Pollination Charts Revisited

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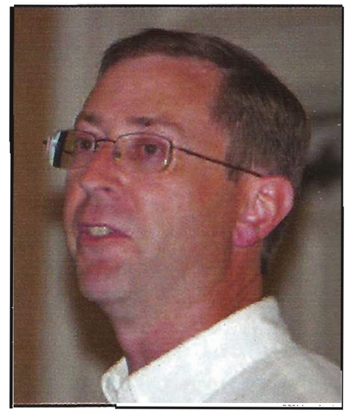
Proper pollination in pecan orchards is vital in order to achieve maximal yields and nut quality. In nature, pecan is nearly always cross-pollinated, and self-pollination leads to smaller nuts with reduced kernel percentage. When self-pollinated progenies are grown out, the seedlings produced tend to be very weak and a high percentage of them die within just a few years.

The flowering mechanism in pecan has evolved to avoid self-pollination. As a first step, pecan trees produce two separate flowers located apart from each other. The male flowers (catkins) are produced at the terminus of the previous season's growth, while the female (pistillate) flowers are produced at the terminus of the newly expanded spring growth. This type of flowering pattern, where separate male and female flowers are produced on the same plant, is termed monoecious, which is Latin for "one household". While separating the flowers from each other increases cross-pollination, it is not sufficient to ensure cross-pollination. This is because the pollen most likely to land on the pistillate flower is that which is located closest to it, which would be pollen from catkins on the same tree.



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A second step has evolved to prevent self-pollination whereby the male and female flowers on the same tree mature at different times, this type of flowering pattern is termed dichogamy. For any given pecan tree, for the most part, the anthers will not be shedding pollen at the same time the pistillate flowers are receptive to pollen. Now, if all pecan trees followed the same flowering pattern, pollination would be very poor. For example if all cultivars were like 'Desirable', they would release their pollen first and then later would be receptive to pollen. However, there would be little pollen available when needed since it had all been released prior to receptivity. To ensure the production of pollen throughout the flower-

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ing season, pecan has two types of flowering patterns. Type I flowering (protandrous flowering) trees release their pollen first and then later become receptive. In the complementary pattern of Type II flowering (protogynous flowering) pistillate flowers are receptive first and then later release their pollen. In natural stands there will be approximately equal numbers of Type I and Type II trees, ensuring pollen is available throughout the flowering season. Interestingly, flowering pattern is controlled by a single dominant gene. The presence of a dominant allele at this gene (*Pp*) means the tree will be protogynous, whereas two recessive alleles (*pp*) means that tree will be protandrous. Since in nature protandrous trees (*pp*) nearly always cross with protogynous trees (*Pp*) the 1:1 ratio is maintained, since half the trees will receive the dominant *P* allele from the protogynous parent, which with the recessive p allele from the protandrous parent produces a *Pp* genotype. The other half of the trees will receive the recessive *p* allele from the protogynous parent, which in combination with the recessive *p* allele from the protandrous parent produces a *pp* genotype.

While flowering times are broadly controlled by the two patterns of flowering, other factors also play a role. Tree age can be influential, with older trees often flowering at somewhat different times than younger trees. Flower positions within the canopy also affect flowering, with interior and lower positions often maturing more quickly. Bud break also affects flowering times. Those varieties that leaf out sooner generally will flower sooner. Thus a Type I tree that leafs out quickly will shed pollen earlier than a Type I tree that leafs out later. In fact, a very late Type I variety may shed pollen at the same time as an early Type II variety. Because of these factors, flowering times can vary widely by location and year.

Setting aside the biology of flowering in pecan, what does all this mean for the grower in designing his orchard cultivar makeup? Since most pecan orchards consist of large blocks of a single cultivar, it is necessary to include

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adequate pollinator trees to ensure your main variety sets a maximal crop. Choosing of pollinators is usually accomplished through the use of some type of pollination chart. Pollination charts have typically appeared similar to the one in Table 1. In these charts separate bars are used to give you the average pollen shed and pistil receptivity times for each cultivar. A downfall of these charts is that because the receptivity and pollen shed bars often overlap, they give the impression that many cultivars could potentially self-pollinate. For example, in Table 1, it appears that 'Cherryle' sheds pollen for nearly half the time that it is receptive. This is generally not the case, and in any given year 'Cherryle' seldom produces pollen at the same time it is receptive. What is happening is that the charts are the average of several years' data, lengthening the bars and bringing them closer together.

In Table 2 we have the raw data that was used to produce the 'Cherryle' bars chart in Table 1. Each row of this chart gives the pollen shed and pistil receptivity for an individual tree. There are a few things to take away from Table 2. Firstly, note that there is a fair amount of variation from tree to tree, and even more variation from year to year. In 2008 and 2010

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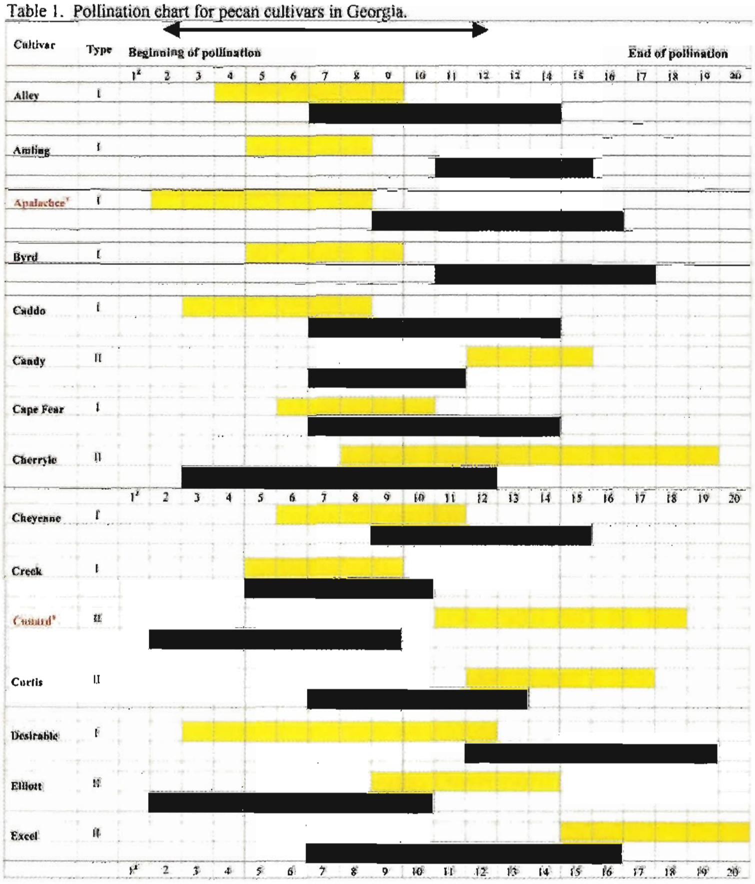
Table 1. Pollination chart for pecan cultivars in Georgia.



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'Cherryle' bloomed much later in the flowering season than it did in 2006 and 2011. Some cultivars tend to vary from year to year like this, while other cultivars are more consistent in their flowering time over years. Also note that only once (in 2011) was a tree releasing pollen at the same time it was receptive. However, because of the tree to tree variation there were times one tree of a Cherryle could pollinate another tree of Cherryle. However, the potential for self-pollination was much less than the averaged data over all years provided in Table 1 would lead you to believe.

This leads to the question of how the averaged data is

Table 1 continued

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presented. What is the best way to determine how big the final pollen shed and pistil receptivity bars should be? In the past, I believe most authors have begun the pollen shed and receptivity bars with the earliest date that flowering has ever occurred and ended with the last date that it ever occurred. I felt this gave too much emphasis to rare outliers and instead began and ended my bars with first and last observation that occurred in at least two different years. This still leaves you with longer time periods in the averaged data that what would occur in a given year, but does narrow them down somewhat. A final change I made to these charts is that rather than using calendar dates to categorize the bloom season I divided the bloom season up into 20 periods labeled from 1-20.

Each year's bloom period began with the first flower to mature and ended with the last to mature. In this data set, bloom periods varied from 22 to 26 days, so each segment represents either 1 or 2 days. The advantage to doing this is that you can correct for the year to year variation in the beginning of the bloom season, it also makes it easier to match up the bars as you read down the table.

In order to use the tables, find the cultivar you

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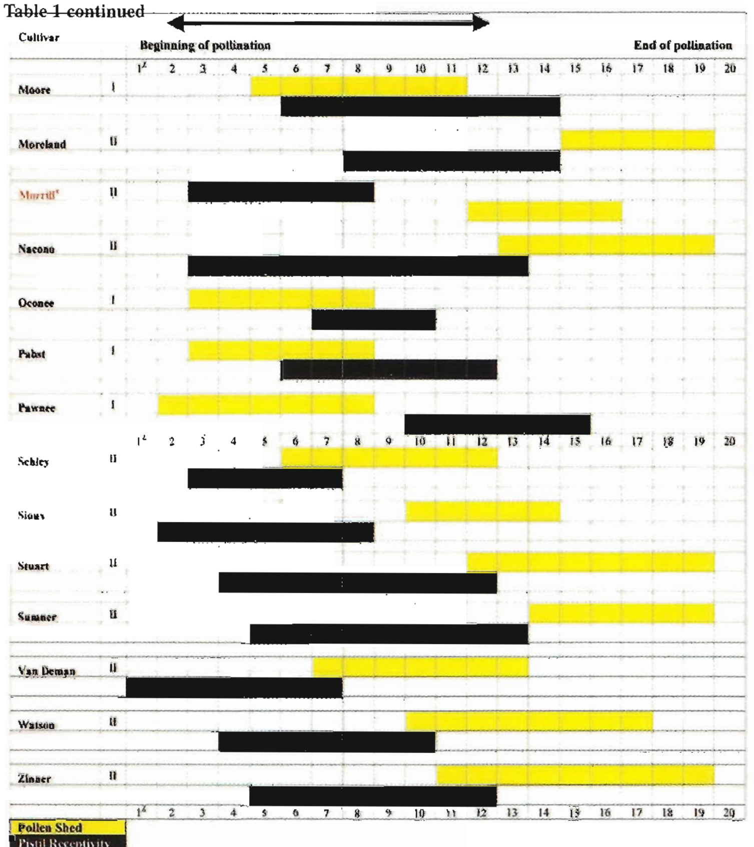
~~Table 1 continued~~



[z] The pollination season was split into 20 approximately equal time periods beginning with the first flower maturation and ending with the last tree to mature. Total number of days in the season varied from 22 to 26 days depending upon the year.

[y] Dates for cultivars in red are based on literature or limited observations and should be considered preliminary.

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wish to have pollinated and locate the black bar associated with that cultivar. The length of the bar represents the time period that the cultivars pistillate flowers are normally receptive. To find a pollinator, look for a cultivar whose yellow bar matches, or nearly matches, the black bar. The greater the overlap between the two, the better it will function as a pollinator. Note that just because cultivar A pollinates cultivar B does not mean that cultivar B will pollinate cultivar A. You need to check cultivar combinations in both directions and will sometimes need to introduce a third cultivar into the mix to make it all work.

The pollination chart in Table 1 should include most new and older cultivars of interest to growers in the Southeast. Please note that the data for 'Apalachee', 'Cunard', 'Lakota', and 'Morrill' is very preliminary as we have limited observations for these trees. You can find a complete copy of this chart on my website at http://www.caes.uga.edu/commodities/fruits/pecan-breeding/cultivars/cultivar_list.html

Also located on the website is an alternative pollination compatibility chart which summarizes the pollination compatibility of all cultivar combinations.

Table 2. Pollen shed and pistillate flower receptivity for pecan cultivar 'Cherryle' in Tift County, GA in 2006, 2008, 2010, and 2011.