Floral Induction and Biennial Bearing in the Cranberry

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Additional index words. Vaccinium macrocarpon Ait., *floral induction, inhibitors, biennial bearing, yield components.*

Abstract

Treatments of flowering and non-flowering uprights by either defloration (flower and fruit removal) or defoliation respectively showed optimum dates for effects upon floral induction and biennial bearing. The optimum date of defloration was June 24, 1977. In 'Bergman' non-flowering uprights the optimum date of defoliation was July 4, 1977. 'McFarlin' uprights did not respond to defoliation, perhaps because their capacity for floral induction was low.

The decrease of floral induction in non-flowering uprights and the increase in flowering uprights indicate that the biennial tendency of both can be altered in either year of their cycle.

Biennial bearing has been studied in fruit trees and is an important consideration in orchard management (Davis 1957). Competition for nutrients between floral initials and flowers and developing fruits has been invoked as a mechanism for alternate bearing (Davis 1957). However, hand pollination of individual shoots of usually seedless varieties of apple (Chan 1967) and pear (Huet 1973) has demonstrated that developing seeds directly inhibit floral initiation in terminal buds. Promotion by mature leaves of floral initiation has been used to determine the date of floral induction in apple (Struckmeyer and Roberts 1942), pear (Huet 1973) and cranberry (Roberts and Struckmeyer 1943). In these experiments, shoots were defoliated at intervals through the growing season. The last date at which floral bud initiation was inhibited by defoliation was taken as the end of the induction period. Flower initials first appear in British Columbia in late July but induction must be earlier (Lenhardt and Eaton 1977).

Cranberry uprights have a tendency to biennial bearing (Lenhardt and Eaton 1976, Lenhardt and Eaton 1977). The present work describes experiments using defoliation and defloration to modify that behavior. We have used this technique to test for an inhibitory effect of flowers and fruits on flower initiation and to determine the date of floral induction.

Materials and Methods

In the summer of 1977 five plots were located in each of two commercial cranberry bogs, one planted with cv. Bergman and the other with cv McFarlin. In each of the plots, ten non-flowering uprights were defoliated and ten flowering uprights were deflorated (flower and fruit removal) on each of the following treatment dates: June 6, 20, July 4, 11, 18, August 2 and 12, 1977. On the first treatment date ten flowering and ten non-flowering uprights were tagged for use as controls in each plot. At the end of the growing season, the uprights were harvested and examined in the laboratory to determine which of them had set terminal mixed buds containing floral initials.

The data were analyzed by multiple regression to test for linear and quadratic effects of date of defoliation and defloration upon the percentage of mixed buds and for differences between cultivars in the position and shape of these curves. Flowering and non-flowering uprights were analyzed separately.

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[2]I. H. Milne, L. Doliner and T. Kyte gave valued technical assistance. Financial support was provided by the B. C. Cranberry Marketing Board and National Research Council of Canada operating grant A2023.

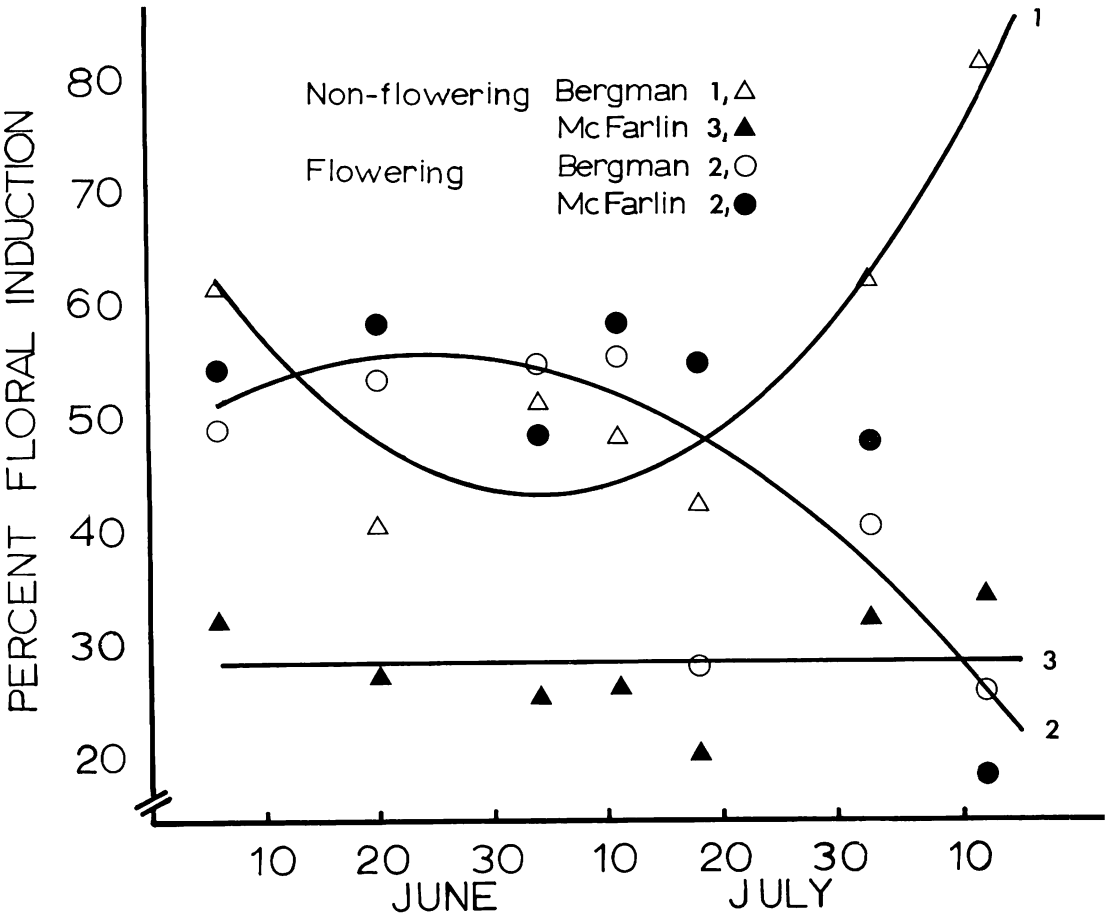

Fig. 1. Floral induction in cranberry uprights that did and did not bear flowers in 1977. Curves fitted by multiple regression.

Results and Discussion

Non-flowering uprights. The effect of defoliation of 'Bergman' non-flowering uprights was expressed as a concave curve (Table 1, Fig. 1). This indicated that, before July 4, defoliation became more effective in depressing floral induction as the season advanced. After July 4 defoliation was less effective. At the end of the season, the defoliated uprights had at least as much floral induction as untreated non-flowering uprights. This result would be consistent with the formation of a floral stimulus in the leaf.

The optimum date for defoliation in 'Bergman' to inhibit mixed bud formation was July 4 in 1977. If this was the date of floral induction, it agrees with early July dates already reported (Roberts and Struckmeyer 1943, Lenhardt and Eaton 1977). There were more of the mixed buds on 'Bergman' non-flowering uprights than on those of 'McFarlin.'

'McFarlin' non-flowering uprights had a relatively low rate of induction

Table 1. Quadratic equations indicating floral induction of cranberry uprights in response to time of defoliation and defloration.

Cultivar	Flowering Upright	Treatment	a	b	c	Optimum
Bergman	no	defoliation	62.2781	−1.3693	0.0242	July 4
Bergman	no	control	67.08			
Bergman	yes	defloration	51.1411	0.4536	−0.0125	June 24
Bergman	yes	control	12.79			
McFarlin	no	defoliation	27.9814	0.0	0.0	
McFarlin	no	control	33.58			
McFarlin	yes	defloration	51.1411	0.4536	−0.0125	June 24
McFarlin	yes	control	27.01			

Uprights with terminal mixed buds as a percentage of total uprights, $Y = a + bX + cX^2$, where
X = number of days after June 6, 1977;
a = percentage of mixed buds on uprights treated June 6, 1977;
b = daily increment in percent of mixed buds; and
c = increment in percent of mixed buds per day squared.

and did not respond to defoliation treatment (Table 1, Fig. 1). 'McFarlin' uprights tend to arise from older wood while those of 'Bergman' tend to arise from runners (Tallman and Eaton 1976). Thus the differing origins of the runners in these cultivars may account for their different capacity for floral induction. There was no significant difference between cultivars in their percentages of newly formed mixed buds.

Flowering uprights. The effect of defloration (including fruit removal) was expressed as one convex curve applicable to both 'Bergman' and 'McFarlin' (Table 1, Fig. 1). This indicated that the effectiveness of the treatment in floral induction grew slightly before an optimum date and then diminished rapidly.

The results of defloration towards the end of the growing season approached those of the untreated flowering uprights. This result would be consistent with the existence in flowers or developing fruits of an inhibitor of floral induction. The optimum date of defloration in both 'Bergman' and 'McFarlin' was June 24, indicating earlier induction in flowering uprights than in non-flowering uprights.

Summary. The decrease of floral induction in non-flowering uprights and its increase in flowering uprights as a result of treatments indicate that the biennial tendency of both kinds of uprights can be altered in either year of their cycle.

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