

# Cranberry

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### When and How Long to Flood for Insect Control

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Flooding in late spring (late May or early July) can remove lots of arthropods from cranberry beds. For over 100 years, the Wisconsin cranberry industry has used flooding as a way to suppress arthropod populations. One critical element of this strategy is the trade-off between lethality for insects and harm to the cranberry plant. One basic question underlying our flooding research, therefore, has been the following: How late can we push the flood timing to hit the caterpillars, and how long can we hold the water without hurting the plant?

In collaboration with Wisconsin pest management consultants and growers, we set up a large-scale experiment in central Wisconsin in 2011. This work involved 23 pairs of flooded and unflooded beds (46 beds total, among 11 commercial growers), and we included not only arthropod metrics (Sparganothis fruitworm, cranberry fruitworm, and black-headed fireworm densities), but also plant metrics (chlorophyll, upright growth, flowers/upright, harvestable crop) and surface water metrics (temperature, dissolved oxygen, and pH).

In parallel, we conducted a submergence tolerance study in a greenhouse setting, where we could concurrently manipulate the effects

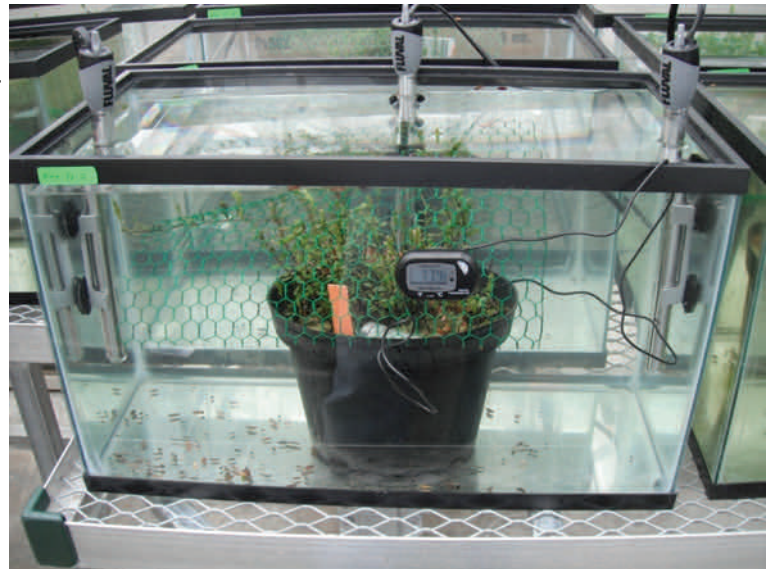


Figure 1: Submergence Study in Greenhouse

of water temperature (cool, warm regimes) and submergence duration (0, 48, and 96 hrs) on three different cranberry varieties ('Stevens,' 'Ben Lear,' and 'GH1').

From our field data, we showed that spring-time surface waters in Wisconsin were generally well-oxygenated and cool (8.2 ppm at flooding, and then 7.7 ppm as water drained; 64-65°F). As water temperature rose, dissolved oxygen (DO) declined. At the majority of the marshes, DO levels were not worrisome, although there was some evidence of hypoxia at a few marshes (see circled data points in Figure 2 on p. 2). Still, this was not a problem for the cranberry plant. The take-home message: Wisconsin reservoirs are well-oxygenated, and the floodwaters remained well-oxygenated during the spring flood.

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## When and How Long to Flood for Insect Control (Continued from p. 1)

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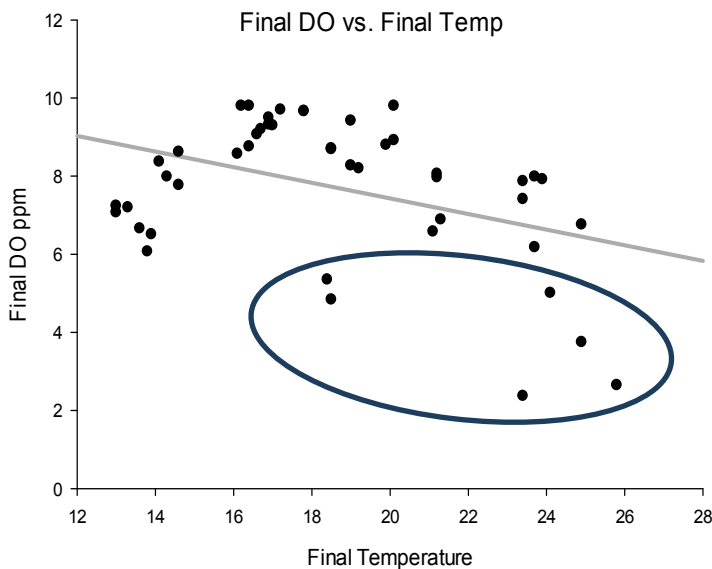


Figure 2: Evidence of Hypoxia

### Insect trapping results:

After 30-40 hours of flooding, the floodwaters warm up and begin to lose dissolved oxygen. At week-2 post-flood, black-headed fireworm trap-catch in pheromone-baited traps was significantly lower in flooded beds than in the non-flooded beds. That’s good news. Sparganthis fruitworm and cranberry fruitworm trap-catch numbers in flooded versus non-flooded beds (which received insecticide treatments) were equivalent, suggesting that the effects of the flood were similar to that of insecticide treatments alone. That’s good news, too.



### Pheromone-based trapping

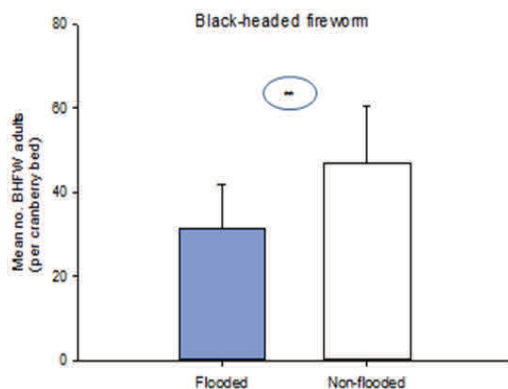


Figure 3: Insect trapping results

**Plant response data:** In terms of the cranberry plant, there was initially some evidence of flood-induced stress. (Figure 4) By week-1, chlorophyll was reduced in the leaves of flooded beds, and by week-4 (see table below), the average number of flowers per-upright in flooded beds (3.83 flowers/upright) was lower than the non-flooded beds (4.16 flowers/upright). However, by harvest there was no difference in the harvestable crop between flooded (204.3 grams/sq. ft.) and non-flooded beds (203.0 g/sq. ft.). The flooding effect on the plant in the field was non-existent.

### Early-season:

	Flooded	Non-flooded	P
<b>Week 1:</b> Chlorophyll (SPAD)	9.40	10.84	0.029
<b>Week 2:</b> Upright lengths (mm)	45.36	46.65	0.342
<b>Week 3:</b> Hooks/upright	2.58	2.72	0.420
<b>Week 4:</b> Hooks + Flowers/upright	3.83	4.16	0.016*

Figure 4: Flooding /Non-Flooding effects

We found the same to be true in studies of prolonged submergence of sods in our greenhouse trials. Here, we learned that over the long term, cranberry sods can sustain complete submergence for 96-hrs, whether the water is cool or warm, as long as dissolved oxygen levels remain above approximately 40% saturation (~5 ppm). However, 7 days after treatment (see Figure 5 on next page; Greenhouse trials: upright length at 7 DAT), there were significant differences between controls (0 hours submergence) and 96 hours of submergence. For each variety, being submerged for the longer duration significantly reduced the growth of uprights. After 7 weeks, though, this trend was no longer evident. The response of both ‘Stevens’ and ‘GH1’ were similar among the 0, 48, and 96 hour submergence duration regimes (see Greenhouse trials: hooks per upright at 49 DAT—Figure 6 on next page.)

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**When and How Long to Flood for Insect Control (Continued from p. 2)**

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Notably, there was a significant difference between cold and warm effects, where warm water caused a greater reduction in upright growth 49 days-after-treatment (DAT). Interestingly, the ‘Ben Lear’ sods suffered much more,

early evidence of flood-induced plant stress, yet by harvest (Sept/Oct), the difference between flooded and non-flooded beds was non-existent. Note in the Figure 7 on p. 4 that early in the season (left panel, “Early-season”), there were fewer hooks and flowers per upright, but by harvest (right panel, “Late-season”) there was no significant difference between flooded and non-flooded beds. Why might this be? Does the plant possibly compensate by re-allocating resources? An old study done in Wisconsin (using ‘Searles’) shows how cranberries are “shed” all season, eventually reaching about 2 fruit/upright by harvest (see Figure 8 on p. 4, from Hawker & Stang 1985). What this suggests is that mild stressors, like spring flooding, might reduce flowers per-upright early in the season (from an average of about 4 per-upright to 3 per-upright), but it doesn’t matter because by harvest, berry counts and weights are the same between flooded and non-flooded beds. One explanation for this is that the sods only mature approximately 2 berries/upright. Thus, as long as spring flooding does not reduce the average number of berries/upright to fewer than 2, there is not a significant problem for the plant with a long, early-season flood.

**Greenhouse trials:  
upright length at 7 DAT**

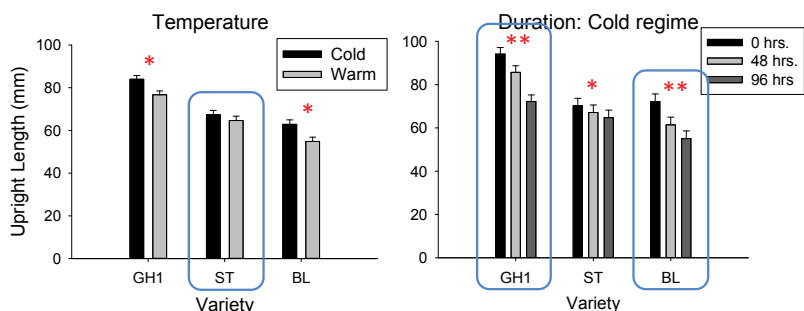


Figure 5: Hooks Per Upright Results @ 7 DAT

even in the cold water regime, but this can be explained by the markedly depleted oxygen levels in the ‘Ben Lear’ water. Here we suspect there was elevated microbial activity reducing available oxygen.

For the ‘Stevens’ and ‘GH1’ sods, the cold water regime (Figure 6) was quite similar to water temperatures and dissolved oxygen levels in the field. This allowed us to focus on the cold water regime in the greenhouse to assess how well these plants could sustain prolonged submergence. After being submerged for 96 hrs and then being allowed to grow under natural conditions for 7 weeks, there was no difference (in terms of hooks or flowers per upright) between these plants and those that had not been submerged at all. This suggests that as long as dissolved oxygen levels are not too low (< 40% saturation), cranberry sods (‘Stevens’ and ‘GH1’) can remain submerged for prolonged periods (48-96 hrs) in the springtime without suffering significant injury.

**Greenhouse trials:  
hooks per upright at 49 DAT**

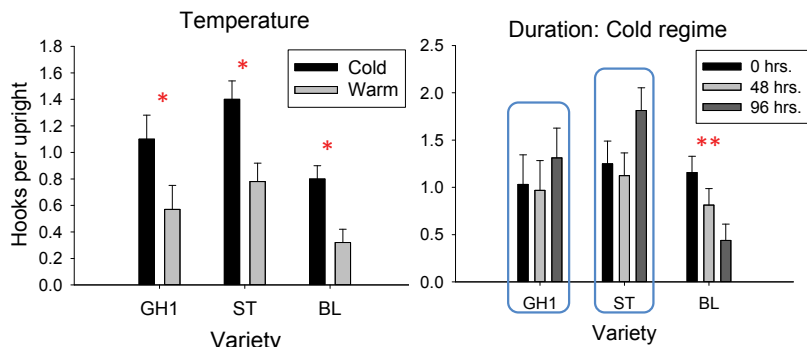


Figure 6: Hooks per Upright Results @ 49 DAT

In the field, we observed a similar trend in which there was

**Continued on p. 4**



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(Continued from p. 3)

Altogether, the findings from our 2011 study suggest that 30-40 hours of flooding in late spring do not affect the cranberry harvest, and the floods do help to suppress insect populations. Growers flooding for longer periods

### New Insecticide Registered on Cranberry

By Christelle Guédot

Fruit Crops Entomologist/Pollination

Ecologist

**Venerate™ XC** is a new insecticide registered on cranberry in 2014 by Marrone© Bio Innovations. Venerate™ XC is a biological insecticide/miticide containing multiple active ingredients from heat-killed cells and fermentation solids of *Burkholderia* species strain A396. Venerate™ XC causes enzymatic degradation of the exoskeleton and interferes with the molting process. Mortality of the insect targets occurs through contact and/or ingestion of venerate™ XC.

Venerate™ XC is a concentrate and must be mixed with water and applied at 1-8 quarts per acre as a foliar spray. It is approved for cranberry in Wisconsin and is registered for control of armyworms, fireworms, leafrollers, loopers, and sparganothis fruitworm. It is registered for suppression only of aphids, cranberry blossom weevil, mites, and thrips. Scouting for early signs of infestations and proper timing of applications targeting newly hatched larvae, nymphs or immature pests is important. Thorough coverage of infested plant parts is necessary for effective control of insects and mites.

Venerate™ XC has a 4-hour REI and a 0-day PHI. It has no limit on the number of applications per season.

Venerate™ XC is not toxic to bees, fish, birds or most beneficial insects. However, to minimize potential exposure to bees and other pollinators, do not apply while bees are foraging.

Venerate is OMRI approved and NOP compliant so it is a good option for organic growers. Its new modes of action can complement IPM programs and reduce risks of insecticide resistance.

Our very own Jack Perry has tested it in the previous season and will do so again this season, so stay tuned!

Venerate™ XC has an MRL tolerance exemption, however, you are encouraged to check with your handler before using any new product.

And as always, make sure to read the label before using any pesticide. Here is the link to the label [http://www.marronebioinnovations.com/lighttray/site/wp-content/uploads/2014/04/VENERATEXC\\_SpecimenLabel\\_2014\\_01\\_web.pdf](http://www.marronebioinnovations.com/lighttray/site/wp-content/uploads/2014/04/VENERATEXC_SpecimenLabel_2014_01_web.pdf)

For more information on Venerate go to <http://www.marronebioinnovations.com/products/brand/venerate/>

### Does the plant compensate for early-season stresses?

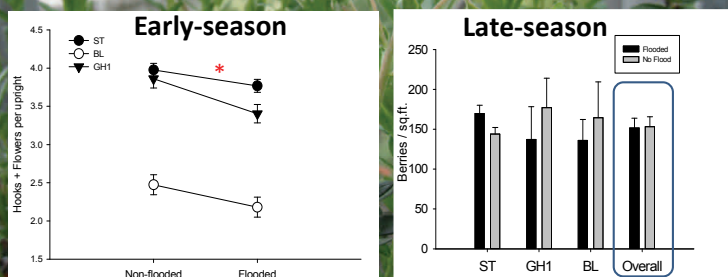


Figure 7: Comparison of Early-Season to Late-Season Plant Stress

will want to watch dissolved oxygen levels in their flood-water, because over time, dissolved oxygen levels slowly decline.

### Does the plant compensate for early-season stresses?

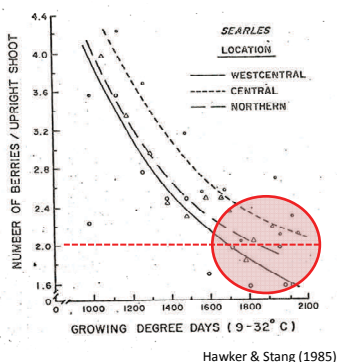


Figure 8

### References Cited

Hawker, G.M., and E.J. Stang (1985) Characterizing vegetative growth and fruit development in cranberry (*Vaccinium macrocarpon* Ait.) by thermal summation. *Acta Horticulturae* 165, 311-324.



## Proposed Changes to Worker Protection Standards By Jane Larson, Worker Protection Standard Coordinator DATCP

The U.S. Environmental Protection Agency has proposed changes to the Worker Protection Standard. **The EPA has now extended the comment period on those changes to August 18, 2014.**

The Worker Protection Standard applies to anyone who:

- Owns or manages farms, forests, greenhouses and nurseries where pesticides are used
- Hires or contracts with workers to apply pesticides or work with plants to which pesticides are applied
- Has workers who will be in areas where pesticides are applied within 30 days of application or within a quarter mile of treated areas

The changes involve five major areas: training, notification, hazard communication, minimum age and personal protective equipment.

On the following are two brief EPA summaries of the changes to this message. One is an overview, and the other compares the current standard with the proposed changes. Washington State University Extension has done a more detailed comparison of the current WPS versus the proposed changes. You can find that at [http://pep.wsu.edu/pdf/factsheets/WPS\\_Rule\\_Revision\\_Matrix\\_WSU\\_V3.pdf](http://pep.wsu.edu/pdf/factsheets/WPS_Rule_Revision_Matrix_WSU_V3.pdf).

For more details, visit the EPA website at <http://www.epa.gov/oppfead1/safety/workers/proposed/index.html>. It provides an overview; if you scroll to the bottom of the screen, you will find more detailed information about individual parts of the proposal.

For the actual legal language and to comment on the proposal, go to <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2011-0184-0119>. You can also view comments already made at the site.

This is a federal law and a federal proposal, but DATCP is charged with enforcing the law in our state. You are encouraged to familiarize your constituents with the proposal and encourage them to send comments to the EPA. If you see problems with the proposal, provide specific examples of why particular provisions would not work, would be difficult to implement, or would increase costs. If you support the changes, the EPA needs to hear that, too.



*References to products in this publication are for your convenience and are not an endorsement of one product over similar products. You are responsible for using pesticides according to the manufacturer's current label directions. Follow directions exactly to protect the environment and people from pesticide exposure. Failure to do so violates the law.*

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(We will also remove your name from the paper copy list.)

Thank you!





## Proposed Changes to the Farm Worker Protection Standard

The Environmental Protection Agency issued proposed changes to the Agricultural Worker Protection Standard (WPS) to increase protections from pesticide exposure for the nation's two million agricultural workers and their families. Proposed changes:

- Annual mandatory trainings (rather than once every 5 years) to inform farm workers about the protections they are afforded under the law, including restrictions on entering pesticide-treated fields and surrounding areas, decontamination supplies, access to information and use of personal protective equipment. Expanded trainings will include instructions to reduce take-home exposure from pesticides on work clothing and other safety topics.
- Expanded mandatory posting of no-entry signs for the most hazardous pesticides. The signs prohibit entry into pesticide-treated fields until residues decline to a safe level.
- First-time ever minimum age requirement: Children under 16 will be prohibited from handling pesticides, with an exemption for family farms.
- New no-entry 25-100 foot buffer areas surrounding pesticide-treated fields will protect workers and others from exposure from pesticide overspray and fumes.
- Mandatory record-keeping to improve states' ability to follow-up on pesticide violations and enforce compliance. Records of application-specific pesticide information as well as farmworker training and early-entry notification must be kept for two years.

### Additional Proposed Changes

- Personal Protection Equipment (respirator use) must be consistent with the Occupational Safety & Health Administration standards for ensuring respirators are effective, including fit test, medical evaluation and training.
- Requirement to make available to farm workers or their advocates (including medical personnel) information specific to the pesticide application, including the pesticide label and Safety Data Sheets.
- Additional changes make the rule more practical and easier to comply with for farmers.
- Continues the exemptions for family farms.

For more information: [www.epa.gov/pesticides/](http://www.epa.gov/pesticides/)  
February 20, 2014



# AGRICULTURAL WORKER PROTECTION STANDARD (WPS) COMPARISON OF THE MAJOR NEW PROPOSED PROTECTIONS TO THE EXISTING PROTECTIONS



PROPOSED NEW PROTECTIONS	CURRENT PROTECTIONS
<b>Pesticide Safety Training</b>	
<b>Train workers and handlers every year.</b> Stricter qualification for trainers of workers.	Train workers and handlers every 5 years.
<b>Expand training content to include information on reducing take-home exposure.</b> Workers and handlers would be trained on reducing take-home exposure, the hazards from residues on clothing, and warned not to take containers home.	No training provided on reducing take-home exposure. Workers and handlers are trained on hazards from residues on clothing and warned not to take containers home.
<b>Reduce "grace period" to 2 days</b> before full WPS training is required, expand the content of the abbreviated, pre-"grace period" training, and require distribution of information sheet listing training points.	Grace period is 5 days and there is less content to the abbreviated training, and no information sheet.
<b>Require recordkeeping of training for 2 years.</b>	Recordkeeping of training is not required.
<b>Mandatory Posting of No Entry Signs</b>	
<b>Require posting of treated areas</b> when Restricted-Entry Interval (REI) is greater than 48 hours. The REI is the interval after application during which worker entry is generally prohibited, except as allowed under the early entry exceptions.	Either oral or posted notification is acceptable for REIs of any length, unless the pesticide labeling requires both.
<b>Minimum Age</b>	
<b>Require pesticide handlers and early-entry workers to be 16 years old.</b>	No minimum age.
Members of owner's immediate family are exempt from this (and most other) requirements of the WPS.	No minimum age requirement.
<b>No Entry Buffer Areas Adjacent to Areas being treated on Farms and Forests</b>	
<b>Prohibit entry into 25- 100 foot buffer areas around the field during pesticide application on farms, forests, nurseries, and greenhouses</b> to protect persons from pesticide overspray and fumes. The buffer size depends on the type of application.	Applies only in nurseries and greenhouses.
<b>Personal Protective Equipment (PPE): Respirators and Closed Systems</b>	
<b>Adopt the OSHA standard for respirators:</b> fit test, medical evaluation, and training. Require recordkeeping to document completion of these requirements.	Employer must provide the respirator listed on the pesticide labeling and ensure it fits. Recordkeeping is not required.
<b>Add specific performance standard requirements for closed systems based on California (CA) standard to permit PPE exceptions.</b> Does not include the CA requirement to use closed systems for certain types of pesticides.	The closed system definition fails to provide specific criteria for the PPE exception.
<b>AGRICULTURAL WORKER PROTECTION STANDARD (WPS)</b>	



<b>COMPARISON OF THE MAJOR NEW PROPOSED PROTECTIONS TO THE EXISTING PROTECTIONS</b>	
<b>PROPOSED NEW PROTECTIONS</b>	<b>CURRENT PROTECTIONS</b>
<b>Hazard Communications</b>	
<p><b>Require employer to maintain and make available to workers, handlers, or their authorized representatives application-specific information, labeling and Safety Data Sheets (SDS). Retain this information for 2 years.</b></p> <p><b>Remove burdensome requirement to post application-specific information at central display.</b></p>	<p>No requirement to make safety information available to authorized representative.</p> <p>Record keeping is not required, except, application-specific information must be posted at a central display until 30 days after the REI expires.</p>
<b>Notification for Early-Entry Workers</b>	
<p>In rare circumstances, early-entry workers can enter while REI is in effect. For these situations, <b>provide notification of the pesticide application (what was applied, when and where), specific task to be performed, and amount of time the worker is allowed to remain in the treated area, along with the pesticide hazard information from the labeling.</b></p> <p><b>Require recordkeeping for 2 years of the notifications</b> that are provided to early-entry workers.</p>	<p>Early-entry workers must be informed only of hazards written on pesticide labeling.</p> <p>Recordkeeping is not required.</p>
<b>Definitions</b>	
<p><b>Expand the definition of "immediate family" to more accurately reflect farm families</b> that qualify for the exemption from most WPS requirements.</p>	<p>Currently the definition does not include family members such as grandparents, grandchildren and in-laws.</p>

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