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Reviewed Research Paper

Potential Methods for Gene Exchange Between Rabbiteye and Highbush Blueberries[1]

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Cultivated blueberries (*Vaccinium* sp.) are mainly tetraploid ($4x = 2n = 48$) or hexaploid ($6x = 2n = 72$, and hybrids between these 2 groups are of considerable interest. The 2 species whose hybrids would probably be the most valuable are tetraploid highbush (*V. corymbosum* L.) and hexaploid rabbiteye (*V. ashei* Reade). Both rabbiteye and highbush have been improved by plant breeding, and each has strengths which could compliment the weaknesses of the other. Direct hybridizations between the 2 were once believed to produce almost sterile pentaploids (2, 3). More recent work has shown that hybrids are not only fertile but range in chromosome number between pentaploid ($5x = 60$) and tetraploid (6, 12, 13). However,

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fertility is low enough in these hybrids that they are not themselves commercially useful. Several methods for obtaining gene transfers between rabbiteyes and highbush hold potential and are the subject of this review.

Due to early thinking that 6*x* X 4*x* crosses produced infertile 5*x* plants Darrow *et al.* (2, 3) recognized the need for tetraploid rabbiteye of hexaploid highbush breeding lines to facilitate gene transfers. Since tetraploid hybrids involving rabbiteye can theoretically be obtained from existing species (6*x* x 2*x* = 4*x*), tetraploid rabbiteye-type hybrids have previously received the most attention. Diploids which have been used in 6*x* x 2*x* crosses are *V. tenellum* Ait., *V. elliottii* Chap. (3), and *V. darrowi* Camp (3, 8).

Hybrids between hexaploid and diploid species are hard to obtain. Sharpe and Sherman (8) reported only 5 hybrids from 7500 pollinations. Furthermore, hybrids from these crosses are not always tetraploid. The only cross that has given documented tetraploid plants has been *V. ashei* x *V. tenellum* (3). Most reports on using other diploid parents do not discuss chromosome numbers of the hybrids. A recent study by Goldy (4) found 3 *V. ashei* x *V. darrowi* hybrids to be pentaploid. The 3 hybrids had numerous meiotic irregularities which resulted in reduced fertility. Even though initial hybrids are pentaploid, further breeding must reduce them to tetraploids, since 3 tetraploid cultivars have been released that have *V. ashei* x *V. darrowi* ancestry (10, 11).

Two other methods for obtaining rabbiteye x highbush hybrids are being tested in the University of Florida blueberry breeding program, and both utilize octoploid breeding lines. The procedure involves treating tetraploid highbush blueberries with colchicine to obtain octoploid plants. These octoploid plants are then either backcrossed to highbush, theoretically producing hexaploid plants which can be hybridized with rabbiteye, or used directly in 6*x* x 8*x* crosses. Octoploid breeding lines have been produced by Chandler (1) and Goldy (4).

Goldy (4) evaluated the fertility and crossability of an octoploid plant in 4*x* x 8*x* crosses and found it to be significantly less fertile than 4*x* x 4*x* controls. He also found that 739, 4*x* x 8*x* pollinations gave 125 seedlings, of which only one was hexaploid, and it mitotically unstable, having somatic cells ranging in chromosome number from 48 to 168. However, most cells, had 72. The other 124 seedlings proved to be tetraploid. The one hexaploid plant has not yet flowered, but it is hoped that it will produce some 3*x* gametes for use in rabbiteye crosses in spite of its mitotic instability.

Direct 6*x* x 8*x* pollinations were made in 1983 and a large number of berries set from 751 pollinations. The idea in making these crosses is to produce heptaploid plants that can be backcrossed to the hexaploid level to obtain hexaploid end products. Since chromosome elimination does occur in blueberries (6, 7), it is hoped that heptaploid plants will breed as hexaploids by elimination of the 12 extra chromosomes. Chromosome counts for seedlings from 6*x* x 8*x* crosses cannot be obtained until 1984.

Another method previously suggested for crossing rabbiteyes and highbush is to double pentaploid rabbiteye x highbush hybrids to decaploid (10*x*) and do breeding at this level (8). Decaploid plants have been produced and studied, and appear to be fairly fertile (5). So far this method has not produced any useful plants and it appears to have been dismissed, possibly prematurely.

The final methods to be reviewed deals again with direct 6*x* x 4*x* hybrids. Since the hybrids produce euploid as well as aneuploid gametes, it may be possible to backcross the hybrids to hexaploid or tetraploid plants obtaining hybrids of increasing rabbit-

eye or highbush character. These backcrossed plants would eventually produce tetraploid or hexaploid rabbiteye-highbush hybrids.

Although only the 6*x* x 2*x* method has so far resulted in the release of cultivars, all the other techniques discussed are potentially, useful in facilitating rabbiteye x highbush gene transfers. Some may prove more useful than others and some will no doubt prove hard to carry out. In making these wide crosses, breeders must not only select true hybrids and confirm their chromosome number, but they also must select hybrids that possess the desired characteristics of the parental species.

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