The "Nuts & Bolts" from the Atlantic Cranberry Management Course 2006 (Fredericton, NB)

April 1st & 2nd – Fredericton Inn

The course was organized by the New Brunswick Cranberry Growers Association in cooperation with the NB Department of Agriculture, Fisheries & Aquaculture. I have done my best to highlight what I felt were key take-home messages, *i.e.,* the *nuts and bolts* (sometimes more than that).

I have a binder from the conference with small printouts of most of the slides from the conference, so if anyone would like to get a copy of the slide printouts from a particular talk or two, just let me know. ~Charlie Armstrong

New Brunswick now has between 450 and 500 acres of cranberries.

List of Talks that I Tried To Summarize:

- ✓ **Insect Management** (Anne Averill)
- ✓ **Cranberry Nutrition: How do I decide?** (Teryl Roper)
- ✓ **Insect Management & Late Water Insects** (Anne Averill)
- ✓ **Cranberry Pollination** (Kenna MacKenzie)
- ✓ **Cranberry Productivity: Causes, Limitations, & Management** (Teryl Roper)

Insect Management by Anne Averill, Associate Professor of Entomology, Univ. of Massachusetts:

- The cranberry tipworm and the blueberry gall midge (or blueberry tip midge) are in fact the very same insect, *Dasyneura oxycoccana* (Johnson). That point was not made during the presentation but I discovered it afterwards through talking with Anne and with Kenna MacKenzie. Kenna is a research scientist (and entomologist) at Agriculture and Agri-Food Canada.
- The researchers in Massachusetts still believe that tipworm is not an economic pest in that state because the plants compensate, contrasted with Maine, Wisconsin, and Canada, where the plants do not compensate as well – probably due to insufficient heat units or some other unfavorable condition(s).
- Sanding and Tipworm: Sanding is effective for one year against tipworm; the sand covers overwintering pupae. In a graph from research at Wisconsin, during one particular season, there was a comparison of tipworm infestation between sanded and unsanded beds. On June 20th, there was a 33% infestation in the unsanded compared to just 4% in the sanded beds. And on July 6th, the infestation was 70% in the unsanded compared to 36% in the sanded. Some early work by Franklin in Mass. in the 1900s found similar results: 37.3% infestation, not sanded, versus 7.1% infestation when sanded. Finally, sanding is most effective when done on an area-wide basis, as you would expect.
- Blackheaded Fireworm: Larval stage is short in duration, so narrow window of opportunity and easy to miss.
    1. Monitor and manage early. Egg hatch is in May (*probably late May for us*), just as vines come out of dormancy.
    2. Populations are patchy.
    3. They like the new growth best.
    4. Small larvae not picked up very well in sweeps and are hard to see. Large larvae are readily picked up in the net but are hard to manage by that point.
    5. Combine sweeps with *visual inspections.* Visually scan a 2x2 ft area for webbed leaves and damage for 30 to 60 seconds. Wisconsin IPM: Four scans per bed is method used, and in British

Columbia they do 10 scans per acre. *Discovery of just a few from a visual scan method may indicate a problem.*

6. Pheromone trapping for Blackheaded Fireworm: Be vigilant. And because adults may be highly patchy, trap captures may also vary widely from one trap location to another.

- Trapping for cranberry fruitworm - ineffective for pinpointing egglaying because the females can delay their egglaying until fruit begin to enlarge, and because the moths travel fairly lengthy distances throughout the land surrounding the cranberries.

Cranberry Nutrition: How do I decide? - by Teryl Roper, Dept. of Horticulture, Univ. of Wisconsin-Madison:

- When fertilizer prills land on the soil, they dissolve and diffuse.
- The absolute distance dissolved nutrients diffuse down into the soil is unknown, but varies with moisture, temperature, and the particular ion in question.
- Nitrogen: A little bit of nitrogen was found as far away as 24" from the location of the prill. Implications? Nitrogen does move some in soil and so the fertilizer placement is not critical.
- Need to provide cranberry plants with sufficient elements so that minerals are never limiting; Levels determined by tissue testing.
- When to apply fertilizer? 1) Time of greatest plant demand, and 2) Time when soil least able to provide it. The timing is not that critical, but several smaller applications are more effective than 1 or 2 large applications.
- When are nutrients most needed? At vegetative growth? At fruit set? At fruit enlargement? Nobody knows for sure – there is no published data. (*I found that surprising*)
- Soil Reservoir of Nutrients: Soils release nutrients over time; the rate depends on the amount in the soil and environmental conditions.
- How much fertilizer do I add? 1) Tissue analysis, 2) Crop, 3) Vigor, and 4) Grower experience
- How much phosphorus? Phosphorus is an important nutrient, but in Wisconsin studies where they added either 5 lbs, 10 lbs, 15 lbs, 20 lbs or 30 lbs of P per acre versus a control, there was no significant difference in crop yield for either sand beds or peat beds from 2001 – 2005. (Note: 20 lbs of straight P is equivalent to 40 lbs of P_2O_5). Tissue tests also did not vary significantly for either sand or peat beds with all of those different rates applied, and at all rates, the result was at least 0.1% dry weight of P in the subsequent tissue tests, and 0.1% is the critical value for P (the amount you want). Conclusions about P: Some P probably better than no P; Few differences among P treatments; Yield, tissue P, soil P did not increase with increasing rates of P; Even the Control plots were not deficient.
- Wisconsin Grower Plots: 3 growers agreed to a Reduced Phosphorus Study last year (2005); Paired beds (marshes), with one set getting normal P and one set getting reduced P. Yield and Tissue test P were compared. Results: no drops in yield from the reduced P marshes. They are still analyzing the tissue test data.
- How much potassium (K)? Several research projects done – 1) K Supplement Study, and 2) K Rate Study. In the Supplement Study (DeMoranville and Davenport, 1994), looking at K supplements versus grower applications, with both liquid and granular products, there was no effect on yield, berry size, rot, or tissue K, and all the tissue samples were in the sufficient range for potassium. For the potassium rate study (unpublished data as yet done by Joan Davenport in WI), yield was actually *reduced* at a high rate of K in 1 of 4 years; High K → Field and storage rot; and as tissue K increased, Ca, Mg, and Fe *decreased*. Why? All cations (positively charged ions) compete for soil exchange sites.

Insect Management & Late Water Insects - by Anne Averill, Associate Professor of Entomology, Univ. of Massachusetts:

- Spring floods were used routinely a long time ago in Massachusetts, mostly to enhance fruit keeping quality but also to manage pests.
- Late Water 'Rules' – Remove winter flood, reapply a deep flood and hold for 30 days, and scout for algae.
- Late Water 'Effects' – Loss of frost tolerance, synchronized bloom, fruit maturity delayed, and impacts on the following: cranberry fruitworm, cutworms, gypsy moth, southern red mite, weeds, and fruit rot (fruit rot is depressed for 2 years). *Does not impact blackheaded fireworm or Sparganothis fruitworm.*
- Table shown with some study results looking at Late Water (LW):
    - Cranberry fruitworm egg infestation without LW was 4.92%, versus only 0.52% with LW.
    - Number of insecticide applications: avg. of 2.7 without LW, versus only 0.88 with LW.
    - Cranberry fruitworm damage at harvest: 0.48% without LW, versus 0.49% with LW, so even with the reduction in insecticide applications, the percent of damage from fruitworm did not really go up.
- Another interesting table compares a 4-week versus a 2.5 to 3-week LW flood, and the resulting Cranberry Fruitworm (CFW) mortality:
    1. Site 1: LW for 2.5 weeks – 50% CFW mortality (28% on the Control plot, or plots – not sure if they had more than one control plot or not – can't tell from the table).
    2. Site 2: LW for 2.5 weeks – 45% CFW mortality (13% for the Control).
    3. Site 3: LW for 2.5 weeks – 40% CFW mortality (34% for the Control). Also, LW for 4 weeks, with 98% CFW mortality and just 20% for the Control plot(s).
    4. Site 4: LW for 3 weeks – 41% CFW mortality (37% for the Control). Also, LW for 4 weeks, with 94% CFW mortality and 71% for the Control plot(s).

    CONCLUSION: 4-week duration is much better!
- Phenological state of the plants is critical in deciding when to apply the LW flood!
    1. Apply before bud swell or color change.
    2. If Spring is warm, apply LW flood earlier rather than later.
- Keep water cool (Increase water volume; recharge)

Cranberry Pollination – by Kenna MacKenzie, Research Scientist, Berry Crop Entomology for Atlantic Food and Horticulture Research Centre in Kentville, NS.

- The cranberry is self-fertile → pollen of the exact same genetic composition can fertilize the ovary, so there is no requirement for mixed cultivar beds.
- Pollination agents are either <u>abiotic</u> (wind and water, for example), or else <u>biotic</u> (insects, birds & mammals, for example) – in other words, nonliving agents versus living agents. Insects are the most common biotic pollinators, with bees being the most important insects for most crops.
- In cranberries, a <u>biotic</u> agent is required to transfer pollen (so wind and water won't do the trick), and bees are the most important biotic agent in cranberry as in many other crops.
- **Yield Components in Cranberry:** *Primary* importance → **1)** proportion of flowering uprights, and **2)** fruit set. *Secondary importance* → **1)** total number of uprights per area, **2)** number of flowers per flowering upright, and **3)** fruit size.
- **Factors Influencing Yield in Cranberry:** pollination level, plant health, climate, pests, and water availability. Teryl Roper would argue that the amount of carbohydrates available in the plants is a big factor, though perhaps that could be considered as part of "plant health."

- **What does this all mean?** Good yield is a result of good pollination. BUT, poor yield isn't necessarily the result of poor pollination. In other words, excellent management, in all respects, *including pollination*, is required for excellent crops!
- **Cranberry flowers have rewards for attracting pollinators:** flowers (color and number), nectar (small amount per flower, but rich), and pollen (the pollen tetrads, or grains, are large and abundant – greather than 5000 grains per flower).
- **Vibratile Pollination (AKA "BUZZ" Pollination)** – With this type of specialized foraging behavior, the bee vibrates her wing muscles, the vibrations are transferred to the flower, causing the pollen to be released in a 'stream' fashion onto the bee. This is a very efficient and effective form of pollination.
- **Fruit Set and Size, and Seed Number, depends on the amount of pollen deposited → more pollen = more seeds = larger fruit.** So how much pollen is "enough?" In a lab and greenhouse study, where a known amount of pollen was placed on each stigma, fruit set, fruit size, and seed number were all measured. Maximum fruit set occurred at 8 tetrads, or pollen grains. Same finding for fruit size and maximum seed number.
- **What are bees? Answer: Specialized wasps that feed on flowers.** Nectar provides them energy (carbohydrates), whereas pollen provides protein. They have specialized structures for pollen collection, and it is estimated that there are 25,000 to 30,000 species of bee in the world. 36 bee species were found to forage in a Massachusetts study – most were occasional or rare visitors, with bumble bees being common, and some specialist bees were also present.
- **Pollen-foraging by bees is more effective than nectar-foraging in terms of pollination. Bees will sometimes simply 'steal' nectar rather than collecting pollen. Pollen-foraging bees leave enough pollen tetrads on the stigma (the magic number of 8 or more), and nectar-foraging honey bees 'probably' leave enough, too. Overall, honey bees deposit fewer tetrads per stigma than bumble bees do (avg. of 45.6 tetrads per stigma for honey bees vs. 58.2 per stigma for bumble bees in a study that was done).** *Whether a bee tends to forage legitimately, or just steal nectar, varies with bee species, site, and year.*
- **Native bees have value.** Plantings with native bee populations will have effective pollinators in the landscape, and thus less reliance on managed bees. **How to conserve native bees?** Maintain natural areas, and plant bee forage plants that, in total, will last for the entire life of the bees and/or their colonies. However, it is also recommended that you mow during cranberry bloom, especially if using honey bees, since honey bees favor many other flowers over cranberry. Because of that, it is recommended that honey bees be brought in when the cranberries are 15-20% in bloom. Place the colonies in groups on bed edges with their entrances facing south or southeast and away from winds if possible.
- **Bumble bees** – Excellent Cranberry Pollinators (used mainly for greenhouse crops, but their use in cranberry is on the rise; relatively small colonies; Suggested stocking rate per acre is 1 to 3 colonies).
- **Alfalfa Leafcutting bees –** Used on massive scale for forage seed pollination in western North America; Used on wild blueberry; Forage on cranberry; Need an alternate source for leaves that they cut; Potential pollinator for cranberry, especially if you are near a wild blueberry operator who is using them; Stocking rate per acre is 20,000 or more bees, which is equivalent to 2 honey bee colonies; Bring them into the cranberries at 15-20% bloom; Place shelters near beds with entrances facing south or southeast and away from winds if possible.

Cranberry Productivity: Causes, Limitations, & Management – by Teryl Roper, Dept. of Horticulture, Univ. of Wisconsin-Madison:

- **What limits yield?** Pests, fertilizer, water, light, heat, and resource partitioning.
- **What do you farm?** Do you farm the soil, or do you farm sunlight (Teryl pointed out, through the course of his talk and research summaries, that basically cranberry growers are farmers of **sunlight**).
- His next slide was one showing the breakdown of solar radiation – the annual total solar radiation – and where it ends up. 30% of it occurs during the time when the cranberry plants are dormant. 35% comes in the form of what is termed non-PAR radiation, where PAR is short for Photosynthetically Active Radiation, so non-PAR means, of course, it *isn't* photosynthetically active. Another 20% of it never strikes the cranberry leaves. 9% of it is reflected. 4% of it is used for respiration. Only 1% of it actually goes for vegetative growth, and only another 1% ends up in harvestable fruit. He then talked some about all of the different things that can interfere, or intercept, sunlight before it can reach the cranberry leaves (weeds, trees, even other cranberry leaves if, for example, they are too overgrown and in need of pruning).
- **What contributes to yield?** Photosynthesis, Crop Genetics, Fertility, and Weather.
- **Yield Components:** The two factors that are most important are 1) Proportion of flowering versus non-flowering uprights, and 2) Fruit set. Focusing on those two factors is considered the best strategy, in general, to trying to increase yield.
- **Cranberry uprights are biennial bearing, where individual uprights tend to flower and fruit in alternate years (fruit in year 1, no fruit in year 2).**
- **How can I get all the pinheads to set into fruit? Why don't they all set?** Fertilizer problems? Pollination problems? Heat stress? Blossom injury? What limits fruit set? Is it pollination or competition for resources in the plant? In a leaf removal study examining the question of resources, removing new growth was more limiting to fruit set than removing 1-year-old leaves. Fruit size was not affected, however, by leaf removal, whether they were the new leaves, the old leaves, or both. The current season growth, however, does support fruit growth, whereas old growth contributes very little. And adjacent uprights do not contribute any to fruit growth in terms of providing resources. Pollination was ruled out as a *big* factor in limiting how many pinheads go on to set fruit, because in a pollination study they did, supplementing insect pollination with hand pollination only increased fruit set from 30% to 38% in two successive years. **In other words, ensuring full pollination still did not substantially increase fuit set.** Bee attractants also did not work consistently at increasing pollination or fruit set. They also studied the use of gibberellic acid in increasing fruit set. What they found is that spraying gibberellic acid (as done by grape growers), will in fact increase fruit set, but overall yield is unchanged because it simply results in smaller berries – greater number of berries, but smaller, so total yield is unchanged.
- **The final question they examined, then, is the question of carbohydrate levels. Could an insufficient amount of sugars available to support fruit growth be the primary factor that limits yield?** Yes. That seems to be the culprit. Carbohydrates increase early in the season, prior to bloom, then fall to their lowest level during flowering. The levels recover some in autumn. This supports the suggestion that carbohydrates limit fruit set. And in an estimation of carbon requirements for cranberry, the net carbon available per upright worked out to be 0.36 grams, and the total carbon that is required for a single cranberry to form is 0.18 grams. Thus, one would expect an average of only two cranberries per fruiting upright. When I asked Teryl what is going on in those instances of uprights with 4 or 5 berries, he said that what those uprights tend to have in common is

that they are higher up in the canopy (more sunlight), and they also have a greater number of current-season (new-growth) leaves versus uprights with only one or two cranberries. So the 'typical' upright, in other words, can only store enough carbon (in the form of carbohydrates), to manufacture two cranberries.

Some other tidbits of information that came from the course:

- Do not use Casoron on newly sanded beds (stresses the vines too much)
- Symptoms of Stinger® damage on cranberry include 1) flagging over of the tips, and 2) early flowering.
- Glyphosate (ingredient in Roundup®) binds very readily with soil particles, so if your target weeds are dusty or dirty at all, do not apply the Roundup® but wait until the weeds are clean first. Otherwise, too much of the material will just bind to the dirt/dust and will not be absorbed into the weeds.
- Hardwood sawdust as a weed suppressor (mulch): Weeds with small seeds can't grow through it; Recommended using a depth of 2", and only hardwood sawdust. A slide was shown, depicting a sawdust-covered area next to a 'no' sawdust area, and the difference in weed levels was very striking – very much like the photos you see showing very good herbicide results; those side by side comparisons between the herbicide-treated plots and the control plots.
- Researchers are exploring the use of cranberries in chicken feed, because of the antibacterial properties of the cranberry (beneficial to the health of the chickens). I believe the Cranberry Institute is behind this effort, so we should be hearing more about it in the future.

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