Magnolia improvement by polyploidy

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The effect of polyploidy on magnolia flowers is not relatively well known. There are many clones which are polyploid, but a direct comparison between diploids (the basic condition in magnolias) and experimentally-produced polyploids derived from diploids is rarely found. Even more unusual are cases where the polyploid form is derived from the same tissues as the diploid form, and thus have the same genes exactly duplicated in a multiple number. Unless polyploids are exactly duplicated in their genetic make-up, one cannot be certain that any differences between the diploids and the polyploids are not partly of genetic origin.

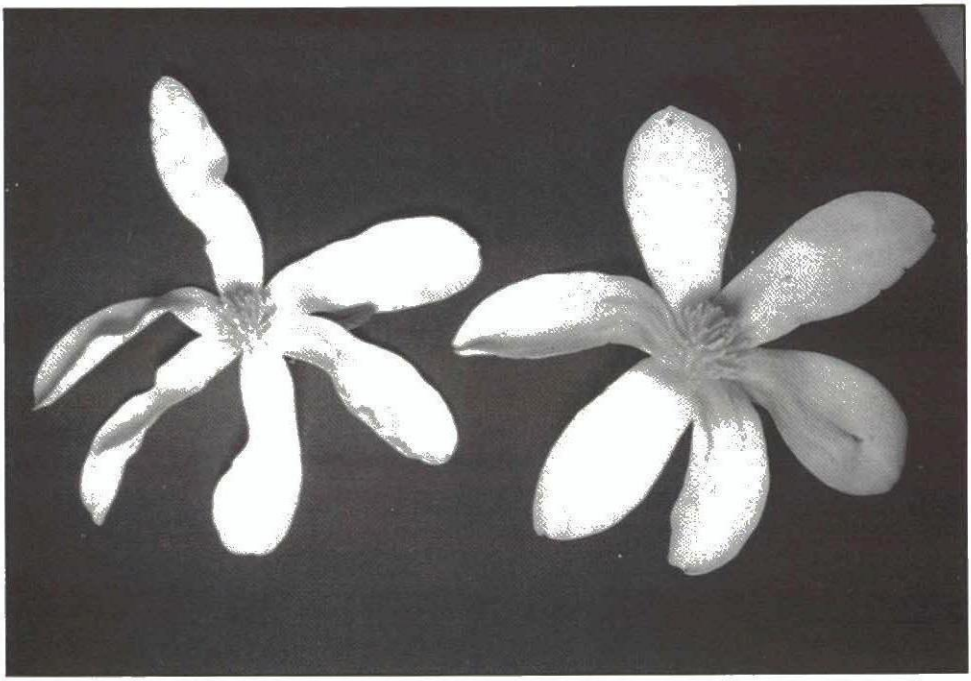
Most magnolia polyploids are produced experimentally by colchicine treatment of germinating seedlings or by hybridization of aneuploid clones. Aneuploids are those plants whose cells contain some chromosomes in greater or fewer number than other chromosomes in the same nucleus. They are therefore irregular or unbalanced polyploids such as one would encounter in hybridizing semi-fertile triploids or pentaploids for example. The high chromosome number found in some of the soulangiana hybrids arose in this manner (i.e. by hybridization and selection).

There are few known examples, if any, of the development of polyploid magnolia clones by doubling directly the chromosome number in branches of a particular clone. To accomplish such polyploids one would of necessity be forced to treat tissues of a larger plant. A method of accomplishing the doubling of adult wood (i.e. not seedlings) was developed by Holger Jensen more than 50 years ago and is reported in Issue 45, Fall 1988 of MAGNOLIA. This method should be given wider usage because it has the advantage, not possible in treating seedlings, of selectivity of a particular clone as contrasted with unselected seedlings.

This article reports a description of flower differences in a plant of which half the branches were diploid and half were polyploid. Thus, barring chance mutations, the two halves may be considered identical in their gene behavior with the exception that the identical genes are duplicated in the polyploid half. In brief, it is reasonably certain any differences in the flowers are directly attributable to the polyploid condition and not to genetic differences.

Background information

In 1983, seeds listed as *Magnolia stellata* were obtained from the Magnolia Society Seed Counter. This



Diploid (left) and tetraploid (right) flowers of Magnolia kobus.

lot of seeds, later identified as *M.* x *loebneri,* was germinated under artificial lights in my basement. When the seedlings reached the stage of growth that the first true leaves were visible in the center of the two cotyledons, they were treated with a .025% aqueous solution of colchicine. Seedlings selected as being affected by the treatments were later transplanted in the field. One of these affected seedlings subsequently put out growth that clearly was from tissue unaffected by the colchicine treatment, in this case near the roots. The unaffected branch was allowed to grow along with the branch that was affected. Thus the plant consisted of branches made up of two ploidy levels, the normal diploid (with 2-fold number of chromosomes) and experimentally-induced tetraploid (with 4-fold number of chromosomes). This tree was therefore unique because the tissues of both ploidy levels presumably had the same genes. Consequently any visual difference between the two halves of the tree could be attributed solely to the differences in chromosome numbers. This article describes the differences in flower characteristics.

Flower characteristics

The above plant flowered first in 1989, but the flowers were destroyed by a frost before they were fully expanded. Thus it was not until 1990 that any detailed study could be made.

Diameter of flowers. The overall diameter of the flowers was the same in the diploid as in the tetraploid, being 3 5/8 inches (9 cm)

and 3 3/4 inches (9.5 cm), respectively. Whether this similarity in flower diameter is unique in magnolias is unknown. It certainly is not the norm for most plants, because it is generally the accepted experience that the diameter of polyploid plants is much greater than in diploid plants. I believe additional information will show likewise in magnolias that the higher ploidy levels will have larger flowers. The stems, leaves, buds, seeds, etc., in polyploids all show gigas condition as was indicated in an earlier paper (See Vol. XX, No. 2, Winter 1984-85, pages 1-9 [Issue 38] of this Journal).

Tepal width. The width of the tepals is very noticeably greater in the polyploid flowers. The width of the diploid tepals of *M. kobus* averaged about 14 mm, while those of the tetraploid averaged 19 mm, an increase of about 35%. This difference in tepal width is readily observed in the photograph which accompanies this article.

Tepal texture. Even greater than the width of tepal is the increase in tepal texture. A visual examination of the cross section of the tepals between the two ploidy forms shows that the tissues appear to be nearly twice as thick. This increased texture (perhaps in conjunction with increased width) results in broad, flat, non-twisting tepals in the tetraploid. The thinner, narrower tepals of the diploid tend to bend, fold, and curl.

I did not test the keeping qualities of the flowers, either cut or uncut in 1990 because of circumstances beyond my control. I am convinced, however, that the durability of the flowers of the tetraploids would be increased in the same manner as has been observed in other genera.

Anther size and substance. A visual examination is sufficient to show the increased size of the anthecium. In fact, the larger anthecium adds markedly to the beauty of the polyploid *M. kobus*.

Other observations. The appearance of this reported polyploid form of *M. kobus* resembles that of the two named cultivars 'Norman Gould' and 'Janaki Ammal.' In my judgment these two cultivars are tetraploid forms of *M. kobus* and not *M. stellata* tetraploids as previously reported in some magnolia literature. I propose that this correction be made in future publications. ❧