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for Wisconsin

Cranberry

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Contents:

POLLINATION AND FRUIT SET

Fruit set is defined as the number of fruit that are produced from a given number of flowers. It is usually defined as a percentage. Fruit set is perhaps the most important yield component and it has been studied over a number of years. One way to understand what is important to determining fruit set is to limit factors that contribute to fruit set and then see which one reduces fruit set the most.

Before discussing research related to this topic it is important to describe the flowering situation of cranberries. Cranberry pollen is a tetrad that is shed from the pore hole in the bottom of the anther. The pollen tetrads are heavy and are not windborne. Flowering uprights typically have five flowers and they open from the bottom to the top. The lower flowers are more likely to produce fruit than flowers in the upper postions.

One of the first requirements for fruit set is pollination. Pollination is the movement of pollen grains from the anther to the stigma. Pollination in cranberries is carried out by insects. Growers typically rent honeybee hives during flowering to ensure there are sufficient insects to pollinate the flowers once they are open. Native insects including bumblebees and various wasps and flies are also effective pollinators.

In New Jersey researchers (Cane and Schiffhauer, 2003) examined the relationship between the number of pollen tetrads (grains) applied to the stigma of flowers with fruit set and fruit size. Emasculated individual flowers were given 2, 4, 8, 16, or 32 pollen tetrads by hand. Experiments were conducted in a greenhouse so insects were excluded. They found that fruit set did not increase when at least 8 pollen tetrads were deposited on the stigma (Fig. 1). Fruit size increased slightly above 8 pollen tetrads (Fig. 2). However, seed number per fruit, a contributor to fruit size, increased with increasing pollen deposition.

In one study (Birrenkott and Stang, 1989) the researchers supplemented insect pollination with hand pollination to ensure that pollination was not the limiting factor. In both years of their study fruit set with insect pollination alone was 30%. When insect pollination was supplemented with hand pollination fruit set increased to 38%. However, yield was not increased significantly even when fruit set was increased. Thus, pollination can be limiting to fruit set, but not necessarily to yield.

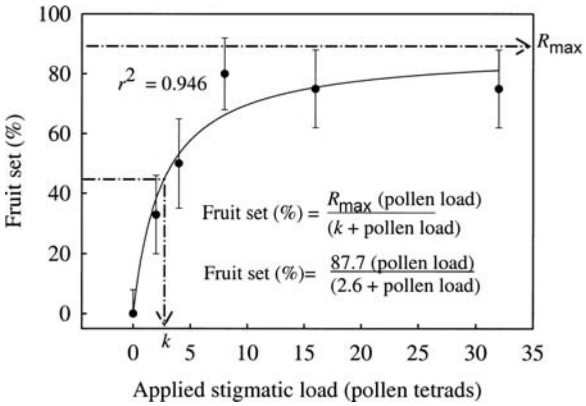

Figure 1. Relationship between pollen load and fruit set in cranberries.

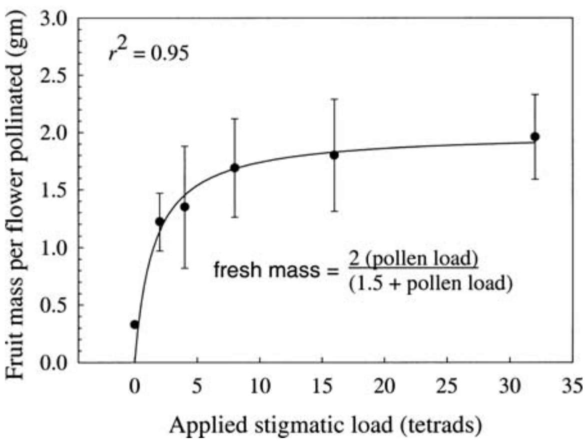

Figure 2. Relationship between pollen load and fruit size in cranberries.

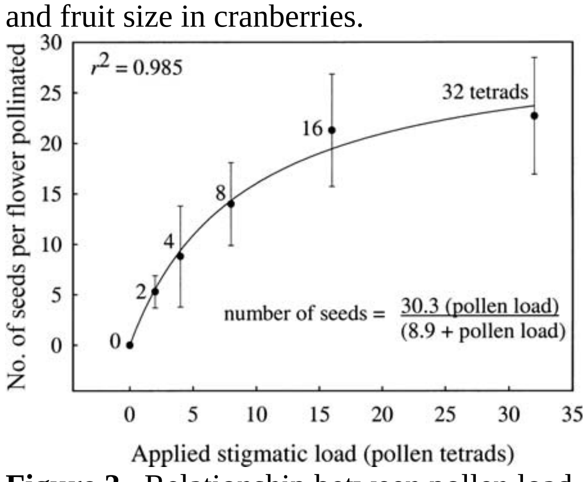

Figure 3. Relationship between pollen load and seed number per fruit in cranberry. Data from Cane and Schiffhauer, 2003.

Interestingly, this research also found that setting a higher percentage of flowers in the lower positions also reduced the number of fruit that set in the upper positions. This suggests that there is competition for resources among berries on an individual upright.

These same researchers studied the effect of removing lower flowers/fruit on fruit set on upper flowers. They found that if the lower two flowers were removed at hook stage that 45% of upper position flowers produced fruit. If fruit removal were delayed until full bloom fruit set in the upper position was still about 46%, but if fruit removal were delayed until early fruit development (fruit set) only 36% of upper position flowers set fruit. If no lower position fruit were removed fruit set in the upper positions was about 25%. Thus, flowers and fruit on an individual upright compete with one another for resources. This further supports the conclusion that fruit set in cranberries is at least partially limited by resources such as carbohydrates.

In another study (Baumann & Eaton 1986) researchers looked at fruit set, fruit size, and seed number by position across three cultivars: Ben Lear, Bergman, and McFarlin. The results are shown in Table 1. As we go from the lower to upper flowers on an upright fruit set declines along with seed number and berry size. The reduction in seed number suggests that pollination may be involved, underscoring the importance of having adequate pollination through honeybees and other insects for pollination. This also supports the hypothesis of competition between berries on an upright.

Table 1. The effect of position on the upright on fruit set, seed number and size of Ben Lear, Bergman and McFarlin cranberries in British Columbia. N=100.

Position	Fruit set	Seed number	Berry wt. (g)
1 (low)	73	12.7	0.83
2	54	9.3	0.58
3	28	4.6	0.28
4	15	2.6	0.15
5 (high)	12	2.1	0.13
LSD	0.07	1.46	0.07

(Data from Baumann and Eaton 1986)

It is possible to increase fruit set to near 100% with the use of plant hormones. Gibberellic acid (GA) is known to increase fruit set through the formation of parthenocarpic (seedless) fruit in other crops in addition to cranberries. Devlin and DeMoranville showed in Massachusetts in 1967 that spraying cranberries with varying concentrations of GA would increase fruit set (Table 2). However, the increase in fruit set also resulted in a decrease in fruit size. Yield was unaffected. Terminal bud set was poor, likely resulting in a reduced crop the following year. Uprights in treated plots were elongated and spindly.

Table 2. Effect of varying concentrations of GA on cranberry fruit set and size.

GA (ppm)	Fruit Set	Berry weight (g)
100	73	0.37
300	87	0.37
500	75	0.43
Control (0)	28	0.71

Data from Devlin and DeMoranville, 1967.

Similar results were found in Wisconsin (Stang, unpublished data). In this study different formulations were used at a constant rate of 100 ppm. The results were very similar.

Table 3. The effect of 100 ppm of GA_3 or GA_{4+7} on fruit set, yield, and fruit size of cranberries in Wisconsin.

	Fruit set (%)	**Yield ($g/81cm_2$)**	**Berry Wt. (g)**
GA_3	51 a	17.7 a	0.47 a
GA_{4+7}	51 a	21.2 a	0.53 a
Control	26 b	19.6 a	1.05 b

Stang, unpublished data.

Interestingly, fruit set can be increased by spraying cranberries with Gibberellins, but yield remains unchanged. This further supports the hypothesis that fruit set, and yield, are resource limited.

If fruit set is resource limited we have not yet addressed the question of what resource is limiting. The next article will address this question.

In this article we have learned:

- That pollination is required for fruit set.
- At least 8 pollen tetrads are required per flower to maximize fruit set.
- That insect pollination alone may not be sufficient for maximum yield.
- That berries compete for resources along a single upright.
- That fruit set, but not yield, can be increased by treating cranberries with the growth regulator Gibberellic Acid.

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Never think that you are not good enough yourself. A man should never think that. My belief is that in life people will take you very much at your own reckoning.

Anthony Trollop

NO WISCONSIN CALLISTO EXEMPTION

We have received some inquiries from growers regarding the use of Callisto herbicide in Wisconsin in 2006. We have not requested a Section 18 Exemption from EPA for the following reasons:

1. Data from other states suggest a substantial yield reduction in treated vines. We need to have more experience with Callisto under Wisconsin conditions to see if yields will be reduced here, and if so, by how much.
2. We lack a real emergency. Section 18 exemption requests are based on having a significant new weed problem that has been documented to cause economic loss, or to have lost a tool that previously had controlled a problem pest.
3. We need additional data to fulfill the data requirement by EPA. Several Callisto plots will be set out this year to hopefully generate sufficient data for next year.

Based on data collected during 2006 we'll make a decision about whether to pursue an exemption for 2007. For now Wisconsin growers **cannot** legally use Callisto. Callisto residue found on any Wisconsin fruit would seriously endanger the marketability of the entire crop.

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