

INTRA- AND INTER-SPECIFIC HYBRIDIZATION OF *CORNUS FLORIDA*, *C. KOUSA*, AND *C. NUTTALLII*

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ABSTRACT

A performance trial of cultivars and numbered selections of *Cornus florida* L., *C. kousa* Hance and *C. nuttallii* Audubon was initiated at Cook College, Rutgers University in 1965, as the foundation of a program of intra- and inter-specific hybridization among plants of these three species. Plants of these species were found to be highly self-incompatible. Intra-specific hybridization within *C. florida* resulted in the introduction of two cultivars named, patented and trademarked as follows: 'D184-11" PP#8213, **Wonderberry®** and 'D376-15', PP#8214, Red Beauty@. Despite considerable cross-sterility, F₁ inter-specific hybrids of *C. kousa* X *C. florida* were obtained. Six superior hybrids have been named, patented, and trademarked. They are C. X 'Rutban,, PP#7205, Aurora; 'Rutcan', PP#7210, Constellation; 'Rutdan' PP#7204, Celestial; 'Rutfan', PP#7206, **Stardust®**; 'Rutgan', PP#7207, Stellar Pink; and 'Rutlan', PP#7732 Ruth Ellen. These are the first reported inter-specific hybrids of these two species.

INTRODUCTION

Plants of the various cultivars and numbered selections of *Cornus kousa*, *C. florida* and *C. nuttallii* available in the nursery trade were assembled in a performance trial at Cook College, Rutgers University (U.S.D.A. Plant Hardiness Zone 6a) in 1965 as the starting point for intra- and inter-specific hybridization. A field trial is very important in any long-range hybridization program: first, it allows one to study the nature and extent of the genetic variability exhibited by plants of each of the species and thus assess the level of genetic improvement one can expect to achieve in a hybridization program; the performance trial provides parent material for hybridization; and thirdly, the trial provides the current standards of excellence for evaluating plant material generated from controlled crosses. Resulting progenies must include superior, or novel, plants if success is to be achieved. Primary goals at the outset were to develop pink and/or red-bracted plants of *C. kousa* type and of *C. nuttallii* type and pink- and/or red bracted, dwarf plants of *C. florida*.

GENETIC VARIABILITY

Early in this study, it was discovered that all the plants in the performance trial were very highly self-incompatible. Two seedlings resulting from self-fertilization were obtained within *C. florida* but both were weak, abnormal in appearance, and produced a paucity of flower heads with minute bracts and no true flowers. Only a few plants of *C. nuttallii* were included in the trials but they were self-incompatible. Thus, the plants of all three species were considered obligately cross-pollinated in nature and were expected to exhibit a high degree of both phenotypic and genetic variability. This was confirmed by examination of the plants of *C. florida* and *C. kousa* in the trial. Within both these species, there are plants of dwarf, pendulous, or fastigiata habit. Plants of *C. florida* had floral bracts of white, red, or pink pigmentation; some exhibited floral "doubles" or various foliage variegations. In the case of *C. florida* 'Welchii', the white-margined leaves apparently constitute a periclinal chimera resulting from a dominant mutation as all seedlings of this clone are albino and do not survive. White-green and yellow-green foliage variegations were also observed in *C. kousa*. Pink- or red-bracted cultivars of *C. kousa* were not observed among the plants included in the trial. However, the bract of white-bracted plants in *C. kousa* often become pinkish for a day or two as the bracts become senescent. Also, the bracts of a flower head in which the true flowers are "blasted," or winter-killed, often appear dark pink or reddish.

Considerable variation in vigor and winter hardiness was observed among clones of both *C. florida* and *C. kousa*. Low vigor was particularly evident among unnamed accessions of *C. kousa* and is believed to result from the introduction to the United States of a small sample of germplasm from the wild early in this century and from subsequent inbreeding (Orton, 1985). Variability in the size, shape, and texture of the floral bracts was particularly high in the case of *C. kousa*.

SPECIES DIFFERENCES IN OVERWINTERING FLOWER BUDS

In the vicinity of New Brunswick, New Jersey, plants of *C. florida* being flowering about May 1, whereas plants of *C. kousa* begin flowering about June 1. Close examination of the floral structures in plants of these species revealed why plants of *C. kousa* flower a month later than plants of *C. florida*. It is common in the nursery industry and in horticultural and/or botanical literature to refer to the true flowers in flower heads of *C. florida* and *C. kousa* as being protected in the overwintering floral buds by the enclosing floral bracts. While this is true for *C. florida*, it is not true for *C. kousa*. In the latter species, the floral bracts are minute, feathery structures clasping the tiny, developmentally immature flowers and the flower head is enclosed by two pair of vegetative bracts at the base of the very abbreviated peduncle. Homologous structures are clearly visible in *C. florida*, being 1/4 to 1/3 in. in length near the base of the 1/2 to 1 in. peduncle of the overwintering

flower buds. As growth resumes in the spring, the floral bracts enclosing the true flowers of *C. florida* unfold and enlarge to provide the showy floral display. The deciduous vegetative bracts enclosing the true flowers of *C. kousa* drop as growth resumes in the spring but the developmentally immature floral bracts and true flowers attain mature size a month later than in *C. florida*. This is to be expected when one considers that the peduncle of the nearly sessile flower head of the overwintering bud increases to a length of 2 1/2 to 3 1/2 in. by the time of flowering and floral display.

In *C. nuttallii*, the true flowers are well developed, but are naked in the relatively large overwintering flower buds. Neither the vegetative bracts nor the floral bracts subtending the flower heads enclose the true flowers. As with *C. florida*, the floral bracts subtending the true flowers in the overwintering buds of *C. nuttallii* are developmentally more mature than in *C. kousa*. Thus, flowering and the ornamental display of the floral bracts occur about the same time as in *C. florida*.

POLLINATION TECHNIQUES

The pollination techniques for hybridizing self-incompatible plants within any of the three species of large-bracted dogwood included in this work are very straightforward. For interspecific hybridization, one has to deal with the non-coincident periods of flowering in nature. This can be accomplished by forcing the later-blooming parent in a greenhouse or by storing pollen of the earlier-flowering parent (Orton, 1985).

Plants of *C. florida* and *C. nuttallii* show relatively low cross-sterility compared with that encountered in crosses of plants of *C. kousa* with plants of either *C. kousa* or *C. nuttallii*, although small numbers of F₁ interspecific hybrids can be achieved readily in these latter crosses. However, a very high level of sterility is observed in the F₁ progeny.

INHERITANCE OF PINK AND/OR RED FLORAL BRACTS

The author has never seen a plant of *C. kousa* that consistently exhibits pink or red bracts. In recent years, various so-called pink-bracted cultivars have been introduced to commerce but the ones tested ('Dwarf Pink,' 'Satomi,' and 'Rosea') have all exhibited white bracts with just a very slight trace of pink at the margin of some leaves when grown under greenhouse conditions in early spring. Further, crosses of 'Rosea' with the other two "pink" cultivars listed have failed. With both *C. florida* and *C. kousa*, I have found that cultivars morphologically indistinguishable are usually cross-sterile, suggesting that one is dealing with self-incompatibility of clonal material introduced to the trade under different cultivar names.

Work with *C. florida* indicated the pink- or red-bracted characteristic is conditioned by a single recessive gene in the homozygous state (Orton, 1982). One could speculate that the

reportedly pink-bracted clones of *C. kousa* may be heterozygous for a single recessive gene conditioning bract color. Such heterozygotes in *C. florida* often produce "apple-blossom pink" bracts during a cool spring, hinting that a gene homologous to the gene in *Cornus florida* is present in *C. kousa* clones that exhibit pink bracts. If true, progeny resulting from crossing such a heterozygote with a plant of *C. florida* homozygous for the recessive gene conditioning anthocyanin pigmentation of the bracts should segregate 1:1 for pink-bracted seedlings and white-bracted seedlings.

Such crosses were made and approximately half of the seedlings had cotyledons exhibiting anthocyanin pigmentation, a trait associated with pink and/or red-bracted segregates in *C. florida* (Orton, 1982) but the plants were small, very weak and seldom survived the first growing season. Thus, it is doubtful that a reliably good red-bracted form of *C. kousa* will be found in nature. The pink-bracted plants observed among hybrids of *C. kousa* X *C. florida* are known to be heterozygous for the single recessive gene conditioning pink or red bracts in *C. florida*. As is true with the heterozygotes in *C. florida*, the intensity of the anthocyanin pigment in the floral bracts of the hybrids varies from year to year depending on seasonal factors.

INTRASPECIFIC CULTIVARS

The two cultivars described below resulted from intraspecific hybridization within *C. florida*.

'D376-15' PP 8214, Red Beauty. Plants of Red Beauty are semi-dwarf, with dark green leaves, and a densely branched, unusually symmetrical form. The floral bracts are bright red and showy early in the season.

'D184-11' PP 8213, **Wonderberry®**. Plants of Wonderberry® are unusually vigorous, with large, thick, dark green, leathery leaves. Each white floral bract has a spot of red at the tip and the showy display is rather typical of the species. The trees are unusual for their display of large, tubular, bright red fruit nearly twice the size typical of the species.

INTERSPECIFIC CULTIVARS

Six F₁ interspecific hybrids of *C. kousa* X *C. florida* have been patented and introduced to commerce as Rutgers University's Stellar® series. Plants of all six hybrids exhibit more vigor than is typical for plants of either parent species and all exhibit large, flat leaves of a rich, dark green color. Similarly, all of the hybrids are highly resistant to infestation by the common dogwood borer. Additionally, the hybrids have moderate to high resistance to *Discula destructiva*, the incitant of dogwood anthracnose and are more tolerant of drought conditions than plants of either parent species. Plants of the Stellar® series are highly floriferous, and the period of floral display is intermediate to that of plants of the parent species.

The over-wintering floral buds are also intermediate to those of the parent species: the true flowers on the flower heads of each hybrid are enclosed to varying degrees by both the two opposing sets of floral bracts and the two opposing sets of vegetative bracts immediately subtending each flower head. All of the hybrids exhibit some flower heads in which a few of the true flowers are not enclosed by any of the subtending floral or vegetative bracts. However, plants of all six hybrids consistently have provided a good floral display in Zone 6a. U.S.D.A. Plant Hardiness zone 6a (-5 to -10F). Fruit display is of little ornamental value as all six of the hybrids are sterile and the parthenocarpic fruit are small and nonpersistent.

The hybrids in the Stellar series are listed below in the order in which the floral display of each hybrid commences in the spring.

Cornus 'Rutlan' PP 7732, Ruth Ellen. Plants of Ruth Ellen are similar to, albeit larger than, plants of *C. florida* as they are low and spreading rather than upright as with young plants of *C. kousa*. At 19 years, the original seedling was 18 ft tall, had a uniform spread of 22 ft, and was densely branched close to the ground. The period of floral display of Ruth Ellen slightly overlaps the last day or two of the floral display of most plants of *C. florida*. At the peak of the floral display, the trees are brilliant white in appearance and very showy even from a distance.

Cornus 'Rutfan', PP 7206, Stardust®. Plants of this cultivar are similar to the *C. florida* parent as the general form is low and horizontal but they are much smaller than plants of Ruth Ellen. The plants are heavily branched to the ground like a hedge. At 19 years, the original seedling was 11 feet tall with a uniform spread of 19 feet. The floral display of **Stardust®** typically starts one day later than that of Ruth Ellen®. The white floral bracts of **Stardust®** are obovate with an acute tip. The bracts are distinctly separate and do not overlap. Although plants of this cultivar are low and densely foliated, evidence of infection by *Discula* has not been observed.

Cornus 'Rutcan' PP 7210, Constellation. Plants of **Constellation®** are erect in habit and much more vigorous than plants of *C. kousa*, but do not exhibit the vase-shaped habit typical of young plants of *C. kousa*; that is, the plants branch low and are uniformly wide from base to top. The floral display commences two days after that of Ruth **Ellen®**, and is quite spectacular even when viewed from a distance. At 19 years, the original seedling was 21 ft tall and 17 ft wide. The white floral bracts are obovate with an acute tip. Both the inner and outer (lower) floral bracts are separate with no overlap and are significantly longer than are the floral bracts of **Stardust®**.

Cornus 'Rutdan', PP 7204, Celestial™. This hybrid is vigorous and erect in habit, exhibiting a uniform width rather than the vase-shape of a young plant of *C. kousa*. The floral display

commences four to five days after that of Ruth Ellen. The expanded floral bracts are white with a tinge of green and form a small cup early in the season. However, the bracts flatten and become pure white in a few days. Bracts are obovate to nearly rounded with an acute tip and a base broadly tapered. Margins of adjacent bracts often touch but do not overlap. At 19 years, the original seedling was 17 ft tall and 14 ft wide.

Cornus 'Rutban', PP7205, Aurora. Plants of Aurora are very vigorous, erect in habit, and uniformly wide throughout. They are also very floriferous. The period of floral display is about the same as that of Celestial@. The floral bracts are white and provide a heavily textured, velvety appearance, and become creamy-white as they age. They are nearly rounded to obovate with a broad, tapering base and an acute tip. The margins of the basal one-third of adjacent bracts typically overlap. At 19 years, the original seedling measured 18 ft tall and 18 ft wide.

Cornus 'Rutgan', PP7207, Stellar Pink. Plants of Stellar Pink@ are very vigorous and erect in habit. They branch low and are uniformly wide throughout. The period of floral display of the floral bracts is similar to that of Celestial™ and Aurora@. The rounded, overlapping bracts are a soft pink in color and have a nice textured appearance. From a distance, the pink bracts are not as showy as the red bracts of good clones of *C. florida*. However, they provide a very attractive display when viewed more closely. At 19 years, the original seedling was 20 ft tall and 19 ft wide.

The six hybrids of the Stellar series listed above represent Rutgers University's answer to "dogwood decline". This program of hybridization continues at Rutgers University and numerous advanced generation intra- and inter-specific hybrids are in various stages of field testing prior to introduction to the commercial trade.

*For purposes of comparison, 26-year-old plants of *C. florida* 'Springtime' and 'Sweetwater' in the performance trial measured 10 ft tall by 16 ft wide and 12 ft tall by 19 ft wide, respectively.

LITERATURE CITED

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