Late Blight

SLIDE 1:
This is Steve Johnson, University of Maine Cooperative Extension, bringing you information on Potato Late Blight. It is possible to receive a Maine Board of Pesticides Control recertification credit for this presentation. As this presentation is approximately a half hour, another presentation would also have to be viewed. Additionally, a test must be passed with a minimum of 80 percent correct answers on each presentation. While there is no charge for viewing this information, there is a charge for taking each test, whether the tests are passed or not.

SLIDE 2:
For late blight disease or any plant disease, for that matter, to occur, hosts, pathogen and environment all have to be present. Few diseases can rival the widespread misery produced by potato late blight.

SLIDE 3:
So what causes potato late blight? Late blight is caused by *Phytophthora infestans*--a fungus-like organism. This pathogen is an obligate parasite which means that it can only survive on a host. It cannot live in the soil or on dead plant debris. This organism will not survive long in the soil or away from association with a living host.

SLIDE 4:
Often the late blight pathogen overseasons or overwinters in infected seed, volunteer potato plants, or in cull piles. These tubers will sprout; and if infected, can produce sporangiospores which will produce sporangia that can spread to unprotected healthy plant tissue. This will continue the cycle and produce more sporangia later on. In the field, this cycle has been seen as quickly as 5 days but more frequently 6-7 days. Under cool conditions, this sporangia don't directly germinate. They will release zoospores. Zoospores are biflagulate swimming motile form of the pathogen. Zoospores are often associated with tuber blight in the fall. Tuber blight is how the pathogen frequently overwinters in cull piles or in infected seed. Under certain conditions, namely two different mating types, sexual recombination can occur in the field and give rise to a new species. This new species may give rise to genetically unique offspring, and they may have an advantage as far as increased reproduction, faster cycles, better survivability, or more aggression to a particular tomato or potato.

SLIDE 5:

Recalling the disease triangle so far, we have talked about the pathogen. We know that the host is present when we are growing potatoes. The last corner of the triangle is the environment. So what conditions favor late blight development? Cool, moist weather is conducive to the development of the disease. Nighttime temperatures in the 50’s and daytime temperatures in the 70’s accompanied by rain, fog, or heavy dew are ideal conditions. In Maine, the cool, damp summer days that your boots are wet in the morning and you don’t see the sun during the day and your boots are wet when you go home at night are ideal conditions for late blight pathogen to develop and the disease to occur.

SLIDE 6:
Late blight occurs on all above ground portions of the potato plant. Shown are pictures of lesions on the stems, leaflets, and tubers.

SLIDE 7:
Late blight does affect plants other than potatoes. Tomatoes, pepper, eggplant and some nightshades are susceptible as well. Petunias, wild relatives of potatoes, will also get late blight and some ornamental plants, closely related to potatoes, can also get late blight.

SLIDE 8:
Late blight is a community disease and has to be a community issue. Everybody needs to be on board to stop this fast moving disease. This includes the scientific community, the growers, and the industry support community. Everybody has to be involved in notifying where late blight occurs and have a unified approach to control this disease.

SLIDE 9:
Relying on chemicals alone for late blight control is not enough. Cultural practices have to be performed.

SLIDE 10:
Late blight disease is a classic compound interest disease in the van der Plank sense. Three things affect the disease progress curve--the amount of initial inoculum, the rate of disease progress, and the maximum disease proportion. All three of these allow unique approaches to control this disease.

SLIDE 11:
A parallel way to look at this is to view the curve as seen on the screen. Starting with the initial inoculum, then dealing with the exponential progress of the disease, and finally, the logarithmic progress of the disease.

SLIDE 12:
The initial inoculum is the cheapest and most effective way to control this pathogen. Controlling cull piles is an easy and cheap way to do so.

SLIDE 13:
Control initial is not a new concept. I'd like to show this from 1943, which is before I was born, to reinforce we have known for a long time that potato refuse, cull piles, dump piles, whatever they want to be called, are a factor in potato late blight.

SLIDE 14:
Initial inoculum can be volunteers as seen here. For those that haven't seen or don't think that late blight can occur on volunteer potatoes, it can as shown right here. These need to be controlled as part of a cultural practice to control this disease.

SLIDE 15:
Seed-borne late blight is a means for long distance dissemination of the pathogen and, therefore, the disease. When seed-borne late blight occurs in the field, as seen in this photo, there is nothing that can be done but to physically remove this plant and those around it. Again, this is part of the cultural control for late blight.

SLIDE 16:
Another effective control for initial inoculum is Mancozeb-based seed treatments. We encourage these strongly. Mancozeb-based seed treatments can be effective in reducing the amount of inoculum that can emerge from potentially infected seed.

SLIDE 17:
The exponential progress is where the real action takes place in this disease epidemic. Initial inoculum may be a millionth of a percent. During the exponential phase of the disease progress curve, it may go up to 1 percent. This is a million-fold increase in disease. This is when fungicide applications need to be initiated and new growth needs to be protected.

SLIDE 18:
The logarithmic phase is when most people see the disease and get very concerned. The disease levels may go from 1 percent to 25 percent or 25 to 50 percent in the field. At most, that's a 10 percent increase in disease. Most of the problem has already occurred and most of the issues are already behind you by the time you see this level of disease.

SLIDE 19:
The three keys are: when to spray, what to spray and when to salvage.

SLIDE 20:
Fungicide applications are initiated by severity values and they are timed by severity values. Severity values are a measure of how conducive the day is to the late blight pathogen and the subsequent disease. I mentioned earlier about the cool, damp conditions. This is simply a numeric calculation of it. When hours of relative humidity are above 90 percent, the average temperature is collected. At that point, you can see from the screen, if it is 68 degrees, 20 hours gives 4 severity values; if it is 58 degrees, 20 hours gives 3 severity values; and if it is 45 degrees, 2 severity values are accumulated. These severity values are accumulated to initiate the application. We tend to initiate applications at 18 severity values.

SLIDE 21:
Application timings, be they 5-day, 7-day, 10-day or longer are based on the previous 7 days of severity value accumulation. It is all based on humidity. The rain can simply make the spray schedule more aggressive such as from a 7 to a 5 day schedule. A 5-day recommendation can be given in the absence of rain. As seen on the screen, over 5 severity values accumulated during the previous 7-day period, gives a 5-day spray schedule. This is how most areas do late blight prediction. This is how we do it in Maine as well.

SLIDE 22:
Fungicides are contact, translaminar, or systemic materials. Sometimes, they are combination of one or more of these. The protectant materials, the EBDC's and chlorothalonils are contact fungicides. They do not move in the plant tissue, and they have to be on the plant before the late blight pathogen arrives. The translaminar fungicides will move into the plant tissue. They do not move up into the transpiration stream. Most of them move very quickly into the plant but move very slowly through the leaflet once they are there.

Systemics actually move into the tissue and move up the transpiration stream. Most are upwardly mobile, a few are downward mobile. These are materials that will go into the new growth.

SLIDE 23:
In controlling late blight with fungicides, the keys that have been in place for many, many years are even more important--time and rate of coverage. The most important application is the first one, getting the initial application on when it is needed and getting the right interval for subsequent application is critical. Often times, the full rate is not needed. A lot of this depends on the weather or the particular growth stage of the plant. The coverage is very critical especially on contact materials as these materials do need to be replaced as they will photooxidize or rain erode away.

SLIDE 24:
As seen here, the difference between a 5 and a 7-day application. When a 5-day application is called for and not used, the results can be rather dramatic. When a 5-day interval is called for, it’s really needed.

SLIDE 25:
This is the above ground growth rate of Russet Burbank under Maine conditions. The red bars are a doubling of leaf area. Clearly, early in the season, the full rate is not needed. Timing is more critical as the plant will outgrow any contact material or its redistribution.

SLIDE 26:
Good timing and proper rate are all wasted if the coverage is not correct. It is not just coverage on the plants, it is coverage on the entire field. You can see extra rows planted here that were beyond the boom width and never were protected. These rows serve as spreader rows. Later in the season, this entire field ran into problems.

SLIDE 27:
When to salvage, when to kill part of the field, is a real gut check. The light sandy area in the middle of the field is where seed-borne late blight started. The wide area was killed around it. How much area is needed to be killed and what time of year does this technique work best? This is best left to local professionals in your local area as there can be a lot of different conditions that will affect that. However, this technique is most effective early in the

season, towards the middle of the season, or late in the season; killing these areas are less effective.

SLIDE 28:
Harvesting a late blight affected field is an additional challenge. One thing that has to be clear is that vines need to be not just dead, but dead, dead, dead! Any skinning or abrasion as can be seen in the photo can encourage tuber to tuber spread during harvest or the storage transfer.

SLIDE 29:
So, what happened in 2009? Late blight pretty much erupted the third week of June up and down the eastern sea board. Infected tomato plants were relocated from south to north. With that, the late blight pathogen was well distributed; initial inoculum was widely spread; tomatoes were susceptible; it was brought into home gardens; and the disease conditions were conducive with rain most of June and July through the area. The conducive conditions lead to a widespread epidemic, specifically on tomatoes; and it did move onto potatoes as well.

SLIDE 30:
With the widespread epidemic of 2009, new genotypes of the pathogen were identified. According to Ken Diehl from ARS, US 22, US 23, and US 24 were new isolates for 2009. In some cases, both mating types A1 and A2 were present in the same field. This has the potential to give rise to new genotypes through sexual recombination. This could provide yet more different epidemics in the future.

SLIDE 31:
So with the age old nemesis of late blight and the possibility of new genotypes arising, chemicals alone are not enough. Cultural practices have to be controlled, as well as widespread information sharing and positive approaches to control and understanding of the disease.

SLIDE 32: How do you avoid late blight? Let’s look at the period from seed selection to seed handling. Do you have a long term relationship with the seed grower that you got your seed from? This is very important to get those lines of communication open. Has the seed been tested by the Department of Agriculture or equivalent to insure that there is no late blight in the seed. Planting late blight infected seed is a recipe for disaster.

Did the test show no late blight not only was the test taken but did it show no late blight in the seed sample? Was a delivery inspection performed?

SLIDE 33: During the period from seed handling to planting, did you take an additional late blight sample and take a look at it yourself or have another outside agency take a look at it? Again, did the test show no late blight? Did you rack over the seed before cutting trying to remove all the suspect tubers? Did you treat with Mancozeb? This is very important in trying to reduce the late blight spread tuber to tuber. Did you treat with Cymoxanil? This does also work to reduce the tuber to tuber spread. It seems to work in conjunction with Mancozeb just a little bit better. Many cases Mancozeb alone is enough to produce a good seed. Did you cut and plant –no precutting? Now you are going to be planting.

SLIDE 34: The period between planting and early emergence. Are cull potatoes properly disposed? Do you have piles like this sitting around? Cull piles aren't just piles of potatoes--they are rock piles. Have you checked rock piles in places like that as well? Are the volunteers controlled? Depends on the season, volunteers can be an issue. Is the seed cutter disinfested regularly? In other words, how often do you disinfest the seed cutter—between lots, daily, hourly, it's important. Are the seed pieces dry at planting? Were they breaking down, were they slimy, were they wet. This is a good way to spread pathogens which is late blight. We have hit early

SLIDE 35: emergence to the 18 severity value threshold? How do you avoid late blight during this period? Again, cull potatoes--are they properly disposed? Do you have cull piles around? Have you checked those rock piles? They will be coming out there as well too. Are the volunteers controlled? Usually, in the nonpotato land. In last year's potato land, there may be a small grain. Is your sprayer calibrated and serviced? Have you listened to the hotline or read pest alert for the current severity values? Do you know how close it is to initiate applications? As 18 severity values approaches, have you scouted your fields? You want to do this beforehand. Is late blight absent? You've hit the 18 severity value threshold. This may be anywhere from the end of June to the first part of July.

SLIDE 36: You have reached the 18 severity value threshold. During that period, late blight detected in th region. What can you do to keep yourself late blight free? Again, are cull potatoes properly disposed? Have you checked rock piles to make sure there's no volunteers or potatoes growing in them? Are the volunteers controlled in the nonpotato fields? They can act as a source of inoculum to catch and then can keep the epidemic progressing. Have you scouted your fields? Is late blight absent in your fields? Have you listened to the hotline for initiation and timing of control measures? You have passed the 18 severity value threshold, so you should be doing this. Have you built a good hill? It is harder for the late blight spores to enter the soil and find the potatoes when there is a good hill.
Are you maintaining coverage on new growth? This may mean less than a 7-day schedule. You get the point that late blight is detected in the region.

SLIDE 37: Late blight is detected in the region. The next step down is detected in the area, which is more localized to you, what can you do to keep yourself more late blight free? Is the inoculum source of the late blight detection known? Are you more than 10 miles south of the known late blight infection in the region? Have you scouted your fields and looked for it? Specifically, those that are north of the late blight find. Is late blight absent in your scouted fields? Are you maintaining coverage on new growth? Again, this may mean less than a 7-day schedule. Now, we have late blight detected in the area.

SLIDE 38: We go from late blight detected in the area to late blight detected on the farm. What can you do to slow this or prevent this from happening? Again, is the inoculum source of the late blight detection known? Are you more than 10 miles south of it? Have you scouted your fields? Is late blight absent in the scouted fields? Are you maintaining coverage on new growth? Again, this may mean less than a 7-day average.

SLIDE 39: Late blight has been detected on your farm. Decision times. Have you scouted all of your fields? Do you know that only one or just a few have late blight? Is the source of the inoculum for late blight known? It could continue to come in and reinfect your fields if you do something drastic such as kill parts of a field, you could still have inoculum coming in--that may not be the best approach under some conditions. Is the late blight pocketed? Is it just one area or is it widespread across the whole field? Can the late blight be removed? Do you kill out an area seen on this screen or do you not? Now comes decision time.

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