Integrated Cranberry Crop Management for Wisconsin

Cranberry

Crop Management Newsletter

Volume XIX
Number 5
July 5, 2006

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CARBOHYDRATES AND PHOTOSYNTHESIS

In the last article we examined the effects of limiting resources on fruit set and yield of cranberries. We learned that shading cranberries would reduce the amount of carbohydrates (products of photosynthesis) in the vines. Shading reduces light that, in turn, reduces photosynthesis resulting in reduced carbohydrates in the vines.

The primary products of photosynthesis are sugars. Sugars can subsequently be used in various ways in plants. They can be chained together to form starch. They can be latticed together to form cellulose (cell walls, etc.), or they can be used as an energy source for other plant processes (respiration). Once sugars are used to make cellulose plants can no longer use these sugars for other things. They remain linked in cellulose. We use the term 'non-structural carbohydrates' to describe the combination of starch and soluble sugars such as glucose, fructose, and sucrose. These sugars are available for the plant to use to provide energy or more structure.

We examined the seasonal changes in carbohydrates through the course of two years in cranberries. We sampled at two week intervals beginning in early spring and ending in early winter. We cut a piece of the bed out with a golf green cup cutter. We brought them to the lab and divided them into uprights, stems, and below ground tissue. We dried the tissue, ground it, and analyzed for soluble sugars and starch. The results for Searles and Stevens are shown in Figures 1 & 2.

Uprights always had higher concentrations of carbohydrates than stems or below ground stems and roots. Uprights were about 10% sugars and starch before

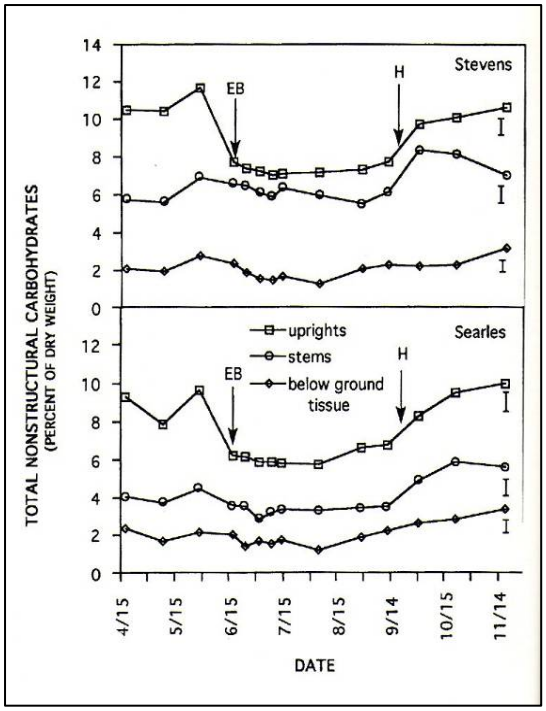

Figure1. Seasonal changes in total nonstructural carbohydrates in cranberry tissues in 1991.

flowering. As flowering began that concentration dropped to about 7% and stayed at about that level during the balance of the growing season, then increased back to near 10% in the fall after harvest. The sugar and starch concentration in the stems and below ground stems remained relatively constant through the season. The pattern was similar for both Searles and Stevens.

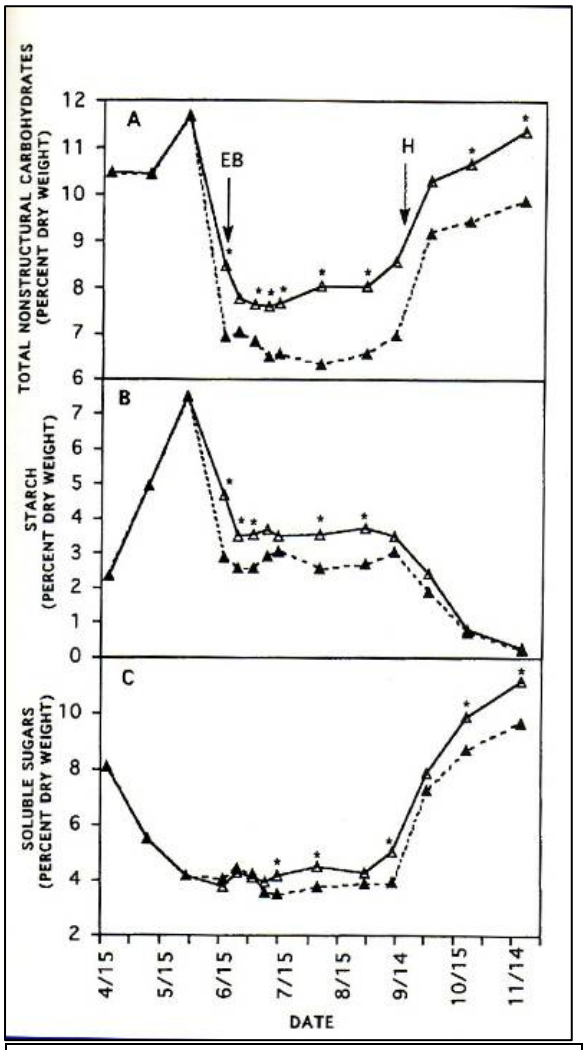

Figure 2. Changes in non-structural carbohydrates in 'Stevens' cranberry vines through a season. A. Total non-structural carbohydrates. B. Starch. C. Soluble Sugars.

When we look at the uprights in more detail we find a similar pattern (Fig. 2). Starch increased early in the season, then declined markedly as flowering began and stayed low throughout the season and declined further just before and after harvest. Fruiting uprights contained less starch than non-fruiting uprights during fruit development. Soluble sugars declined beginning in the early season and remained low until just before harvest. Fruiting uprights had slightly lower concentrations of soluble sugars than non-fruiting uprights. A summation of these two curves is shown in panel A of Figure 2 and the differences in fruiting and non-fruiting uprights are emphasized.

Two important conclusions can be drawn from this research. First, carbohydrates are reduced as fruit begin to develop and the concentration of carbohydrates does not recover until harvest. Second, the reduction in carbohydrates is greater in fruiting than non-fruiting uprights. Fruit appear to be a significant consumer of carbohydrates and attract significant amounts of carbohydrates to support their development. Thus, photosynthesis in the leaves is the source of sugars and fruit and vegetative growth are sinks for sugars.

Because carbohydrates fall to their lowest levels during the flowering and fruit set period, carbohydrate availability may be limiting to fruit set. Previously we showed that fruit along a given upright compete with one another for resources and based upon the shading, leaf removal, and carbohydrate analysis work it seems plausible that the limiting factor is carbohydrate availability.

Fruit are a significant sink for carbohydrates and photosynthesis is the source, but how much carbohydrate do cranberry vines produce through photosynthesis during the course of a season? To estimate that amount we measured photosynthesis every two weeks through a season and we did sunrise to sunset measurements on two days. The bi-

weekly measurements were taken on clear sunny days near noon. The results of the bi-weekly measurements are shown in Figure 3. Leaves of current season growth had a rate of photosynthesis that was roughly double that of one-year-old leaves throughout the season. The peak photosynthetic rate occurred in early June, then the rate slowly declined through the remainder of the season. Surprisingly, Searles had a slightly higher rate of photosynthesis than Stevens. In addition, the area of current season leaves on an upright remained steady through the season while the area of on-year-old leaves declined as the leaves dropped. Thus, not only did one-year-old leaves have a lower rate of photosynthesis, they also had declining leaf area. This suggests that current season leaves are the primary source of carbohydrates for fruit growth. Another research project to be described later further supports this conclusion.

The pattern throughout a day is shown in Figure 4. The rate of photosynthesis is low in the early morning while light is low, climbs rapidly during the morning reaching a peak about 10:00 am. The rate then declines slightly, but remains steady through the afternoon. As dusk approaches the rate drops as light once again becomes limiting.

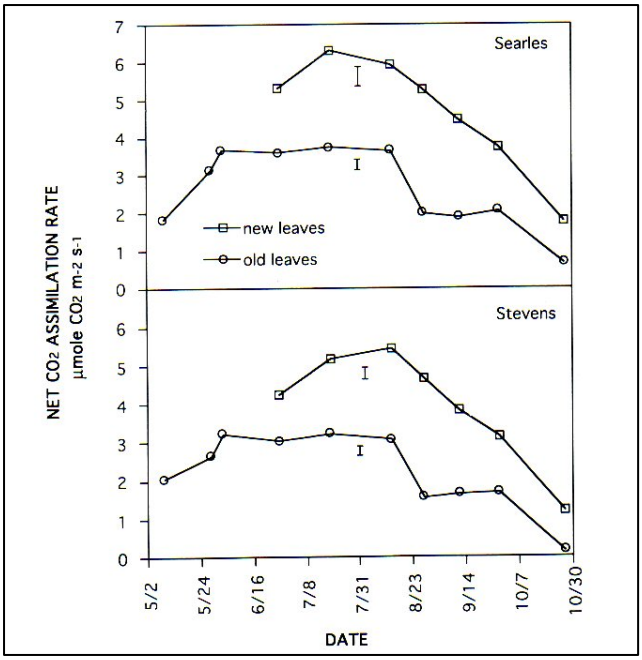

Figure 3. Seasonal changes in net photosynthesis of cranberry uprights during 1991.

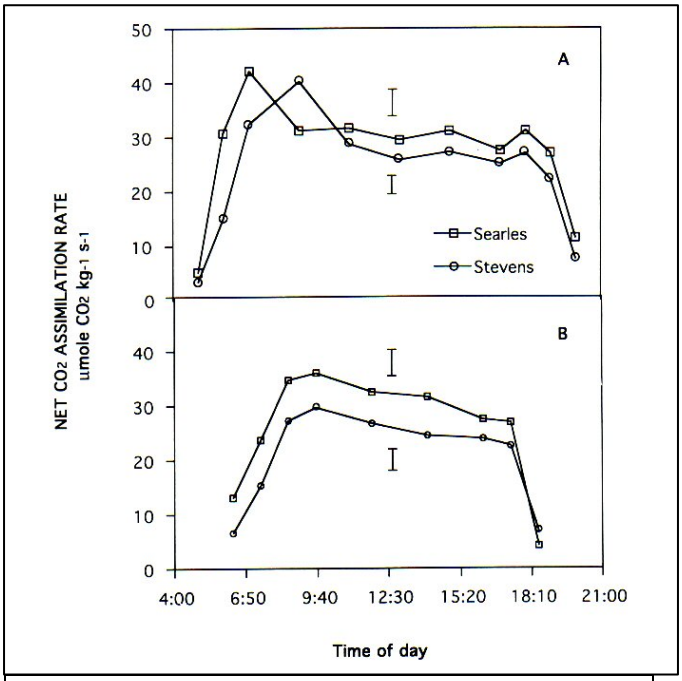

Figure 4. Diurnal changes in photosynthesis of Searles and Stevens Cranberry vines in Wisconsin on two dates in 1991.

If we sum the carbon fixed through photosynthesis during a season and compare that with the carbon content of mature fruit we can construct a carbon budget. Using the data we had we estimated the carbon fixed by a single upright and the carbon cost of fruit (Table 1).

Activity	**Carbon**
Grams C fixed per upright	0.45
Respiratory cost	0.09
Net C available per upright	0.36
Grams C per mature berry	0.09
Respiratory cost of fruit	0.09
Total C required per fruit	0.18

If these estimations are correct they suggest that the average number of fruit that can be supported by a given upright is two. My experience is that on average about two fruit set per fruiting upright.

In this article we learned:

- Non-structural carbohydrates are at their lowest point during the flowering, fruit set, and fruit development period.
- Uprights show the effect more than woody stems.
- Fruiting uprights have a lower carbohydrate concentration than non-fruiting uprights.
- Current season leaves have a higher rate of photosynthesis than one-year-old leaves.
- On average a fruiting upright can fix sufficient carbon to mature two berries.

The next article will describe research regarding where the carbon that supports fruit growth originates.

Teryl Roper, UW-Madison Extension Horticulturist

WHAT WILL GYPSUM REALLY DO?

I'm hearing reports from many areas about using calcium sulfate (Gypsum) on fruit crops. The reasons for applying this salt range from opening pores in plants to let nutrients in to changing plant or soil pH. Indeed, gypsum has been promoted to provide almost mythical benefits to those who will apply it. This article will examine gypsum and what research shows it will actually do.

Gypsum is a simple salt composed of Calcium and sulfate ions in equal quantities as: $CaSO_4$. It is slightly soluble. Most of us are reasonably familiar with gypsum as a major component of sheetrock wallboard used in our homes. Gypsum is slightly soluble in water.

The most common use for gypsum in soils is reclamation of sodic soils. Sodic soils usually have very high pH and high sodium content. Sodic soils are rare in Wisconsin, but can be found widely in western states. Soils with high sodium content won't aggregate when wet and moisture won't work through them. These soils are very difficult to work. Application of gypsum to sodic soils replaces some of the sodium (Na^+) ions with calcium Calcium (Ca^{++}) ions and allows the soil to be reclaimed. This action is very similar to the action in your water softener where calcium ions in the water displace sodium ions placed in the tank when the system recharges, thus keeping the calcium (but not the sodium) out of the plumbing.

The other use for calcium sulfate is to remedy calcium or sulfate deficiencies in soils. Other than these uses gypsum has no value as a soil additive.

Some advocate applying calcium sulfate directly to plants to achieve benefits. I know of no reports in the literature indicating a reproducible positive response under controlled conditions to applications of calcium sulfate. I can think of no biological mechanism where calcium sulfate would enhance uptake of other nutrients. Again, application of calcium sulfate directly to plants would help remedy either calcium or sulfate deficiencies (determined by a tissue test).

A couple of years ago a report was published in a reputable scientific journal about yields increasing significantly following an application of ethyl alcohol to plants. There was a lot of excitement about these findings and because these are easy experiments to do many people attempted treating different crops with ethyl alcohol. The subsequent reports I have read indicate **NO** yield response to applications of ethyl

alcohol to plants. The original researchers withdrew their paper. A few years ago someone was recommending peroxide and molasses applications to plants as a yield enhancer. Subsequent controlled research showed no effect. Others have recommended wetting agents or surfactants to enhance nutrient uptake, again, subsequent controlled research showed no effect on yield.

There are no magic bullets short of good sites and great management that will consistently produce good crop yields. My fifth grade teacher put it well: "Taking the easy route is what makes rivers and men crooked."

Teryl Roper, UW-Madison, Extension Horticulturist

ROUNDUP REMINDERS

With flowering over and fruit setting growers will once again be thinking about wiping weeds with Roundup. Be sure to read the product label before you begin an application. A few points warrant reminders:

- **Wear appropriate PPE**. This includes a long sleeved shirt and long pants and shoes plus socks. Waterproof gloves are not required, but are prudent. I see many violations of this label requirement.
- Coverage is the most important variable. You must have good coverage of the weed's leaf surface in order to get enough material throughout the plant to kill it completely. Dyes added to the wiping solution help you tell where you have wiped. Add dye per the package instructions.
- Increasing concentration does not make Roundup more effective. Concentrations that are too high may be detrimental as they can kill the contacted tissue before enough is translocated to kill the roots. A 10 to 20% Roundup solution works for most people. Even a 5% solution may be sufficient. This is a case where less is more. I am sure that the lack of control some growers experience is a result of using too much herbicide, not too little.
- Cut stump applications are allowed for woody brush. Cut the plant off then treat the stump with a Roundup solution. Making an emulsion with lanolin and then applying to the stump will help keep the Roundup on the surface so it is absorbed for a longer period of time.
- Adding liquid ammonium sulfate per the label specifications can help entry of the active ingredient and will improve performance.
- Regular Roundup requires a 6 hour rainfree period following application to get into the plant. Don't apply if rain is imminent.
- Remember the 30 day PHI.
- Keep the wiper surface clean. If dirt, weeds or other debris covers the wiper too little solution will accumulate on weed leaves.

Teryl Roper, UW-Madison Extension Horticulturist

Among the greatest blessings in life is to be safe with someone – someone without evil intent, someone who wouldn't violate a trust, who wouldn't take advantage of innocence or ignorance; someone who isn't planning in his heart to compromise principles. . . . We may have all else in life, but if we can't count on character, on integrity, if we haven't the sense of being safe, we have little that matters very much.

Richard L. Evans

Men build too many walls and not enough bridges.

Sir Isaac Newton

DETERMINING WEED SUSCEPTIBILITY TO GLYPHOSATE IN WICK-WIPING

Cranberry production is very reliant on the herbicide active ingredient glyphosate for control of several weed species in a wiper application. However, some growers have reported recent difficulty in controlling target species. It is critical to protect and maintain this management option in cranberry production. With this in mind, we are conducting research this year to determine the susceptibility of weeds common in cranberry beds to glyphosate. Weed seed from 6 populations of goldenrod, yellow loosestrife, and barnyardgrass will be sampled from areas where wick-wiping is a common practice. Seed will be planted in trays in a greenhouse and dose-response studies will be conducted to determine the level of susceptibility to glyphosate among populations.

We are currently identifying weed seed population sources and are seeking grower assistance. We ask that participating growers collect barnyardgrass, yellow loosestrife, and/or goldenrod seed from beds where wick-wiping has been a common practice and send it to us for testing. All locations and results will be reported anonymously. This research is kindly supported by the Wisconsin Cranberry Board.

If you are interested in participating, please contact me in the near future so that we can ensure that we have seed sources for 6 populations of each weed species. Please contact me at Colquhoun@wisc.edu or 608-890-0980 if you are interested and so we can discuss seed collection and shipment. Your cooperation in this and our other weed management studies is greatly appreciated.

Jed Colquhoun, Department of Horticulture, University of Wisconsin-Madison