



Vegetable Disease Update – Amanda J. Gevens, Assistant Professor & Extension Vegetable Plant Pathologist, UW-Madison, Dept. of Plant Pathology, 608-890-3072 (office), Email: gevens@wisc.edu. Vegetable Path Webpage: <http://www.plantpath.wisc.edu/wivegdis/>

Considerations for fungicide programs to manage late blight: There is not one recommended fungicide program for all late blight susceptible potato fields in Wisconsin. Fungicide selections may vary based on type of inoculum introduction, proximity to infected fields, crop stage, late blight strain, and other diseases that may be in need of management. This article provides general guidance to assist in development of your fungicide program.

Under high late blight pressure, fungicide programs with Revus Top, Forum, Curzate 60DF, Ranman, Tanos, Gavel, Previcur Flex, or Omega should be used. Mefenoxam containing fungicides such as Ridomil Gold SL can also be highly effective in controlling late blight caused by the pathogen strain US-23. This strain been identified in all WI cases in 2013, to date. Zampro is a newly registered late blight fungicide offering a novel mode of action fungicide in an effective pre-mix for late blight control. Brief comments on each of these fungicides are listed below.

Revus Top contains mandipropamid (Group 40) for late blight and difenoconazole (Group 3) for early blight; excellent protectant on leaf blight; rainfast; translaminar and contact activity.

Forum contains dimethomorph (Group 40) for late blight; can be applied after vine kill; good protectant on leaf blight; good antisporeulant; rainfast; translaminar activity.

Curzate 60DF contains cymoxanil (Group 27) for late blight; locally systemic; excellent curative activity; good protectant on leaf blight; rainfast in 2 hours.

Ranman contains cyazofamid (Group 21) for late blight; excellent protectant for leaf and tuber blight; rainfast; contact activity.

Tanos contains cymoxanil (Group 27) for late blight and famoxadone (Group 11) for early blight; excellent curative activity; good protectant on leaf blight; rainfast; translaminar and contact activity.

Gavel (zoxamide, Group 22+mancozeb, Group M3) is best used as a protectant and has been reported to reduce tuber blight; excellent protectant on leaf blight; rainfast; contact activity.

Previcur Flex contains propamocarb hydrochloride (Group 28); good protectant on leaf, new growth, and stem blight; good curative and antispore activity; excellent rainfast activity; systemic and contact activity.

Omega is a broad spectrum fungicide (fluazinam, Group 29) and especially effective at controlling the tuber phase of late blight (with added benefit of white mold control); excellent protectant on leaf blight; good protection against tuber blight; rainfast; contact activity. Has special label for powdery scab in WI as of 2011.

Ridomil Gold SL contain mefenoxam (Group 4); excellent systemic movement in plant; curative activity; excellent control of stem, leaf, and tuber late blight; rainfast; can only be effective if you are controlling a sensitive strain such as US-23, US-22.

Zampro contains ametoctradin (Group 45) and dimethomorph (Group 40) both with activity on late blight; good preventative disease control; systemic and protective activity.

In Wisconsin, the QoI inhibitors Headline (pyraclostrobin, Group 11), Quadris (azoxystrobin, 11), and Reason (fenamidone, 11) have offered good late blight control at high label rates under moderate late blight pressure and should be used in a manner which mitigates pathogen resistance development - in tank-mix with protectant fungicides such as mancozeb or chlorothalonil-based products and do not apply in consecutive applications.

Headline, Quadris, Reason, Revus Top, and Tanos, also provide good control of early blight in most potato fields in Wisconsin. There are fields/areas where the early blight pathogen population may have some resistance to the QoI fungicide group (11), but generally, this group of fungicides is still effective.

Phosphorous acid formulations such as Crop-phite, Fosphite, Phostrol, Propylt, and Rampart can increase tuber protection to late blight and pink rot. However, rates must be high and multiple applications must be made for significant tuber protection.

Mancozeb used as a tank-mix partner in the final fungicide applications can provide some additional tuber late blight production. Research conducted in Washington and published in 2006 by Porter, Cummings, and Johnson indicated that soil application of mancozeb greatly reduced the incidence of tuber blight when compared to other fungicides. Additionally, in our early blight fungicide trial work at the Hancock Research Station we have often seen yield increases when we use mancozeb as the base protectant tank-mix partner in our final 2 applications.

In years when weather conditions do not favor severe late blight, programs based on chlorothalonil formulations and EBDCs can be adequate to reduce risk of late blight. The addition of TPTH 80WP to any of the protectant programs can enhance disease control particularly towards the end of the growing season. Our current weather conditions, while very hot, can promote disease development due to periods of rainfall, high humidity, and moderate overnight temperatures.

Timing and frequency of fungicide applications are critical elements in an effective disease control program. Five to seven day applications are needed to protect the crop under conditions of rapid growth and high disease pressure. Now that late blight has been detected in WI, protectant programs should be maintained in areas near affected fields until the end of the growing season.

In fields with late blight 'hot spots,' crop destruction is recommended to limit disease development and production of inoculum. A conservative approach to reducing spread from a hot spot includes destruction of 30 rows on either side of the newest lesions at the border of the late blight locus and 100 feet along the row (either side) are killed with Reglone or with Gramoxone (generic). Although harsh, trials at MSU have shown that the latent period between infection and symptom development is about seven days and although not visible, plants within this area are already infected. Fields with very few lesions across a broad acreage, must be intensively managed and consideration for early vine kill and harvest should be made to reduce overall risk.

Dr. William Kirk of Michigan State University offers fungicide program suggestions for late blight control under different late blight disease pressures on susceptible potato varieties. The table along with additional information can be found at:

http://msue.anr.msu.edu/news/potato_late_blight_confirmed_in_allegan_county_on_july_12_2013

Listing of 2013 WI potato late blight fungicides:

<http://www.plantpath.wisc.edu/wivegdis/pdf/2013/Potato%20Late%20Blight%20Fungicides%202013.pdf>

The 2013 A3422 Commercial Vegetable Production in Wisconsin guide is available for purchase through the UW Extension Learning Store website: <http://learningstore.uwex.edu/Commercial-Vegetable-Production-in-Wisconsin2013-P540.aspx>

A pdf of the document can be downloaded or is available at the following direct link:
<http://learningstore.uwex.edu/Assets/pdfs/A3422.pdf>

Potato Late Blight Fungicides Registered for WI, 2013.

In-furrow and seed treatment registrations are omitted. This is not a comprehensive list. Most fungicides listed are for use in conventional production systems. List compiled 4 June 2013.

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Trade Name (rate/A)	Active Ingredient(s)	PHI	REI	FRAC #	Comments
<u>Agri Tin, Super Tin 4L, Super Tin 80WP</u> (4-6 fl oz)	triphenyltin hydroxide	7 days	48 hours	30	Restricted use pesticide. 3 fl oz rate can be used if material is tank-mixed with another fungicide.
<u>Alude</u> (1.25 qt in 90 gal water)	mono and dipotassium salts of phosphorous acid	0 days	4 hours	33	Foliar application
<u>Fosphite, Rampart</u> (1-4 qt in at least 20 gal water/A)	potassium phosphite	0 days	4 hours	33	Foliar post-emergence spray and post harvest spray for control in storage.
<u>Fungi-Phite</u> (Foliar: 2 qt/A Seed trt: 15% volume to volume-2 ton in 1 gal solution)	potassium phosphite	0 days	4 hours	33	Seed piece spray and foliar post-emergence spray. Tank-mix with another effective fungicide is recommended and use high label rate for late blight control.
<u>Badge SC</u> (1-3 pt at 7-10 day interval)	copper hydroxide, copper oxychloride	0 days	24 hours	M1	Protectant activity only.
<u>Bravo Ultrex</u> (.7 then .9 to 1.36 lb) <u>Bravo WeatherStik, Echo 720, Equus 720 SST, Initiate 720, Chlorothalonil 720 SC</u> (.75 then 1-1.5 pt) <u>Bravo Zn, Equus 500 Zn</u> (1 1/8 then 1 1/5 to 2 1/4 pt) <u>Echo Zn</u> (1 to 2.125 pt) <u>Equus DF</u> (.7 then .9 to 1.36 lb) Echo 90DF (5/8 then 7/8 to 1.25 lb)	chlorothalonil	7 days	12 hours	M5	11.25 lb a.i./acre maximum on standard label. However, WI has a special 24(c) registration for long season potatoes extending the max a.i. from 11.25 to 16 lb a.i./acre with Bravo (Syngenta) and Echo (Sipcam Advan) formulations.
<u>Cabrio Plus</u> (2.9 lb)	pyraclostrobin+m etiram	3 days	24 hours	11+M3	17.4 lb/acre maximum per season. Do not apply more than 2 sequential applications.

Potato Late Blight Fungicides Registered for WI, 2013.

Trade Name (rate/A)	Active Ingredient(s)	PHI	REI	FRAC #	Comments
<u>Champ WG</u> (1 to 1.5 lb 3 to 4 lb in severe areas) <u>Champ Formula 2 Flowable</u> (2/3 to 2 2/3 pt) <u>Champ DP Dry Prill</u> (2/3 to 1 lb 2 to 2 2/3 lb when disease is severe)	copper hydroxide	0 days	24 hours	M1	Use high label rates for foliar late blight protection.
<u>Kentan DF</u> (1-2.5 lb 4 lb when severe)	copper hydroxide	0 days	24 hours	M1	Use high label rates for foliar late blight protection.
<u>Kocide 2000</u> , <u>Kocide 3000</u> (.73-3 lb .5-1.75 lb)					
<u>Nu-Cop 3L</u> (2/3 to 2 pt 2 to 4 pt if severe)					
<u>Nu-Cop 50DF</u> (1-1.5 lb 3-4 lb if severe)					
<u>C-O-C-S WDG</u> (1.5- 4 lb)	copper oxychloride, basic copper sulfate	0 days	24 hours	M1	Use high label rates for foliar late blight protection.
<u>Curzate 60DF</u> (3.2 oz foliar)	cymoxanil	14 days	12 hours	27	Locally-systemic fungicide. Must be tank-mixed with a protectant fungicide. Rainfast within 2 hours.
<u>Dithane F45 Rainshield</u> (.4 to 1.6 qt) <u>Dithane M45</u> (.5 to 2 lb) <u>Roper DF Rainshield</u> (1 -2 lb)	mancozeb	24 hours	3 days	M3	Max rate per acre/season is 11.2 lb a.i. Plant as soon as possible after seed treatment.

Potato Late Blight Fungicides Registered for WI, 2013.

Trade Name (rate/A)	Active Ingredient(s)	PHI	REI	FRAC #	Comments
<u>Evito 480SC</u> , <u>Aftershock</u> (3.8 fl oz)	fluoxastrobin	7 days	12 hours	11	Follow label for resistance management.
<u>Forum</u> (Foliar and tuber control: 6 oz)	dimethomorph	4 days	12 hours	40	May be tank-mixed with another effective fungicide for enhanced management – but not required by label. Addition of an adjuvant may enhance management. Can be applied after vine kill.
<u>Gavel 75DF</u> (1.5 to 2 lb)	zoxamide+mancozeb	3 days	48 hours	22+M3	Do not make >6 applications/crop. Contact fungicide.
<u>Gem 500SC</u> (3.8 fl oz)	trifloxystrobin	7 days	12 hours	11	Follow label for resistance management.
<u>Headline</u> (6 to 12 fl oz)	pyraclostrobin	3 days	12 hours	11	Follow label for resistance management.
<u>ManKocide</u> (1.5 to 2 then 4-5 lb)	mancozeb+copper hydroxide	3 days	24 hours	M3+M1	Not labeled as a seed trt for potatoes.
<u>Omega 500F</u> (5.5 fl oz)	fluazinam	14 days	48 hours	29	REI is 4 days for high exposure activities. New special local need label 24c in April 2011.
<u>Omega Top MP</u> (5.5 fl oz) – individual label for Omega sold in co-pack with Top MP (difenoconazole)	fluazinam	14 days	48 hours	29	Can be applied aerially. REI is 4 days for high exposure activities.
<u>Oxidate</u> (40 to 120 fl oz to 100 gal water, 30-100 gal solution per acre)	hydrogen dioxide	0 days	1 hour	NC	Foliar spray for late blight. Frequent applications (5-day intervals) can limit sporulation.
<u>Penncozeb 80WP</u> , <u>Penncozeb 75DF</u> (.5 to 2 lb) <u>Penncozeb 4FL</u> , <u>Manzate flowable</u> (.4 to 1.6 qt) <u>Manzate Pro-Stick</u> (1 to 2 lb, seed trt: 1.25 lb/50 gal water)	mancozeb	3 days	24 hours	M3	Do not exceed 11.2 lb a.i./acre/year.
<u>Phostrol</u> (2.5 to 10 pt) (Post harvest trt: 1 gal/ton in .5 gal water)	mono- and di-basic sodium, potassium, and ammonium phosphites	0 days	4 hours	33	Can be applied as a foliar for late blight, pink rot, and Pythium leak. Can be applied post-harvest for storage disease control.

Potato Late Blight Fungicides Registered for WI, 2013.

Trade Name (rate/A)	Active Ingredient(s)	PHI	REI	FRAC #	Comments
<u>Polyram 80DF</u> (1.5 to 2 lb in 15 gal water/acre minimum)	metiram	3 days	24 hours	M3	Metiram is an EBDC, like mancozeb (M3). Total amount of a.i. per year/acre must include all EBDCs.
<u>Previcur Flex</u> (.7 to 1.2 pt)	propamocarb hydrochloride	14 days	12 hours	F	Apply in a tank-mix with effective protectant. Can be applied as a broadcast or banded application over the row, post-emergence.
<u>Priaxor</u> (4-8 fl oz)	fluxapyroxad+pyr aclostrobin	7 days	12 hours	7+11	Cannot apply more than 3 applications/season. Follow label for resistance management. Xemium and Headline pre-mix.
<u>Quadris</u> (6 to 15.5 fl oz)	azoxystrobin	14 days	4 hours	11	Alternate away from Group 11 fungicides to manage resistance.
<u>Quadris Opti</u> (1.6 pt)	azoxystrobin+chl orothalonil	14 days	12 hours	11+M5	Alternate away from Group 11 fungicides to manage resistance.
<u>Ranman</u> (1.4 to 2.75 fl oz)	cyazofamid	7 days	12 hours	21	Follow label for resistance management.
<u>Reason</u> (5.5 to 8.2 fl oz)	fenamidone	14 days	12 hours	11	Follow label for resistance management.
<u>Revus</u> (5.5 to 8 fl oz)	mandipropamid	14 days	4 hours	40	Addition of an adjuvant is recommended.
<u>Revus Top</u> (5.5 to 7 fl oz)	mandipropamid+d ifenoconazole	14 days	12 hours	40+3	Addition of an adjuvant is recommended.
<u>Tanos</u> (8 to 10 oz)	cymoxanil + famoxadone	14 days	12 hours	27+11	Must be tank-mixed with an effective protectant fungicide.
<u>Ridomil Gold SL</u> (1 to 2 pt)	mefenoxam	14 days	48 hours	4	Do not apply beyond the at-planting stage.
<u>Ridomil Gold Bravo SC</u> (2.5 pt)	mefenoxam+chlor othalonil	14 days	48 hours	4+M5	Follow label for resistance management.
<u>Ridomil Gold Copper</u> (2 lb)	mefenoxam+copp er hydroxide	14 days	48 hours	4+M1	Tank-mix with an effective protectant.
<u>Ridomil Gold MZ WG</u> (2.5 lb)	mefenoxam+man cozeb	3 days	48 hours	4+M3	Follow label for resistance management.
<u>Zampro</u> (11-14 fl oz)	ametotradin+dim ethomorph	4 days	12 hours	45+40	Do not make more than 2 sequential applications. Follow label for resistance management. Ametotradin is new a.i.; dimethomorph is Forum (formerly Acrobat).