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Fungicide Application for Management of Potato Late Blight in the Columbia Basin

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POTATO LATE BLIGHT MANAGEMENT

Management of potato late blight (LB) in the Columbia Basin of Washington and Oregon requires a combination of several strategies: strict sanitation practices, proper irrigation management, good cultural practices, and proper application of fungicides. Sanitation practices (such as not planting infected seed and using a seed treatment containing mancozeb or cymoxanil, and destroying cull piles before planting), and proper cultural practices (such as not planting within 80 – 100 ft. of the pivot center and preventing wet areas to develop in fields) will reduce disease pressure and increase the effectiveness of foliar fungicides.

- ***Fungicides are most effective when*** they are applied to foliage i) before infection occurs or ii) when the disease is in very early stages of development and cannot be detected yet by the human eye. Later applications are helpful in reducing the rate in which the disease spreads but are not nearly as effective as early applications. Late blight is very difficult to manage once infections become established in sprinkler-irrigated fields because the microclimate within the canopy usually favors further disease spread whenever the field is irrigated. In other words, preventing infection is far better and likely cheaper than trying to manage LB in fields where infection has occurred.

- ***Total crop and canopy coverage with fungicides is essential*** for late blight management. The late blight organism, *Phytophthora infestans*, will most likely find and infect any plants or plant surfaces skipped during application. Given the nature of the potato canopy after row closure, achieving complete coverage of leaves and stems with fungicides can be difficult if proper application methods are not followed. Application skips from air, chemigation, or ground applications have frequently resulted in large areas of late blight infected plants.

POTATO LATE BLIGHT FUNGICIDES

Many fungicides are labeled for use against potato late blight. Each product has specific conditions for use and is labeled with details regarding rates and application method. Fungicides work against late blight by inhibiting one or more of the following: germination of spores (and as a result, reduced infection of plants), growth within the plant, production of spores (sporulation), and formation or development of lesions.

Spore suppression. Some combinations of fungicides, such as Forum (dimethomorph) plus an EBDC, Curzate (cymoxanil) plus an EBDC, and Oronidis Opti (oxathiapiprolin + chlorothalonil) have post-infection activity that inhibits sporulation and/or restricts lesion expansion (5,6). These fungicides may also help reduce tuber infection when applied during and after tuber bulking. Their use at times can be very beneficial, but they should never be used as a predetermined "rescue" instead of using protectant fungicides when recommended because control likely will not be adequate. Again, proper use of protectant fungicides, prior to infection, will ensure good and economical protection.

Soil barrier. Mancozeb and Polyram (metiram) when worked into fungicide programs during tuber maturation are effective on the soil surface in protecting against tuber infection (10). Shallow daughter tubers and soil cracks are main avenues allowing the pathogen to access tubers (11). Plant seed tubers as deep as possible and adequately cover hills with soil to help prevent tuber infections. Cultivars with tubers moderately resistant to late blight include Umatilla, Gem, Alturas, Legend, and Defender. Tubers of Bannock and Ranger are very susceptible and require extra management.

Examples of late blight fungicides

- EBDC (ethylene bis-dithiocarbamate) fungicides. Examples: Metiram (Polyram), Mancozeb (Dithane M-45, Manzate Pro-Stick and Penncozeb), and Maneb (Manex). Chlorothalonil (Bravo, Echo)
- Cyazofamid (Ranman) plus an EBDC or chlorothalonil
- Cymoxanil (Curzate) plus an EBDC or chlorothalonil. Tanos contains 25% cymoxanil and 25% Famoxate
- Dimethomorph (Forum) plus an EBDC or chlorothalonil. Zampro contains ametoctradin + dimethomorph
- Propamocarb hydrochloride (Previcur), plus EBDC or chlorothalonil
- Mandipropamid + difenoconazole (Revus Top)
- Zoxamide (Gavel = zoxamide + mancozeb, Zing = zoxamide + chlorothalonil)
- Oxathiapiprolin (Oronidis Opti = oxathiapiprolin + chlorothalonil)
- Fluazinam (Omega, Omega Top MP)
- Phosphorus Acid (Phostrol and other salts of phosphorous acid) – Two to three foliar applications at two week intervals (beginning at initial tuber bulking, tubers 14 to 70g in weight) provide excellent tuber protection in storage, but little protection on foliage. Two applications are effective for cultivars with moderately resistant tubers such as Umatilla and three applications are needed for cultivars with very susceptible tubers such as Ranger (7). Post-harvest application of tubers is effective if late blight is found in tubers prior to harvest, or if late blight is present in the field at the end of the season. The phosphorous acid application cannot cure infected tubers, but keeps healthy tubers from becoming infected if they are exposed to spores of the late blight pathogen during the harvest operation.

Fungicides not recommended

- Mefenoxam (Ridomil Gold, Ultra Flourish) prepacks are not recommended for management of late blight when the pathogen population is resistant (US-8 and US-11 for example); in addition, mefenoxam can be effective for management of pink rot and Pythium leak.
- Super Tin by itself will not adequately control severe late blight, but it is effective when mixed with Polyram or another EBDC fungicide.
- Copper fungicides alone will not adequately control foliar late blight in conventional (non-organic) fields in the Columbia Basin. Copper may be an alternative for organic potatoes.

METHODS OF FUNGICIDE APPLICATION

The choice of application method is important in managing late blight. The general methods of fungicide application, with strengths (+) and weaknesses (-) given for each are listed below (2,3). All methods will control late blight but given the particular circumstances, such as late blight risk, infection in the field or nearby fields, availability of equipment, expense etc., the particular method chosen may provide better control at a reduced cost:

1. Air (plane or helicopter)

a) +/- applies medium amount of fungicide to the canopy; applies individual drops of water containing a high concentration of fungicide, primarily to the upper canopy, and at least two applications on a weekly basis are required to ensure product has protected new foliage and redistributed by irrigation water across leaves and stems (laterally) and to the lower canopy to provide adequate protection
b) + quickest method
c) + uses little water (5 to 10 gallons/acre. The use of >5 GPA is no more effective than 10 GPA; either amount requires redistribution by irrigation water)
d) - ineffective in moderate or higher winds
e) - must be scheduled with a commercial applicator
f) - ineffective near obstacles (trees, power lines, houses)
g) - gaps of non-treated foliage may result from poor fungicide application (skips)
h) +/- moderately expensive
i) +/- droplet size must be considered during low humidity to ensure water containing product reaches canopy

2. Ground (spray booms attached to self-contained or tractor-pulled equipment)

a) + applies greatest amount of fungicide to and throughout canopy providing reasonable protection throughout the canopy following application.
b) +/- faster than chemigation, but slower than air
c) + uses little water (20 to 100 gal/acre)
d) + most effective method in high velocity winds
e) - requires either purchase of expensive equipment or contracting with a commercial applicator
f) - soil compaction from wheel tracks may reduce tuber yield and quality
g) - standing water in wheel tracks provides a favorable environment that may increase late blight infection/ incidence
h) - most expensive method because of equipment cost
i) + can be used most anywhere; even when obstructions are present
j) + can be used as needed
k) + redistribution of fungicide applied to the upper canopy is still required to maintain good concentration of material and protection from late blight in the lower canopy through the next week
l) + protection skips don't occur if nozzles work properly

3. Chemigation (fungicides injected into irrigation system, most often a self-propelled center pivot sprinkler irrigation system).

a) - applies least amount of fungicide that stays in the canopy (the rest washes through) but fungicide is nearly evenly distributed throughout canopy due to high water volume used and will provide protection thoughout the canopy after application.
b) - slowest method
c) - tremendous water volumes result even when pivots are run at a fast lap (5100 to 6250 gallon/acre)

d) + can be applied in winds equal to or faster than those in air application, particularly where drop nozzles are used, but works best when there is little or no wind
e) + can be scheduled and performed by trained personnel employed by grower
f) + can be applied using equipment already at the site
g) + least expensive application method
h) - may require a more frequent application schedule (more often than 7 days) due to low fungicide levels applied to canopy and may not provide adequate protection particularly in the upper canopy (due to wash off) if environmental conditions favor late blight
i) + as long as nozzles work properly, and injection pump works properly, protection skips will not occur.

4. <u>Attached Boom</u> A method in which a spray boom is attached to the center-pivot sprinkler irrigation system (applies fungicides evenly along the length of the pivot using a water system independent of the irrigation water) (1).

a) + more efficient in applying fungicides than chemigation (equal to ground application)
b) + little water required
c) - equipment costly but may be able to be used to apply other pesticides
d) +/- has many of the characteristics identified in "ground" application listed above.

5. <u>Air/chemigation</u> A cost saving method that provides good protection when used on a 7-day schedule is the alternating use of air application of fungicides with chemigation. The most effective way to use this method is beginning with an air application. This method provides some of the good aspects of both methods**.**

a) +/- air applies medium amount of fungicide to the canopy, mostly the upper canopy; chemigation applies the least but uniform coverage.
b) +/- quickest (air) and slow (chemigation) depending of method used that week
c) +/- uses little water (air) or high levels (chemigation)
d) +/- ineffective in moderate or higher winds (air), chemigation okay
e) +/- must be scheduled with a commercial applicator (air), not so with chemigation
f) +/- ineffective near obstacles (trees, power lines, houses) (air), not so with chemigation
g) +/- gaps of non-treated foliage may result from poor fungicide application (air) not so with chemigation (if equipment is operating properly)
h) +/- moderately expensive (air), chemigation cheapest

Additional Considerations

- In the Columbia Basin in 1995, aircraft application was the most commonly used method (75%), followed by chemigation (25%), and ground (very little application). The use of chemigation has increased in recent years because it is less expensive than air application. Equipment availability and other financial considerations may determine the method more than delivery efficiency of the fungicide.
- Application methods vary in terms of how much fungicide is deposited on and within the canopy and how redistribution occurs over time within the canopy due to irrigation water application amounts or rainwater and movement downward. For example, one study showed that chemigation deposited low amounts of chlorothalonil on and in the canopy and redistribution over time by water caused chlorothalonil levels to drop even more. In such a situation, fungicide levels could fall below those required for sufficient control of late blight, particularly near the end of a standard 7-day application interval.
- Application methods also vary in terms of how far into the canopy (upper vs. lower leaves) the fungicides penetrate initially. If protection is needed immediately in the lower canopy, then air may not

be the best application choice if no other application has been done or the previous application occurred more than 2 weeks ago.

- Alternating air application with chemigation on a 7-day interval can increase fungicide residue levels in the crop canopy at a reduced cost. This methodology provides several of the benefits of both methods without the adverse effects of using one application method repetitively.
- Stems are infected at higher rates than in the past. Before the early 90's most infections were seen on leaves. Moisture on stems dries more quickly than that on leaves. However at least two factors have contributed to more stem infections: 1) Late blight populations are more aggressive (more capable of causing diseases) than in the past (9); and 2) Related to the first point, because of the upright nature of stems, less fungicide is generally found on them therefore they may not be as adequately protected, particularly as time passes from the last application. Maintaining adequate levels of fungicide on **both** leaves and stems is important.

Fungicide application tips

The important components of late blight management are: Proper timing of the first application, proper fungicide selection, proper frequency of fungicide use, proper rate of fungicide, and proper application method. Keep in mind the following suggestions when applying fungicides:

- ***Consult the toll-free late blight hotline (800-984-7400)*** for timing of initial fungicide application and intervals between applications. The Columbia Basin Late Blight Forecasting Model (4), current disease conditions, and weather forecasts are used to determine fungicide timing. The model is based on the number of rainy days in April and May. Both hotlines in Washington and Oregon information lines provide information on the probability of late blight occurrence in the Columbia Basin before the end of May. The hotline also provides information on when and where late blight has been found.
- ***Begin applications at least 7 days prior to late blight exposure.*** Usually this requires making the first application just prior to row closure and continuing on a 7-day interval for three weeks or more. Early applications are the most important because of the susceptibility of the foliage and the higher chance for favorable weather condition for late blight development (weather is usually cooler and wetter during the early season). Preventing late blight early could save a number of applications later if no or little late bight is reported and weather is warm and dry. In fields where late blight is found, continued application of fungicides is required throughout the season.
- ***Continue applications UNTIL HARVEST*** at recommended intervals to protect both new and old foliage (8). Consult the toll-free information lines for suggested intervals. Applications in late season may be as important as early season applications, even if late blight up to that point has been a minor problem in the Basin. In late August or September, plant water use decreases while watering levels sometimes stay constant, dews begin to form, and overall temperatures are reduced, all of which extends the wetting period of foliage and can contribute to extensive late blight infection. In addition, symptom expression in these older plants can be sometimes difficult to recognize due to natural senescing of leaves, which left untreated could further fuel a late season epidemic and allow infection in tubers going into storage.
- ***Do not skip any plants.*** Total crop coverage is essential.
- ***Maintain adequate residue levels*** of fungicides on the foliage. Use a consistent and appropriate application interval.
- ***Let fungicides dry*** on the foliage before beginning normal irrigation.
- ***When disease pressure is high, use short application intervals*** (5- 7 days).
- ***Ridomil Gold, copper, and tin fungicides are not effective against late blight by themselves***. Super Tin is effective when mixed with metiram (Polyram) or mancozeb. Tin mixtures are most efficient from mid-season until harvest.

- ***Apply the first fungicide application by air and then rotate with chemigation.*** This is an effective and cost-saving program for late blight fungicide application**,** especially when disease incidence and pressure require a 7-day application frequency.
- ***All fields need protection from late blight.*** This includes fields scheduled for early harvest.
- Use of Phosphorus acid on foliage can reduce tuber infection. A post-harvest application will be effective if late blight is found in tubers prior to harvest.

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Selected references can be found at http://plantpath.wsu.edu/dajohn
Addition information at www.USAblight.org

July 13, 2016

Summer Farm Festival and Malheur Experiment Station Field Day

Cooperating to bring you this year's Summer Farm Festival and Field Day are the OSU Malheur Experiment Station, The Ontario Chamber of Commerce, Malheur County Soil & Water Conservation District, Owyhee Irrigation District, OSU Malheur County Extension Service, Malheur & Owyhee Watershed Councils, NRCS.

Schedule

FREE LUNCH

8:00 AM - 9:00 AM
Registration

9:00 AM - 10:20 AM

A. Onion Production Tour
Discussions will include the latest on internal rot, *E. coli*, managing onion thrips, and weed control in onion. We will showcase a study evaluating the response of five onion cultivars to the recently registered method of applying Outlook (dimethenamid-p) through drip irrigation.

B. Unmanned Aircraft Systems
In the booth area Ron Looney of Empire Unmanned will give a presentation on Unmanned Aircraft Systems (UAS or drones) and associated imagery.

10:30 AM - 11:50 AM

C. Sweet Potato and Potatoes
Evaluation of herbicides for weed control in potato and sweet potato. Evaluation of drip irrigation and comparison to sprinkler irrigation for potato in an attempt to lower the comparative cost of drip irrigation. Control of potato psyllids.

D. Alternative Crops
This tour will highlight alternative crops such as pumpkins, quinoa, and wildflower seed production.

E. Tour for youth. Water, Soil, and Crops. A fun tour designed to educate young people about agriculture.

11:00 AM - 12:00 Local issues presented in the barn

11:00 - Proposed Owyhee Monument - Mark Mackenzie

11:20 - GMO Creeping Bentgrass - Jerry Erstrom

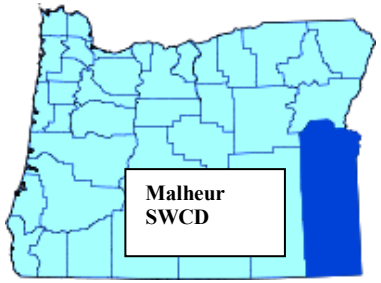
11:40 - Food Safety Modernization Act - Stuart Reitz

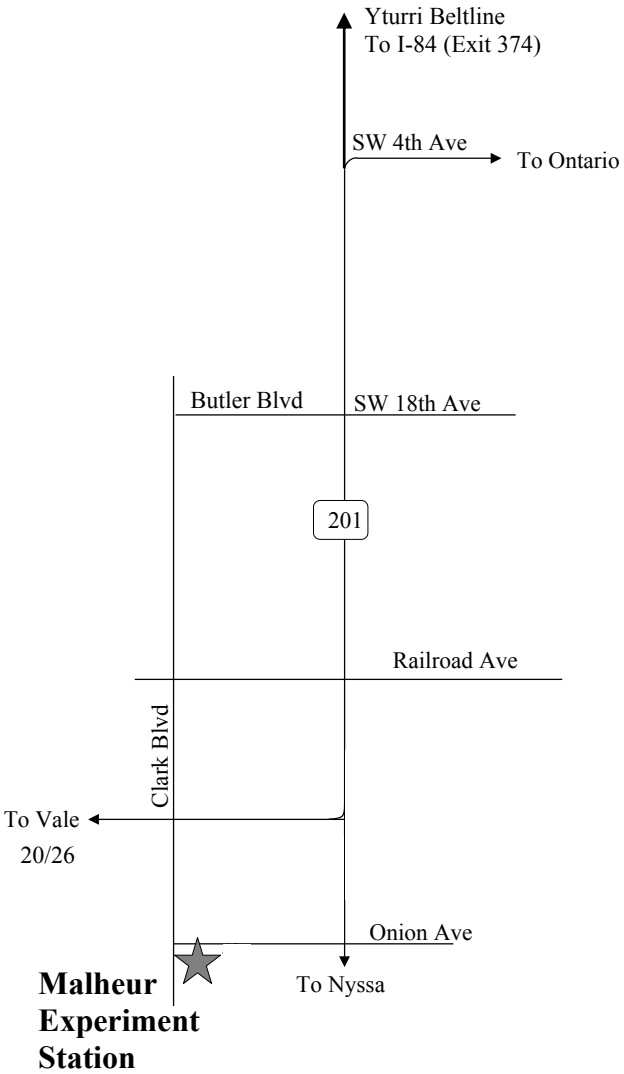
12:00 Lunch

12:10 - Long Term Resource Planning at Idaho Power - Phil DeVol

BOOTHS

For more information about Malheur Experiment Station projects and resources, check out our website at
http://www.cropinfo.net





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Summer Farm Festival and Malheur Experiment Station Field Day

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