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## Fungicide Schedule for Potatoes

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### **Late Blight**

The causal organism, *Phytophthora infestans*, overseasons in infected potato tubers. The main source for initial inoculum is cull piles or infected seed. High quality seed and conscientious growers see to that most years start with low levels of initial inoculum. In a normal year, the expectation is that there would be little or no initial inoculum from Maine seed and the initiation of protective materials should be made based on a predictive model. Importing seed from areas where late blight has occurred in the previous season changes the assumption of low initial inoculum. Growers need to pay very close attention to seed imported from a known late blight area. Seed treatments containing mancozeb and early applications to a crop grown from such seed may prove beneficial.

### **Late Blight**

The potential for late blight to appear is predicted with severity values based on weather conditions. Severity values have long been used in the United States to initiate and schedule applications for control of late blight and are based on hours of relative humidity above 90 percent and the average temperature during this period. When 18 severity values have accumulated from 50 percent emergence, an initial spray application is recommended. After this point, a spray interval is recommended based on additional severity value accumulation during the previous seven days. The late blight predictive scheme used in Maine weighs relative humidity more importantly than rainfall in predicting the timing of the applications. Applications should be based on weather conditions, not on a calendar. Severity values are available from the University of Maine Cooperative Extension Potato Program. If weather conditions dictate a five-day spray schedule, a seven-day schedule will may be inadequate in the presence of inoculum. Strict adherence to a calendar-based spray schedule irrespective of weather conditions can yield plants with inadequate protection at times and unnecessary protection at other times. If the initial application for disease control is predicted to occur when the plants are actively growing, more frequent applications may need to be made to insure protection of the newly emerged foliage. When growing rapidly, potato plants can double their leaf area in five days or less. This could leave half of the leaf area unprotected. Potato late blight is a community disease and continues to pose a threat. All potato growers should be continually monitoring their fields for this disease. Coupled with the protectant spray program,

growers should give careful attention to all sources of inoculum including cull piles, rock piles and other sources of volunteer potatoes.

### **Early Blight:**

Early blight of potatoes is caused by *Alternaria solani*, a fungus which overseasons as viable mycelium and as viable spores in infected crop refuse. *Alternaria solani* is generally thought to be a weak parasite. Plants that lack vigor or are maturing are predisposed to the pathogen. Early blight is often a disease of senescence, where the older leaves are infected first. The disease can progress upward; attacking newer tissue as the older leaves droop and dry up. Under severe epidemics, leaves may be killed prematurely. High temperatures and high humidity favor this development of this disease. Rain is not necessary for the development of early blight. This disease can cause losses in the field as well as in storage by tuber infections although tuber infections are not common in Maine. Most fungicides used for late blight will provide control of this pathogen. Proper fertilization and mineral balance in the growing and senescing plants will reduce the susceptibility of the plants to the pathogen. Control of early blight can be greatly aided by crop rotation as this will help reduce potato refuse. Proper fertility levels will delay the onset and reduce the severity of the disease.

The prediction of the onset of early blight is based on the potato plants being driven by temperature. Daily minimum and maximum temperatures are used to calculate Pdays. Pdays measure the physiological development of the potato plant and are a better measure of the development of the potato plant than are calendar days. Each calendar day can accumulate from 0 to 10 Pdays, dependent on the temperature. Pdays can be used to trigger the first application for early blight control and are available from the University of Maine Cooperative Extension Potato Program.

Early blight control needs to be initiated from 450 to 700 Pdays from emergence, depending on the season. The season-dependent thresholds for Early Blight have been initially established for Maine conditions and are available from the University of Maine Cooperative Extension Potato Program.

### **Materials for White Mold**

#### **Chemical: Boscalid**

Remarks: Fungicide Resistance Group 7. This is not a late blight material. Do not exceed 20.5 ounces of product per acre per year. Do not exceed 2 applications per year at the high rate or 4 applications at the low rate. Do not make two successive applications. The reentry interval is 12 hours and the preharvest interval is 10 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Endura</b>	5.5 to 10 oz.	Do not exceed 20 ounces of product per acre per year per season. <u>This is not a late blight material.</u>

**Chemical:** *Coniothyrium minitans* (fungal parasite of *Sclerotinia sclerotiorum*).

<b>Contans WG</b>	1 to 4 lbs.	Soil must be between 50°F and 80°F.
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Soil should not be disturbed after Application. Best results have been reported when there is a minimum of 8 weeks between application and planting. This material tends to reduce overwintering sclerotia in the top 1 inch of soil.  
This is not a late blight material.

**Chemical: Metconazole**

Remarks: Fungicide Resistance Group 7. This is not a late blight material. Do not exceed 16 oz. of product per acre per year. Do not exceed 4 applications per year or 16 oz. per season. Do not make two successive applications. The reentry interval is 12 hours and the preharvest interval is 14 days.

**Quash Fungicide**

4 oz.

Do not exceed 16 oz. of product per acre per year. Do not exceed 4 applications per year. Do not make two successive applications.

**Chemical: Fluopyram + pyrimethanil**

Remarks: Fungicide Resistance Group 7 + 9. This is not a late blight material. Do not exceed 3.5 pts. of product per acre per year. The reentry interval is 12 hours and the preharvest interval is 14 days.

**Luna Tranquility**

11.2 oz.

Do not apply more than 54.7 oz. product per acre per season. Must be alternated with materials (no two consecutive applications containing any fungicide resistance group 7 or group 9 compound).

**Chemical: Fluazinam**

Remarks: Fungicide Resistance Group 29. This is also a late blight material. Do not exceed 3.5 pts. of product per acre per year. The reentry interval is 12 hours and the preharvest interval is 14 days.

**Omega 500F Fungicide**

5.5 to 8 oz.

Do not apply more than 3.5 pts. per acre per season.

**Materials for Late Blight**

**Chemical: Chlorothalonil**

Remarks: Fungicide Resistance Group M5. Do not mix oil based or EC formulations with chlorothalonil products. Do not use surfactants; Do not exceed 11.25 lbs. active ingredient per acre per year. The reentry interval is 12 hours and the preharvest interval is 7 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Bravo Weather Stik</b>	1 to 1 ½ pts.	Do not exceed 15 pints of product per acre per season.
<b>Bravo Zn</b>	1 ½ to 2 ¼ pts.	Do not exceed 21.5 pints of product per acre per season.
<b>Chlorothalonil 720</b>	0.75 to 1 ½ pts.	Do not exceed 15 pints of product per acre per season.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Initiate 720</b>	0.75 to 1 ½ pts.	Do not exceed 15 pints of product per acre per season.

**Chemical: Copper**

Remarks: Fungicide Resistance Group M1. There are some incompatibilities with coppers. The reentry interval is 48 hours and the preharvest interval is 0 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Kocide 3000</b>	0.5 to 1.75 lbs.	
<b>Champ Dri Prill</b>	2/3 to 2 2/3lbs.	

**Chemical: Cyazofamid**

Remarks: Fungicide Resistance Group 21. Resistance management is critical with this group of compounds. Alternate with a compound NOT within this group (no two consecutive applications containing member compounds in this category). No more than 10 applications or 27.5 ounces per acre per season may be made.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Ranman</b>	1.4 to 2.75 oz.	It is recommended to tank mix with a protectant. Must be alternated with protectant materials (no two consecutive applications containing any fungicide resistance group 21 compound). No more than 10 applications per season or more than 27.5 ounces per acre per season can be applied.

**Chemical: Cymoxanil**

Remarks: Fungicide Resistance Group 27. The reentry interval is 12 hours and the preharvest interval is 14 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Curzate 60DF</b>	3.2 oz.	Maximum of 7 applications per year. Use ONLY tankmixed with a protectant

**Chemical: Dimethomorph**

Remarks: Fungicide Resistance Group 40. The reentry interval is 12 hours and the preharvest interval is 4 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Forum</b>	4 to 6.4 oz.	Use ONLY tankmixed with a protectant. Maximum of 32 oz per year. Do not tankmix with metalaxyl or mefenoxam products.

**Chemical: Fluazinam**

Remarks: Fungicide Resistance Group 29. The reentry interval is 48 hours and the preharvest interval is 14 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Omega 500F</b>	5 ½ to 8 oz.	Maximum of 3.5 pints per acre per season.

**Chemical: Mancozeb**

Remarks: Fungicide Resistance Group M3. Do not exceed 11.2 pounds of total active ingredient of all EBDC products per acre per year. The reentry interval is 24 hours and the preharvest interval is 3 days with the exception of Elixir which has a 7-day preharvest interval.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Manzate MAX</b>	0.8 to 1.6 qts.	Do not exceed 11.2 qts of product per acre per season.
<b>Manzate Pro-Stick</b>	1 to 2 lbs.	Do not exceed 15 lbs of product per acre per season.
<b>Roper DF rainshield</b>	1 to 2 lbs.	Do not exceed 15 lbs of product per acre per season.
<b>Koverall</b>	1 to 2 lbs.	Do not exceed 15 lbs of product per acre per season.

**Elixir** 1.2 to 1.8 lbs. Do not exceed 18 pounds of product  
Product also contains chlorothalonil.

**Chemical: Mandipropamid + Difenconazole**

Remarks: Fungicide Resistance Group 40 + Group 3. Do not exceed 4 applications per year. Do not make two successive applications. Do not apply more than 0.52 lbs. a.i./A per season of mandipropamid. The reentry interval is 12 hours and the preharvest interval is 14 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Revus Top</b>	5.5 to 7 oz.	Do not exceed 4 applications per year. Do not make two successive applications. The addition of a nonionic surfactant or crop oil concentrate is recommended.

**Chemical: Mefenoxam**

Remarks: Fungicide Resistance Group 4. Do not exceed the equivalent of 0.34 lb. a.i./A per crop of soil-applied – and 0.40 lb a.i./A if foliar-applied mefenoxam containing products. The reentry interval is 48 hours and the preharvest interval is 14 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Ultra Flourish</b>	0.84 oz/1000 linear feet	For use only at planting. Do not use dribble (Admire) applicators. Apply at a 6 to 8 inch band (12.2 oz per acre at 36 inch row spacing).

**Chemical: Oxathiapiprolin**

Remarks: Fungicide Resistance Group U15. Do not apply more than 0.125 lb. a.i./A per season of oxathiapiprolin. The reentry interval is 4 hours and the preharvest interval is 5 days.

\*\*\*\*\***special note**\*\*\*\*\*

Orondis comes in several variations including:

Orondis Ultra which is a combination of oxathiapiprolin and mandipropamid

Orondis Gold which is a combination of oxathiapiprolin and mefenoxam

Orondis Opti which is a combination of oxathiapiprolin and chlorothalonil

Read the label careful as each of these variations may have different rotation restriction, REI, or PHI as a result of the mixing partner.

\*\*\*\*\*special note\*\*\*\*\*

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Orondis</b>	0.84 oz/1000 linear feet	For use only at planting. Do not use dribble (Admire) applicators. Apply at a 6 to 8 inch band (12.2 oz per acre at 36 inch row spacing).

**Chemical: Propamocarb**

Remarks: Fungicide Resistance Group F. The reentry interval is 12 hours and the preharvest interval is 14 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Previcur Flex</b>	0.7 to 1.2 pts.	Use ONLY tankmixed with a protectant. No more than 6 pints (4.5 lbs a.i.) per acre per season can be applied.

**Chemical: Strobilurin-like materials**

Remarks: Fungicide Resistance Group 11. This is not a late blight material. Resistance management is critical with this group of compounds. Alternate with a compound NOT within this group (no two consecutive applications containing member compounds in this category). There are compound-specific limitations on number of applications as well as total amount of material which can be applied. The reentry interval ranges from 4 to 12 hours and the preharvest interval ranges from 3 to 14 days. Check the control material comparison table for details.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Quadris</b>	6.2 to 15.4 oz.	Use ONLY tankmixed with a protectant. Must be alternated with protectant materials (no two consecutive applications containing any fungicide resistance group 11 compound). No more than 6 applications per season or more than 3.75 quarts (2.0 lbs a.i.) per acre per season can be applied. Benefit of early blight control has been shown in years that have exceeded 350 Pdays by 15 July.

<b>Tanos</b>	6 to 8 oz.	Use ONLY tankmixed with a protectant. Must be alternated with protectant materials (no two consecutive applications containing any fungicide resistance group 11 compound). No more than 6
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<b>Agri Tin</b>	1.87 to 3.75 oz	Do not exceed 11.25 oz of product per acre per season
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<b>Super Tin 80WP Agpak</b>	1.87 to 3.75 oz	Do not exceed 11.25 oz of product per acre per season
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**Chemical: Zoxamide**

Remarks: Fungicide Resistance Group 22 and M3. The reentry interval is 48 hours and the preharvest interval is 3 days. There is mancozeb in this formulation. For every pound of Gavel applied, 0.67 pounds of mancozeb is applied. This needs to be included when considering per acre limitations of mancozeb.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Gavel 75DF</b>	1.5 to 2.0 lb	Maximum applications per season is 6 with no more than 12 pounds of product per acre per season. Notify workers that the area has been treated with dermal sensitizer by warning them orally.

**Chemical: Zoxamide + chlorothalonil**

Remarks: Fungicide Resistance Group 22 and M5. The reentry interval is 12 hours and the preharvest interval is 7 days. There is mancozeb in this formulation. For every pound of Gavel applied, 0.4 pounds of chlorothalonil is applied. This needs to be included when considering per acre limitations of chlorothalonil.

<b>Zing</b>	32 to 34 oz.	Maximum applications per season is 8 with no more than 272 oz of product per acre per season. Notify workers that the area has been treated with dermal sensitizer by warning them orally
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## Fungus Control Material Comparison Chart

<b>Fungicide</b>	<b>FRAC Group</b>	<b>Late Blight</b>	<b>Early Blight</b>	<b>Leak</b>	<b>Pink Rot</b>	<b>REI</b>	<b>PHI</b>
Agri Tin	30	E	E	NL	NL	48 hours	7 days
Bravo Weather Stik	M5	G	G	NL	NL	12 hours	7 days
Bravo Zn	M5	G	G	NL	NL	12 hours	7 days
Champ Dri Prill	M1	P	F	NL	NL	24 hours	0 days
Curzate 60 DF	27	E	NL	NL	NL	12 hours	14 days
Elixir	M3&M5	G	G	NL	NL	12 hours	7 days
Evito 480C	11	G	G	NL	NL	12 hours	7 days
Forum	40	E	F	NL	NL	12 hours	4 days
Gavel 75DF	22&M3	E	P	NL	NL	48 hours	3 days
Headline	11	G	G	NL	NL	12 hours	3 days
Initiate 720	M5	G	G	NL	NL	12 hours	7 days
Kocide 3000	M1	P	F	NL	NL	24 hours	0 days
Koverall	M3	G	G	NL	NL	24 hours	3 days
Manzate Pro-Stick	M3	G	G	NL	NL	24 hours	3 days
Manzate MAX	M3	G	G	NL	NL	24 hours	3 days
Omega 500F	29	E	P	NL	NL	48 hours	14 days
Orondis	U15	E	P	NL	NL	4 hours	5 days
Previcur Flex	F	E	P	NL	NL	12 hours	14 days
Quadris	11	P	E	NL	NL	4 hours	14 days
Ranman	21	E	NL	NL	E	12 hours	7 days
Revus Top	40+3	E	E	NL	NL	12 hours	14 days

### Fungus Control Material Comparison Chart (continued)

<b>Fungicide</b>	<b>FRAC</b>	<b>Late Blight</b>	<b>Early Blight</b>	<b>Leak</b>	<b>Pink Rot</b>	<b>REI</b>	<b>PHI</b>
Roper DF Raindield	M3	G	G	NL	NL	24 hours	3 days
Super Tin 80WP Agpak	30	E	E	NL	NL	48 hours	7 days
Tanos	11	E	E	NL	NL	12 hours	14 days
Ultra Flourish	4	NL	NL	G	G	48 hours	Not listed

E = Excellent, G = Good, F = Fair, P = Poor, NL = Not Labeled

Comparison of *Phytophthora infestans* control materials, based on the **highest** rate registered. (The chart is partially based on the efforts of the Fungicides Sub-Group at a 2007 late blight workshop.)

Product	Effectiveness				Mode of Action			Rain Fastness	Mobility in the plant
	Leaf blight	New growth	Stem blight	Tuber blight	Protectant	Curative	Anti-sporulant		
Bravo etc	G	No	P	No	G	No	No	G	contact
Curzate + Manzate etc.	G	?	F	No	G	E	P	G	translaminar + contact
Manzate etc	G	No	P	No	G	No	No	F	contact
Forum + Manzate	G	?	F	F	G	P	G	G	translaminar + contact
Gavel	E	No	P	F	E	No	No	G	contact + contact
Kocide etc	P	No	P	No	F	No	No	P	contact
Omega	E	No	P	G	E	No	No	G	contact
Orondis	E	E	E	E	E	G	E	E	systemic
Previcur Flex + Manzate etc.	G	G	G	No	G	G	G	E	systemic + contact
Ranman	E	No	P	E	E	No	No	E	contact
Tanos	G	?	F	No	G	E	P	G	translaminar + contact
Revus Top	E	?	F	G	E	P	F	E	translaminar + contact
Tin	E	No	E	E	G	No	E	F	contact

No = No effect; P = Poor; F = Fair; G = Good; E = Excellent; ? = Unknown.

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