

# Botanical Aspects of Pollination

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What is normally thought of as pollination in cranberry (and other fruit species) actually consists of a number of steps that must occur for fruit set and maturation to proceed. Cranberries have perfect flowers, that is to say, cranberry flowers have both male and female parts within the same flower. Cranberries are also apparently self fruitful, meaning that pollen from an individual flower when deposited on the stigma of the same flower will lead to fruit set and maturation. The purpose of this article is to outline in a simple way the steps that occur between deposition of pollen on a cranberry stigma and development of a mature fruit.

## Pollination

Pollination is the movement of pollen from anther to stigma. Anthers are the male portion of the flower and are the site of pollen production (Figure 1.) The stigma is the outer portion of the female portions of flowers. It is connected to the ovary by a long stalk called a style. The stigma is receptive to pollination for up to seven days after emergence. After that point, any pollen deposited on the stigma would be inconsequential. Cranberry pollen is shed as a tetrad (four pollen grains fused together). This is a relatively large pollen that is not easily wind blown. Further, the stigmatic surface tends to point downwards making it unlikely that windblown pollen could land on it. Insects are the common pollinators (agents of pollen transfer) in cranberry.

Once pollen is deposited on a receptive stigma the pollen grain germinates and a pollen tube grows through the style to the ovary. Pollen germination is temperature sensitive, and will germinate in 48 hours at 72° to 86°F. At less than 50°F pollen will not germinate, at greater than 90°F germination begins but the pollen tube frequently desiccates. This pollen tube has three nuclei. One is a tube nucleus that is thought to direct the growth of the pollen tube through the style and into the ovary. The other two are sperm nuclei. These two nuclei are deposited inside a mature ovule.

## Fertilization

In order for fruit set to happen two fertilization events must occur. One sperm nucleus unites with the central cell which is binucleate, creating a new cell that has three copies of each chromosome (3n). This cell divides and creates the endosperm which will serve as nutritive tissue for the developing embryo. The other sperm nucleus unites with the egg cell in the ovule to create a zygote which become an embryo after repeated division and differentiation (Fig. 2). This double fertilization is characteristic of higher plants but is not found elsewhere in the plant kingdom.

## Subsequent events

It is well documented that an increased seed number within a cranberry leads to larger berries. Indeed, each seed results in an increase in fruit size of 36 milligrams. Early opening flowers at lower fruit positions are more likely to set fruit than later opening fruit at higher positions. Fruit at lower positions also tend to be larger in size.

Following fertilization rapid development of the embryo, endosperm and associated structures appears as rapid growth. The growth is associated with the release of plant growth regulators or plant hormones. Three plant hormones appear to be associated with fruit set and development; Auxin, Gibberellic Acid and Cytokinin.

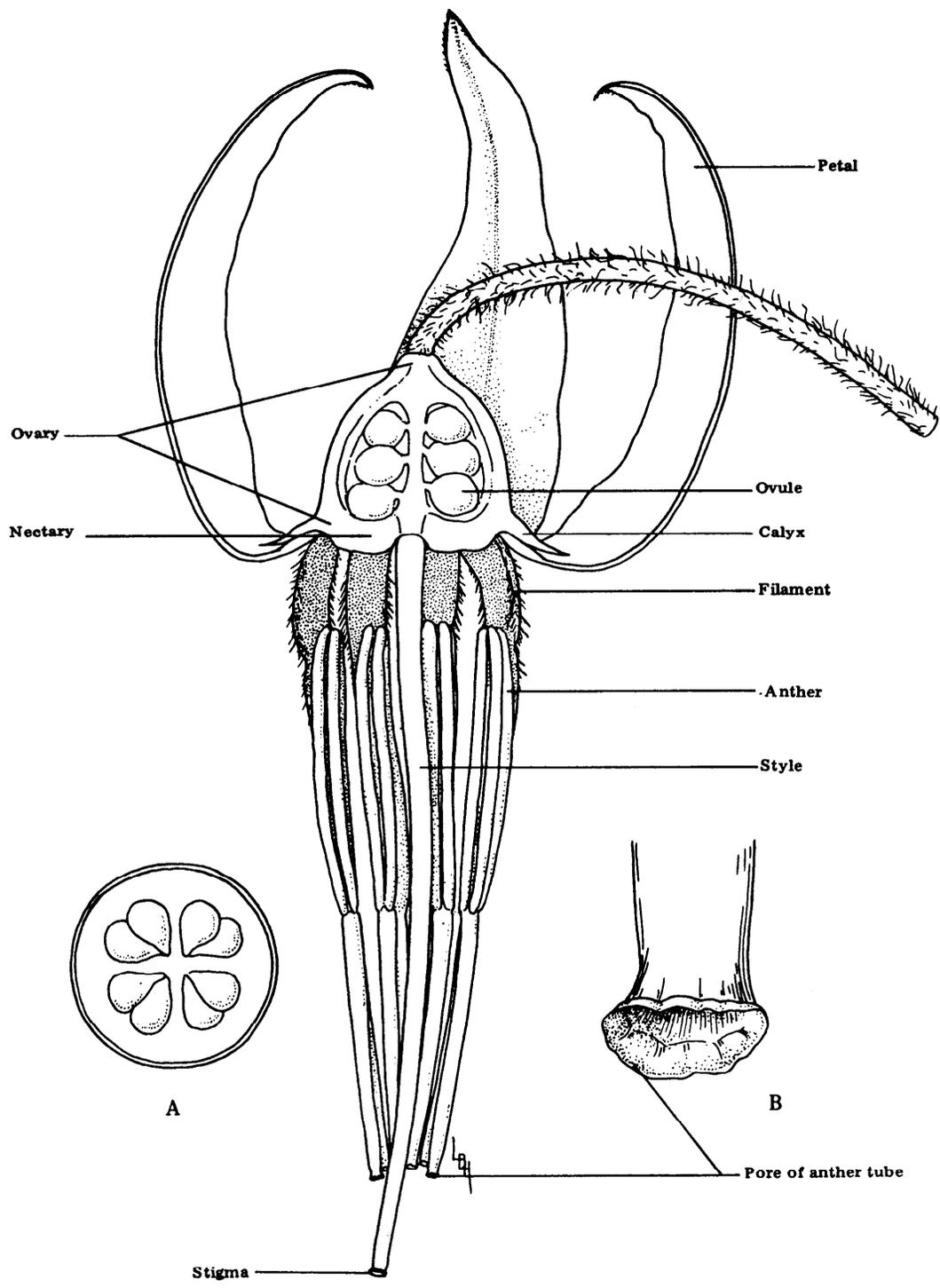
High auxin concentrations have been found following pollination and fertilization of many plant species. Indeed, in some plants fruit set can be artificially induced by application of synthetic auxins (cranberry is not among them). Auxins are associated with cell growth, particularly elongation. Developing meristems (such as the shoot apex) are also rich sources of auxins. In these situations auxin is also associated with inhibition of growth or branching below the apex. Auxin can be both a growth promoter and a growth inhibitor. The release of auxin as the ovule develops is likely integral to the growth of the fruit.

Gibberellins are a large family of closely related chemicals. They are associated with both cell division and cell expansion. Gibberellins are known to be released from developing seeds. Fruit set in some species can be induced by applications of synthetic gibberellins (cranberry included), but unless more resources are provided this usually results in many small fruit. Gibberellins released from developing seeds are known to inhibit development of flower buds for the next season in many fruit crops and may be the cause of biennial bearing. Uneven fruit development in apples is associated with seeds missing on the undeveloped side, this can be remedied with applications of gibberellins.

Cytokinins were discovered in Wisconsin are associated with cell division. Cytokinins are attributed to have affects on many plant functions including senescence, cell enlargement and responses to red and far red light. Developing fruits and embryos are a common source of extracted cytokinin. However, because of the technical difficulties of working with these compounds very little literature is available for them with fruit crops.

## **Conclusion**

Before fruit set proceeds pollen must be deposited on a receptive stigma. The pollen grain must germinate and the pollen tube must grow the length of the style to the ovule. Once the two sperm nuclei are deposited in the ovule, one nucleus must unite with the egg to form the embryo and the other with the central nucleus to form the endosperm. Following this double fertilization the developing seed releases growth substances that causes the ovary wall to enlarge creating the mature fruit that has economic value.



**FIGURE** L-Longitudinal section of a 'Searles' cranberry flower, x 16. A, Cross section of ovary, x 16; B, pore of anther tube, greatly magnified.

