

## **Weed Competition Effects on Cranberry: When and How Serious?**

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Based on numerous surveys of agricultural crops, cranberries are more prone to yield losses due to weeds than almost all other crops. In the past few years I have been trying to document which parameters of cranberry production are most affected by weeds, the threshold levels of weed populations that affect cranberries, how one year's weed populations affect the following year's yield, if there is a difference in variety response to weed competition, and the effect of differences in time of weed competition on yield and fruit quality.

This research was conducted by first selecting hundreds of weed patches within numerous cranberry beds over three years. Weed densities at these sites were measured based on how much light the weeds prevented from reaching the cranberry canopy. I then measured dozens of yield component variables and tried to relate them back to the weed density.

**Vine and yield parameters most affected by weeds:** The yield component parameters fell out into three categories in terms of severity of impact by weeds. *Severely influenced:* total cranberry biomass (fruit + vine), yield, fruit number, fruiting uprights, total vine fresh weight, flower number, fruiting upright with flower buds (return bloom), fruiting uprights with greater than 3 flowers; *moderately influenced:* flower bud density, total upright density, fruit color, fruit size; *slight influenced:* non-fruiting uprights with flower buds, fruit set, % fruit rot, runners, non-fruiting uprights, flowers per fruiting upright.

From this data it was evident that fruit yield is influenced-more by weeds than fruit quality parameters such as size and color. Also important to note is that this data suggest which parameters are most affected by shading due to weeds and thus, most sensitive to deficiencies in carbohydrate resources. For example, flower bud formation on fruiting uprights (return bloom) declined with weeds but flower buds on non-fruiting uprights did not.

**The critical threshold level for weed competition:** Weeds can affect cranberries in a linear fashion or in a non-linear fashion. In a typical linear response there is no critical threshold; with each incremental increase in weed density, there is a corresponding decrease in yield. In a non-linear response the decline in yield does not occur until a certain density of weeds is achieved. Figures 1 and 2 show typical response curves for yield and fruit size for different weed species and varieties. In general, yield and fruit quality respond linearly. Density of fruiting uprights and fruiting uprights with return bloom, however, respond non-linearly. The threshold value for these later parameters

appears to occur when weeds block greater than 50% of the sunlight reaching the cranberry vines.

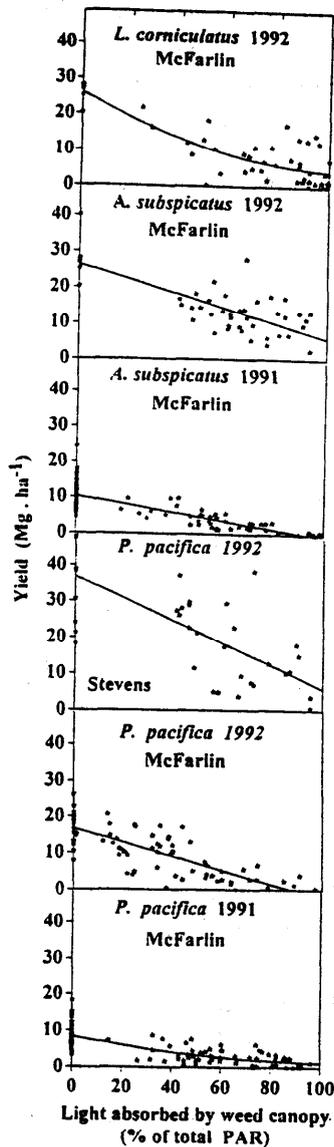


Figure 1.

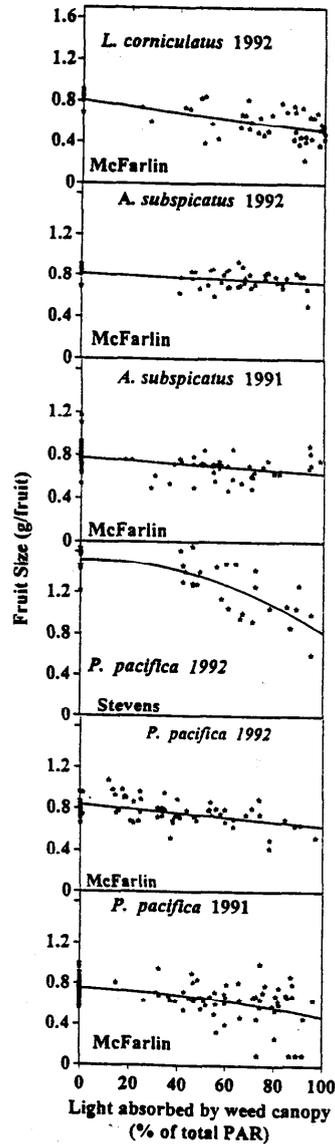


Figure 2.

Figures 1 and 2. Relationship between cranberry yield (Figure 1) and cranberry fruit size (Figure 2), and the percentage of total sunlight absorbed by various weed canopies (total weed coverage = 100% light absorbed). To convert yield to bbl/ac multiply by 10. The weeds represented are Lotus comiculatus (Birdsfoot Trefoil), Aster subspicatus (Purple Aster), and Potentilla pacifica (Pacific silverleaf. The steeper the slope of the line, the greater the impact of weeds on the parameter.

**Long term effects of weeds:** The above data indicate that the current season's carbohydrate accumulation necessary for fruit production is limited by weed competition. Equally important, but less obvious, is that weeds have a severe impact on the fruit-carrying capacity of the crop for the following year. In fact, for Stevens we found that shading caused by weeds was more responsible for crop loss in the year following the shading than in the year of shading (Figure 3). The previous season's influence is likely a combined effect on reduced stored carbohydrate reserves, plant biomass available for photosynthesis in the following year, or flower bud formation.

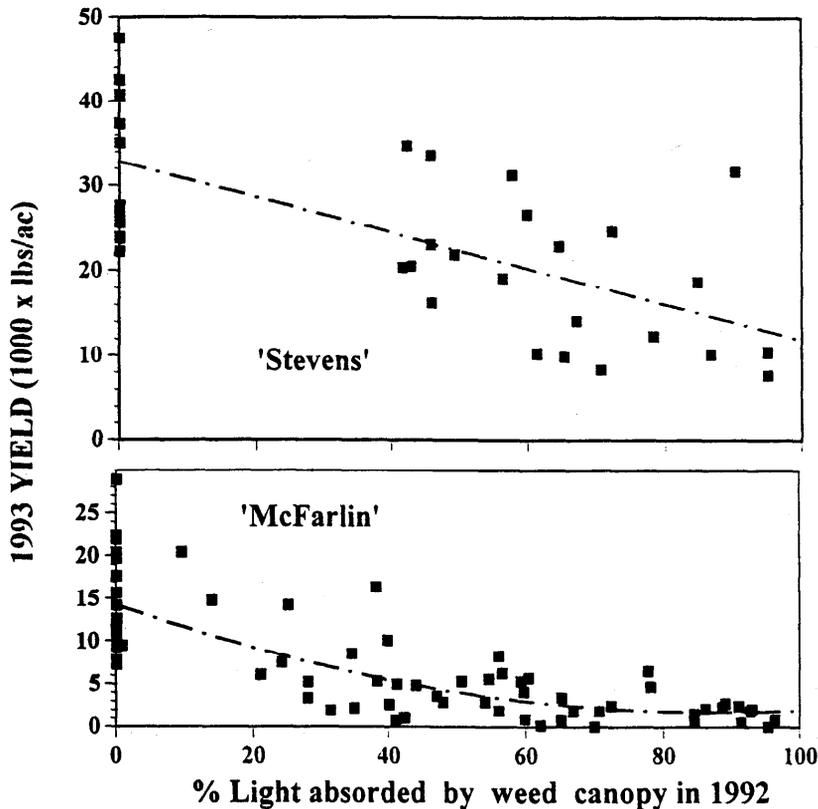


Figure 3. The effect of shading by weeds (% light absorbed by weed canopy) in 1992 on the yield of Stevens and McFarlin in 1993. Data imply that weed competition in the current year has a very significant effect on next year's yield.

Flower bud formation on fruiting uprights (return bloom) appeared to be much more sensitive to weed competition than flower bud formation in non-fruiting uprights. This suggests that biennial bearing in cranberry is resource limited and highly influenced by weed populations. To evaluate that concept, I computed the relationship between weed populations in 1992 and the density of fruiting uprights in 1993. I found that fruiting upright density significantly decreased as weed populations in the previous year increased (Figure 4).

**Varietal response to weeds:** Do all cranberry beds respond to weeds in the same fashion? Should we be equally concerned about weeds in a moderately productive bed as in a highly productive bed? Two interesting conclusions were reached in this regard. First, the lower yielding McFarlin variety was less sensitive to shading than the higher yielding Stevens variety. Stevens yield, for example, declined at a 3-fold greater rate for a given weed population than McFarlin. Stevens were also quite sensitive to weed populations in the previous season while McFarlins were much less affected. Fruit size on Stevens was also more significantly reduced by weeds than on McFarlin. Second, within any one variety the higher the yield potential of a bed the greater the percentage loss caused by an equivalent number of weeds. That is, it pays to have fastidious weed control on high-producing beds but not necessarily on low-producing beds.

**Critical period of weed infestation and type of weed responses:** Cranberries may be especially sensitive to interference from weeds during a specific phenologic period. Shading by weeds during flowering, for example, could restrict bee visitation and reduce fruit set, or shading after flowering could restrict carbohydrates required for fruit set. Our data in this area is more sketchy. Artificial shading experiments by Dr. Roper in Wisconsin indicated that shading during the post-bloom period had a more severe impact on fruit set than shading during the pre-bloom or pre-harvest interval.

How and when a weed causes shading is a function of weed canopy architecture. Weeds belonging to the Rush family, for example, have a very non-imposing leaf structure and are not likely to restrict bee visitation. Some weeds, however, some may be so dense at the time of cranberry bloom as to restrict pollination by bees. Other weeds, such as Potentilla or Birdsfoot Trefoil can partially or completely occlude light from a cranberry canopy in June depending on weed vigor. In fact, heavy Trefoil infestation can become so thick as to cause beds to become quickly void of vines. Other weeds such as aster do not reach full canopy development until August and, therefore, have less early season shading impact. Aster also has a single erect stem that allows more light penetration when the sun is at oblique angles than weeds with a dense canopy. More important to how and when a weed may shade the vines is how aggressive and difficult to control is the weed. That is, a weed may not provide much initial shading during the critical time periods but if it eventually takes over the bog and cannot be easily controlled, it is a disaster.

**Conclusion:** Weeds are one of the most critical limiting factors of cranberry production. Their influence extends across many yield components and across multiple years. Their effect on production often occurs at very subtle levels of weed densities. A special emphasis should be placed on weed control in cranberry beds with high yield potential.