Learning Module #4

Locating a new production facility for crop health and sustainability

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► Hello, everyone, welcome to the webinar! I'm Chuan Hong, a professor of plant pathology at Virginia Tech. I will be leading today's webinar.

► This is the tenth webinar in a series, organized by the multi-institutional research team on the Specialty Crop Research Initiative Project: Integrated Management of Zoosporic Pathogens and Irrigation Water Quality for a Sustainable Green Industry. This project is sponsored by the USDA National Institute of Food and Agriculture. We greatly appreciate the Society of American Florists and the AmericanHort, previously known as the American Nursery and Landscape Association, the advisory panel and many farmers for their continuing support. They have played key roles in every stage of this project from proposal development to field studies and educational programs.

► Credit to the entire project team and the advisory panel as well as all the collaborating growers, this project has been very productive. We have recently updated the project outreach website at www.irrigation-pathogens.info with several new tabs. The Activities tab highlights what we have accomplished over the past 3 years and ongoing programs. The Hot Topics tab presents the latest info on boxwood blight, an emerging disease of grave concern to the ornamental horticulture industry. The Webinar tab provides a link to the recording of each previous webinar along with the materials presented to allow catch up and review.

I encourage you visit the site soon if you have not done so recently.

► This diagram illustrates three distinct stages in the crop production business development and management.

The first stage is planning and purchasing a piece of land during this time a production facility is being located.

The next is to grade the land, set up production beds and irrigation systems, getting ready for crop production, so here we call it “prior to production”. And

The third stage is to really grow plants, every happening is “in-season”.

The ultimate goal is to produce the most and best quality horticultural products possible.

However, the reality is not always perfect, there will be all kinds of issue of different natures and among these issues is plant disease even during a normal growing season.

Before we move forward, I would like to ask you a question:

Poll Question 10.1

Which of these stages do you typically begin thinking and acting on crop diseases and crop health-related issues or pathogen mitigation?
Putting our last four webinars into perspectives of agricultural business stages, two water treatment webinars by Dr. Copes and myself, and the substrate management webinar by Dr. Ristvey target the in-season crop management.

The last month webinar by Dr. Lea-Cox targets the systems setup stage (prior to production). The key message from the last month webinar was that crop health is built into your production systems! When you grade land, make production beds, route runoff water flow in production area, everything you do all impact pathogen reproduction, survival and spread within your nurseries and greenhouses.

Today, I will take a step further to show you that crop health risk at a production facility is, to some degree, pre-determined during the planning stage. Where to build a production facility makes a huge difference in crop health and sustainability!

This concept emerged when I was developing learning modules for an online green industry knowledge center on water and nutrient management about 7 years ago. This knowledge center is housed in the Dr. John Lea-Cox’s lab of University of Maryland in College Park.

The knowledge center includes 26 learning modules and one focuses specifically on Management of pathogens in irrigation water. I encourage you to visit this knowledge center at www.waternut.org, if you haven’t.

Why location is so important? Here is a perfect analogy!

Building a new production facility is like investing in a new property. The most important things to consider in real estate investment are location, location, and again location. The very same thing applies to building a new horticulture facility. The only difference between these two investments is what behind the location! In real estate business, what affects the ranking of a location is its school district. Properties are appreciated much more and faster in a good school district than those in not as good school districts. In parallel, the ranking of a location for horticultural production facility is greatly affected by the availability and quality of water at that location.

Why water?

We all received a wake-up call from Sandra back in 1992. “We are running out of water!”

Water shortage is an issue of global significance in particular for agriculture. No water, no plant can be grown nor will existing crops survive.

In 2004, USDA hosted a listening session in Park City, Utah; and during that meeting, water shortage was termed as an agricultural security issue of national scope.

Yes, water shortage is no longer limited to the western states such as California, Arizona. In 2007, it occurred here in Virginia and mid-Atlantic region, a supposedly water-rich area.

Water shortage could happen anywhere and anytime!

Water is considered as the horticulture’s next game changer at the Seeley Summit in Chicago a couple of weeks ago. And,
This also is echoed in the latest issue of Nursery Management (June 2014). Every drop counts!

Running out of water is NOT an option for any horticulture businesses. As there is NO substitute for water, those who have an adequate supply of water will have the world.

Essentially, there are two major strategies to secure that water supply.

- First is to build a new production facility in a location with plentiful of water.
- Once the land is purchased and the facility is built, the only option left is to capture every drop of water and reuse it for irrigation.

Water recycling does have some economic and environmental benefits. It recycles nutrients and may save some fertilizer expense. In the meanwhile it prevents nutrient-rich runoff water from being released into the environment, protecting the precious natural water resource.

However, this option has been of limited use for horticultural crops so far. As shown in the pie chart, only 8% of the horticultural crops were irrigated with recycled water nationally in 2008. This is due, in part, to some major issues associated with current water recycling practices.

As presented in the previous webinars, runoff retention ponds potentially are plant pathogen accumulators and redistribution centers. At least 57 species of Phytophthora, 29 species of Pythium, and many other pathogens have been found in recycled water. These pathogens are among the major troubles associated with current water recycling practices.

Another major trouble is recycled water quality. For example, pH is an important water quality parameter which has profound impact on the performance of chlorine, and other disinfectants as discussed in previous webinars.

This screen shot shows real-time water pH readings over a 6-month period in four ponds coded in different colors. Both orange and red ponds received runoff directly from production areas.

As you can see, water pH fluctuated dramatically overtime and mostly in the basic range in these two ponds. This water pH range and fluctuation reduces chlorine performance dramatically. Whether they also affect the performance of other practices is yet to be investigated.

As such, farmers’ best bet is to build new facilities at locations with plentiful of good quality water, so, s/he does not have to have any of these troubles.

You might wonder what “good quality water” means? This will be a major focus of following discussion. We will review different sources of water in this respect.

First, let’s look at CITY WATER. City water, of course, is of good quality for people and plants. It usually has a residue chlorine level at 2 to 4 ppm, which suffices to kill zoospores of Phytophthora species and some other pathogens. Thus, use of city water for irrigation is pretty safe in term of crop health. This may be used as a backup option for emergency situations otherwise, it would be too costly for any agricultural enterprises.

What about WELL WATER? Compared to surface water, well water has several advantages:

- Well water is much large in capacity.
- Its yield is very stable, or no dry and wet periods.
- It is more uniform in temperature and soluble minerals.
- It also is free of turbidity!

However, well water has its own share of issues:

- It is not available or practical everywhere.
- It is not always in good quality for irrigation purpose. For example, it may have high iron and manganese content.
- It is strictly regulated, both existence and quantity by permits only.

► Just to give you a sense of the national status of irrigation water sources for ornamental horticultural crops. These data were from the 2008 Farm and Ranch Irrigation Survey.

As shown in this pie chart, most horticultural crop production areas were irrigated with well water with 62% for greenhouse production and 50% for open field production.

The other two water sources are:

Off-farm suppliers

This includes all sources that are controlled by a water supply organization such as the U.S. Bureau of Reclamation; irrigation districts; mutual, private, cooperative, or neighborhood ditches, commercial companies, or community water systems.

On-farm surface water:

These water sources are not controlled by any water supply organization. They could be streams, drainage ditches, lakes, ponds, reservoirs, and on-farm livestock lagoons on or adjacent to the farm land.

►Anyway, well water irrigated 62% of horticultural crop production area and that is a lot!

Poll Question 10.2

So, I would like to ask you that “Do you use well water to irrigate your crops?”, if so, do you know the crop health benefits of using well water for irrigation?

(Comment on the second poll results)

► Generally, well water is considered very clean, so it has not been the focus of our research activities. But I do have some personal stories to share with you today.

Back in 2011, one of the greenhouse producers in Virginia contacted me about disease problem they had then. They suspected of the pathogen from irrigation water. I asked what source of water they used to irrigate his vegetable crops. His answer was well water which was filtered before use.

Wow, that sounded like double secure to me!

His irrigation water must be very clean based on what I learned from the literature. The pathogen must be from somewhere else.

However, the farmer was not convinced with my assessment; instead, he was very diligently doing his own homework, in an attempt to make a case to convince me that his well was contaminated. He put a microcamera into the well and took some shots and emailed to me.
Here were two of those photos. Is this *Phytophthora*? NO.

But as you can see from this process, it was very unlikely that he would be convinced without me checking his water samples. So, he sent me a huge filter that had been used for filtering his irrigation water for a long time along with several water samples.

We baited the water samples and the filter for pathogens; and as expected, we did not recover any species of *Phytophthora* nor any other pathogens from the baiting. He was finally convinced that his well water was clean and started looking into other sources of contamination.

After all, he found the contamination was originated from a *compost pile*, located directly outside of intake fans for greenhouse.

We learned this together in a hard way, but it was good to have the first hand data!

► Another personal experience about the cleanliness of well water was from Alabama. During September 2010, Dr. Warren Copes and I visited this production facility when we were trying to find a good place for this SCRI project. This nursery has three ponds and its major irrigation pond shown in this photo is located at the highest spot of this production facility and is fed with well water and rain water. As you can see this well is underground and it is completely sealed. Well water is pumped into this pond. We were curious whether there is any *Phytophthora* in this pond. Dr. Warren Copes did baiting in this pond twice during the grown season of 2012, and he did not recover any *Phytophthora* species from this water.

To summarize, well water generally is very clean if the well is cased or its head is sealed near the surface. However, some growers underappreciated the crop health benefits from use of well water until they had to switch to recycled water.

► Now, let’s look at **NATURAL LAKE WATER**. Natural lakes are:
   - Fed with springs and rain, and/or
   - Runoff from non-agricultural production areas

► Is there any *Phytophthora* species or other potential pathogenic species in natural lake water? **Yes**!

Are they aggressive plant pathogens? The answer is **No**!

► What about **STREAM WATER**?

Poll Question 10.3

Do you know how clean or dirty is stream water in terms of plant pathogen contamination?

(Comment on the third poll results)

► This table gives you a general picture on how dirty stream water could be. These data were from stream surveys for *Phytophthora ramorum*, the sudden oak death (SOD) pathogen in **five** states, supported by the USDA – Forest Service.

I would like to thank **Drs. Marianne Elliott and Gary Chastagner** of Washington State University for sharing their unpublished data.

This table tells us four important things:
• There are a lot of *Phytophthora* species including many new species in stream water, 26 found in WA, 23 in Virginia.
  o Per my personal experience, the difference in number of species found between states is somewhat an artifact. How many species found is proportional to how much time scientists invested into the survey projects in the states.

• The dominant species in stream water is *P. gonapodyides* with one exception of Tennessee where the dominant species was *P. cryptogea*.
  o *P. gonapodyides* generally is saprophytic species or a weak pathogen at the most. That is very good news for farmers who use stream water for irrigation.

• The major plant pathogenic species found in stream water varied with state. It was:
  o *P. pseudosyringae* in Alaska,
  o *P. ramorum* in Oregon,
  o *P. cryptogea* in Tennessee,
  o *P. cacotorum* and *P. pini* in Virginia, and
  o *P. plurivora* in Washington.

These results highlight the need for research to determine the major pathogen at a specific locale. We cannot assume that the same pathogens present in water everywhere.

• Among the species of economic significance, the most famous one is *P. ramorum*. That pathogen poses a great threat not only to the nursery crops but also to surrounding forests. According to the latest survey data, this pathogen has been detected in waterways outside of nurseries that have received infected plant materials such as camellia, etc. in six southern states (AL, FL, GA, MS, NC, TX).

► Where groundwater is not readily available or suitable for irrigation and when stream is running dry, use of surface water collection from production areas is a necessity; actually, it is a business saver!

► Here are two photos taken in the summer of 2007 and February of 2008. After a prolonged severe drought summer, this nursery was expanding the size and depth of an existing pond while digging a 18-acre new pond. Their goal was to capture and retain every drop of surface water. Again, once a farm is built at a location, RECYCLED WATER is the only option.

► Capture of runoff water and use for irrigation has several major benefits.
  • Self-serving in battle against water shortage.
  • Conserve water, save the world!
  • Protect the precious natural water resources
  • Save some fertilizer expense.

Remember, no free lunch! These benefits come with “extras”. One major issue is pathogen accumulation and redistribution via the irrigation system. We recovered 15 to 25 species of *Phytophthora* from individual runoff retention ponds.
That is a lot! The good news is not all of these Phytophthora species found in agricultural ponds are aggressive plant pathogens nor were they at high concentrations.

► The second major issue is water quality.

Compared to the Red and Orange ponds, the DARK BLUE pond which received no runoff water from the nursery production areas at all had a much lower and stable water pH. It maintained between 5.5 and 6.0. This pH is perfect for chlorine performance.

► GRAY WATER or reclaimed water is from municipal waste water. As illustrated in this drawing I borrowed from the internet, waste water has to go through several steps before leaving a treatment plant. Thus, gray water coming out of water treatment plants is much better in terms of quality than many of us have thought. In particular, it goes through a chlorine tank; it should be pathogen-free!

► According to the Water Reuse Association, a national organization based in Arlington, VA, gray water is being used for a number of purposes. Specifically, it is being used to irrigate edible crops, nonedible crops as well as turf and landscaping. This Water Reuse Association organizes several meetings each year. I attended one of their meetings in Santa Rosa, CA, about 10 years ago and one of the hot topics discussed at that meeting was how wine made from grapes irrigated with gray water tastes.

It tasted at least as good as those from grapes irrigated with other water sources such as stream, well and lake water, according to what I heard.

If it is good for edibles, it should be good enough for most ornamental plants and other horticultural crops. This water resource is not really new but definitely deserves reconsideration for horticultural use.

► As pointed out by Mr. Chris Brown at Lancaster Farms in Suffolk, VA, one of the major issues associated with use of gray water is access. This water resource is only practical for farms close to municipalities and the cost to setup a delivery system is proportional to the distance.

This, again, highlights the importance of locating a new production facility.

► Summary table

► Take-home messages

- Where to build a production facility matters to crop health and agricultural business sustainability.
  - The key factors are Water, water, and again water!
- Water availability and quality should be a premier consideration when planning for a new facility.

► Take-home message (cont’d)

You all knew that the best strategy for disease and crop health management is prevention and take steps to prevent diseases from happening before and during each growing season.

The second take-home message from this webinar is that Disease prevention could and should begin at the planning stage of production facilities!

► Here are a couple of additional reading materials:


► With that, I would like to thank you for your attention! Now, you can UNMUTE your phone, asking questions and sharing your thoughts. You also can post your questions in the Chat box.

In the meanwhile, I would like you ALL to answer two more poll questions

Poll Question 10.4
Poll Question 10.5

(Comment on the poll results while answering questions from attendees)

► Our next webinar will how layout of your water recycling may affect your crop health.