing characteristics. Normally, leaf retention in the fall is good. A heavy fruit set can cause premature defoliation in ‘Elliott’ trees, but it is minor compared to ‘Moore’. During prolonged cool autumns, color retention is poor. Tree form is spreading with an open canopy. The canopy is about as broad as high and overall tree size is smaller than ‘Stuart’ (48). Fruiting branches are maintained throughout the tree as is characteristic of genotypes with open canopies.

‘Elliott’ is protogynous. At Brownwood, Tex. (36), Tifton, Ga. (56), and Byron, Ga. (53) stigma receptivity occurs early to very early in the season. In the southeastern United States, ‘Desirable’, ‘Caddo’, and ‘Pawnee’ are good pollinizers for ‘Elliott’. Pollen shed in ‘Elliott’ is midseason. ‘Elliott’ can pollinate ‘Caddo’, ‘Moreland’, and ‘Oconee’ and is an early pollinator of ‘Desirable’. Nuts

mature in midseason, about 3 days before ‘Stuart’. Shuck dehiscence is exceptionally uniform (48) in contrast to ‘Stuart’ which is very uneven. The uniform shuck opening allows a once-over harvest, making ‘Elliott’ particularly adapted for the profitable early market. ‘Elliott’ is harvested in the first or second week of October in most locations in the Southeast (2, 40, 50).

‘Elliott’ is drought tolerant and water stress will not cause leaf abscission as quickly as in ‘Desirable’. In contrast to ‘Desirable, ‘Elliott’ also does well on marginally well drained soils and sometimes is preferentially planted on such sites. ‘Elliott’ is very susceptible to winter injury if a hard freeze occurs in winter following an excessive yield, but this is rare in the southeastern U.S. Young trees have good resistance to fall freezes (24). Relative to ‘Cape Fear’ and ‘Desirable’, Elliott has moderate resistance to high winds, and damage has been relatively minor in hurricane storms (48). ‘Elliott’s resistance to wind is due to strong crotch angles and an open canopy (3, 5). Because of these characteristics, , ‘Elliott’ requires minimal tree training. Following excessive yields, dieback of some of the smaller branches is common.

Pecan trees are propagated by budding or grafting the scion cultivar onto a seedling rootstock. Each major production region has a favored seed source for their rootstocks, and ‘Elliott’ is commonly chosen in the Southeast (30). ‘Elliott’ is well adapted for use because the seed is small, making it cheaper by the pound. In addition, ‘Elliott’ kernels are usually well developed and give a high rate of germination (27). ‘Elliott’ seed seems to require less stratification than other seed stocks, and often begins to germinate during cold storage (P. Conner, Unpublished data). ‘Elliott’ seedstock produced the largest seedling trunk(28). The generally high level of scab resistance in ‘Elliott’ seedlings reduces the need to control this disease in the nursery. Scions grafted to ‘Elliott’ rootstocks leaf out sooner in the spring, which leads to more freeze damage in some years (29). For this reason, ‘Elliott’ is not suiteable as a rootstock in the northern pecan production regions.

Productivity

‘Elliott’ is not a precocious cultivar (22, 41, 44, 46), especially in comparison to many newer cultivars which were selected for earlier bearing (52). In a trial in Tifton, Ga., ‘Elliott’ trees averaged 1.1 kg/tree in the first 10 years after planting, while the standard precocious cultivar ‘Cape Fear’ averaged 3.5 kg / tree (56). Yields from ‘Elliott’ were also about 1/3 those of ‘Cape Fear’ in south Alabama (40). Yield efficiency of young ‘Elliott’ trees was found to be 28.7 (g kernel / cm2 cross sectional area) which is only 1/3 of the value of the most efficient cultivars (40).

Long-term yield data from mature pecan trees are scarce, but yield estimates of ‘Elliott’ are similar to ‘Stuart’ (1, 4, 48). ‘Elliott’ trees have a strong tendency to bear alternately (Fig. 1). Mature ‘Elliott’ trees in Tifton, Ga. had an alternate

bearing index (I) of 0.68. This is higher than both ‘Desirable’ (0.40) and ‘Stuart’ (0.47). Most cultivars with an alternate bearing index this high are not recommended for production in the Southeast. Limited attempts to control alternate bearing in ‘Elliott’ by mechanical fruit thinning have not been successful. Following an excessive crop year, ‘Elliott’, like ‘Stuart’ and ‘Wichita’, tends to have a high pistillate flower abortion (first drop). The first drop is inversely related to shoot vigor (45). Consequently, vigorous shoot growth is essential for high yields. With excellent management, yields can be high (Table 1).

Nut quality

Nut shape is oval with an obtuse base and cuspidate apex (Fig. 2). Often, one shell half is larger than the other. Nuts are round in cross-section The suture is not elevated and ridges are not evident. The shell is smooth, and very sparsely marked with dark brown stripes, but is moderately to heavily stippled with dots, especially on the basal end. Ground color is light brown. The shell is not thick, but after nut maturity, the shell becomes very hard with time (5, 41). In addition, the flavor of the kernel becomes stronger.

Nut size of ‘Elliott’ is small at about 6.3 g (Table 2). Kernel percentage is not high, and a good percentage is 53. (this is only logic!) The relatively low percentage kernel of ‘Elliott’ reflects its shell thickness plus a moderate percentage fill (Table 2). ‘Elliott’ is noted for producing well-filled nuts and quality normally remains good during years of heavy production, in striking contrast to many alternate bearing cultivars . The small nut size of ‘Elliott’ may contribute to its ability to maintain quality when crop load is high. Within a genotype, small-volume nuts have higher percentage kernel than large-volume nuts (49). Furthermore, genotypes with large-volume nuts (e.g. ‘Stuart’, ‘Cape Fear’, ‘Barton’) often have poor quality during a heavy “on” year.

Kernel color is very light or golden (2, 40, 58). The central partition wall is moderately thin and brittle. Both dorsal and ventral grooves are wide and shallow contributing to the unusually smooth surface of the nut. The shallow grooves and moderately filled nut cavity result in > 90% of “whole halves” (kernel halves not broken or chipped) (55). Overall, the quality and flavor are excellent. Because of early nut maturity, excellent cracking ability, outstanding color and flavor, and consistent nut quality from year to year, ‘Elliott’ sells well in the market, in spite of its small nut size.

Pest Resistance

Pecans are attacked by a wide range of disease and insect pests causing substantial losses to the crop. In the humid growing conditions of the southeastern United States, the most economically damaging of these is pecan scab, caused by the fungus Fusicladosporium effusum, (G. Winters) Partridge &

Morgan-Jones. Scab infection reduces both yield and quality of pecan, and if uncontrolled can result in total crop loss (43). 'Elliott' is one of the few cultivars that is highly resistant to scab in most locations (3, 25, 34, 40, 44). Although occasional scab infections have been reported (26, 41, 58) they were not severe. Recent wet years in the Southeast have refueled interest in planting scab resistant cultivars such as 'Elliott' (16). Because of its scab resistance, some growers have and continue to plant 'Elliott' in low-lying areas where poor air drainage enhances scab development.

Because of its durable and high levels of scab resistance, 'Elliott' has been the focus of several studies to determine the nature of scab resistance in pecan. Early efforts focused on finding biochemical or anatomical differences between resistant and susceptible cultivars. Wetzstein and Sparks (51) found fewer trichomes on the abaxial leaf surfaces of the resistant cultivars 'Elliot' and 'Curtis' compared to more susceptible cultivars ('Desirable', 'Wichita' and 'Schley'). However, microscopic examination of early infection events found that leaf surface morphology was not related to host resistance (57). Gueldner et al. (31) did not find an association between scab resistance in 'Elliott' and leaf levels of juglone or hydrojuglone glucoside. Chortyk et al. (12) found no differences in the leaf surface compounds of the resistant cultivars 'Elliott' and 'Sumner' as compared to the susceptible cultivars 'Wichita' and 'Schley'. The nature of resistance to pecan scab was made clearer when Yates et al. (57) showed that germ tube and appressoria formation were normal on 'Elliott' leaves, but that the formation of subcuticular hyphae was greatly reduced relative to the susceptible cultivar 'Wichita'. Further studies (9, 14, 18) indicated that resistance to pecan scab is race-specific and involves two steps. The first is the recognition of subcuticular hyphae of the fungus and the second is the modification of the intercellular spaces to prevent the spread of the fungus within the leaf.

The presence of multiple races of the scab fungus is well known and has been demonstrated repeatedly (9, 14, 18, 19, 20). Resistance to pecan scab within a cultivar is usually ephemeral as the fungus eventually adapts to overcome the cultivar's resistance. The durability of resistance is quite variable; it can be as short as a few seasons, or can last for several decades (13). While 'Elliott' has been considered as strongly resistant or immune to scab since its release in 1925, occasional infections have been noted. Interestingly, an isolate obtained from 'Elliott' was more successful in infecting 'Cape Fear' leaves than 'Elliott' leaves (14). In a larger study of 12 isolates, none were found to produce a typical susceptible reaction on 'Elliott' (18). This suggests that the high level of resistance in 'Elliott' is a product of the fungus having not yet become well adapted to 'Elliott'. Studies showing intermittent infection over years at the same location seem to support this conclusion (26).

While scab is the major disease in pecan, other pests canbeimportant in some circumstances. In Louisiana, 'Elliott' has good resistance to downy spot (Mycospharella caryigena give authority for all scientific names in this

paragraph), vein spot (Gnomonia nerviseda), and bunch disease (32, 33). In Georgia, the fruit is very susceptible to powdery mildew, but the damage from this disease is light (48). 'Elliott' is intermediate in susceptibility to pecan bud moth (Gretchina bolliana) (38) and is resistant to pecan phylloxera (Phylloxera notabilis) (5). 'Elliott' is moderately resistant to black pecan aphids (Melanocallis caryaefoliae) in Georgia (54). Foliage condition on unsprayed 'Elliott' trees can be poor because trees are susceptible to yellow aphids (Monelliopsis pecanis) leading to a buildup of sooty mold (Capnodium sp.) (23). However, in general and except for black aphids in some years, insects in 'Elliott' are not a major problem. The scab resistance of 'Elliott' and its minor insect problems make it an excellent homeowner tree.

Genetic analysis

'Elliott' pecan seems to be relatively genetically distinct from most other pecan cultivars. Marquard (37) found 'Elliott' to have a rare b allele for the isozyme phosphoglucomutase. Of the 65 cultivars investigated, only the cultivar 'Brake' shared this allele. Conner and Wood (17) used random amplified polymorphic DNA (RAPD) markers to analyze the genetic diversity of 43 pecan cultivars. Similarity coefficients from this study seem to indicate that 'Elliott' is genetically dissimilar from most other cultivars and it clustered most closely with 'Curtis', which also originated in Florida. Geographically, the origin of 'Elliott' and 'Curtis' may be different from that of other southeastern U.S. cultivars. The Florida industry developed from nuts brought by John Hunt on his way home from the Mexican War and planted in Bagdad, Florida about 1848 (8). Mr. Hunt traveled by ship and the nuts were collected along a river bottom. The large size of the parent 'Elliott' tree in 1912 (6) places it in a time frame closer to the Bagdad planting than to the first plantings in other southeastern states which were established in the late 1800s (35). Bagdad Fla. is only 4 km distance from Milton Fla. where the original 'Elliott' tree was located. Regardless, the dissimilarity of 'Elliott's genome to more commonly grown southeastern cultivars may be an important factor the durability of its scab resistance as the pathogen may not have been commonly exposed to the resistance genes of 'Elliott'.

'Elliott' has been used as a source of resistance in breeding programs (7, 42). Roberts et al. (42) found that open pollinated 'Elliott' seeds gave a large percentage of seedlings with high levels of resistance to leaf scab. We have found in our own breeding work that the resistance level of 'Elliott' populations is highly dependant upon the cross what is the heritability? (Table 3). Resistance levels of the progeny tend to be much higher when both parents are resistant as compared to crosses between resistant and susceptible parents. No commercially important cultivars have been released with 'Elliott' parentage. This is likely because 'Elliott' has such a small nut and this character is transferred to a large percentage of its progeny (15). However, because of its widespread usage as a rootstock, it is not uncommon to find seedling trees in an orchard with 'Elliott' parentage that have grown up when the grafted scion died.

A few of these have been brought to the author's attention (P. Conner) and are currently being evaluated as potential new cultivars.

Although the small nut limits 'Elliott's market and price, its moderate yields of excellent quality kernels and strong levels of scab resistance make it a profitable cultivar in most years.

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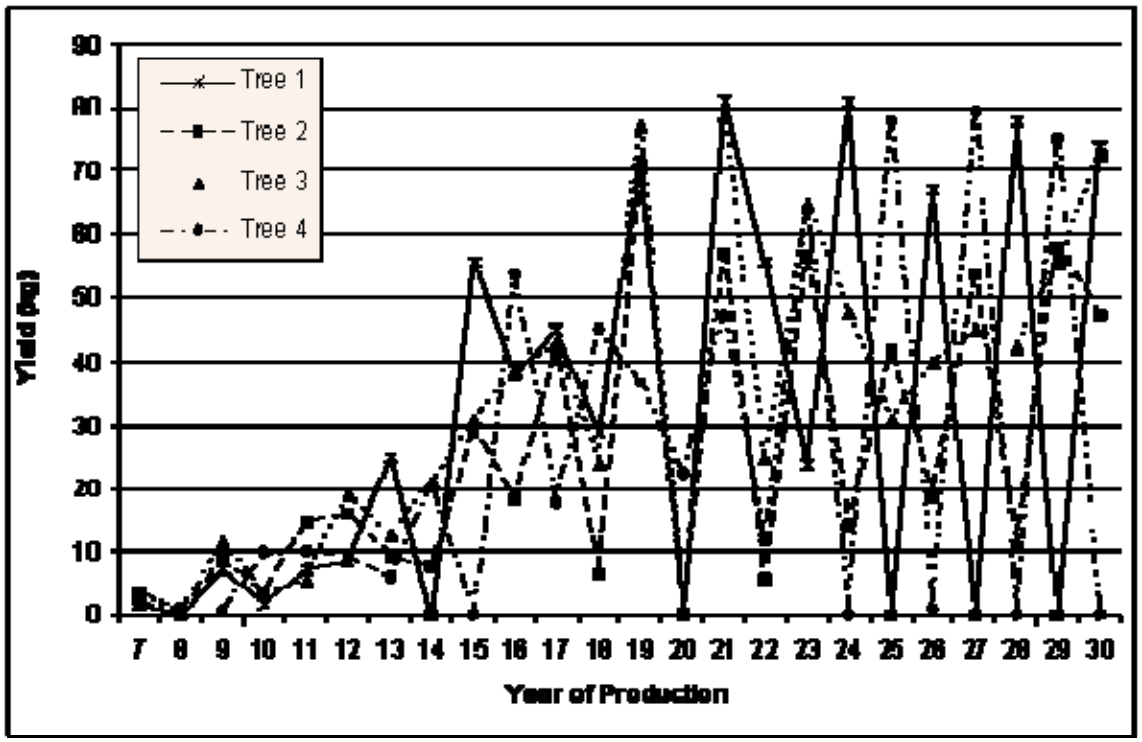

Fig.1. Kilograms of nuts produced from four 'Elliott' trees in years 7-30 from planting. There was no nut production in years 1-6. Trees were planted at Tifton, Ga. in 1955 at a spacing of 12 m by 15 m. What rootstock?

Table 1. Nut yield of an 'Elliott' orchard in Albany, Ga.

Year[a]	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Nut Yield (kg/ha)	834	1115	2116	545[b]	1796	1849	1112	2262	1995	2665	1902

From Sparks (48).
[a]Trees planted in 1965
[b]Trees thinned during the 1976-1977 winter. Doesn't text say it doesn't need thinning?

No comparison cultivars?
Delete table and give 10-year average with range and standard error?

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Figure 2. 'Elliott' pecan nut and kernel shape and size.

Table 2. Nut quality reported for 'Elliott' in various cultivar trials.

Source	Location	Nut weight (g)	Nut weight (nuts/lb)	Percent kernel	Nut volume (cm3)	Spec. Gr.	Percent fill
2	Fairhope, Ala.	6.3	72	52	8.1	0.78	79
56	Tifton, Ga.	5.9	77	51	8.0	0.80	77
1	Colombia, S.Car.	6.3	72	49			
52	Byron, Ga.			52			
44	Gainesville, Fla.	6.0	76	53			
34	Jay, Fla.	6.8	67	51			
40	Fairhope, Ala	6.2	73	50			
58	Melrose, La.	7.2	63	56			
58	Baton Rogue, La.	6.7	68	55			
41	Robson, La.	6.3	72	56			
41	Melrose, La.	6.4	71	53			
41	Baton Rogue, La.	6.4	7.1	54	Is the value 7.1 or (surely)71?		
41	Monroe, La.	7.1	64	55			
4	Monticello, Fla.	5.5	83	53			

No comparators? Number of measurements going into these numbers (i.e. is this from a single sample at each location, and if yes, what sample size? What year?)

What is the logic behind the current arrangement of locations? Suggest alphabetizing, arrange by state, or arrange by nut weight. Also, the table should explain the codes for "source" in the first column, or delete that column.

Table 3. Leaf scab ratings of 'Elliott' crosses in 2003.

Female parent	Male parent	No. seedlings	% #1 rating[z]	Avg. rating[z]
Elliott	Desirable	372	11	3.4
Elliott	Elliott	56	46	2.2
Elliott	Gloria Grande	67	57	2.0
Elliott	Oconne	210	19	3.2
Barton	Elliott	69	80	1.4
Desirable	Elliott	73	8	3.5
Pawnee	Elliott	67	10	3.0

[z]Leaf scab ratings: 1=no scab, 2=small lesions with reduced sporulation, 3=moderate number of large expanding lesions, 4=numerous expanding lesions, stem scab.