

## **Fungicide Schedule for Potatoes**

### **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 well 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.

## Fungicides

### 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.

Trade Name	Rate per acre of product	Comments
<b>Endura</b>	2.5 to 10 oz	Do not exceed 20.5 ounces of product per acre per year per season. <u>This is not a late blight material.</u>

### Chemical: Chlorothalonil

Remarks: Fungicide Resistance Group M5. Do not mix oil based or EC formulations with chlorothalonil products. Do not mix chlorothalonil with Dyston 8. Do not use surfactants; Do not exceed 11.25 lb. active ingredient per acre per year. The reentry interval is 12 hours and the preharvest interval is 7 days.

Trade Name	Rate per acre of product	Comments
<b>Bravo Weather Stik</b>	1 to 1 ½ pts	Do not exceed 15 pints of product per acre per season.
<b>Bravo Ultrex</b>	0.9 to 1.4 lbs	Do not exceed 13.6 lbs 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.

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<b>Echo 720</b>	0.75 to 1 ½ pts	Do not exceed 15 pints of product per acre per season.
<b>Equus DF</b>	0.9 to 1.36 lbs	Do not exceed 13.6 lbs of product per acre per season.
<b>Equus 720 SST</b>	0.75 to 1.5 lbs	Do not exceed 15 pints of product per acre per season.
<b>Equus 500 Zn</b>	1 ½ to 2 ¼ pts	Do not exceed 21.5 pints of product per acre per season.
<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. Do not tank mix Monitor with any copper. The reentry interval is 24 hours and the preharvest interval is 0 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Kocide 2000</b>	0.75 to 3 lbs	
<b>Kocide 3000</b>	0.5 to 1.75 lbs	
<b>Champ Formula 2 Flowable</b>	2/3 to 2 2/3 pints	
<b>Champ WG</b>	1 to 4 lbs	

**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 mfenoxam 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.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Manzate Flowable</b>	0.4 to 1.6 qt	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>Penncozeb 75 DF</b>	1.6 to 2.0 lb	Do not exceed 15 lbs of product per acre per season.

**Chemical: Mandipropamid + Difenoconazole**

Remarks: Fungicide Resistance Group 40 + Group 3. Do not exceed 4 applications per year. Do not make two successive applications. 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>Ridomil Gold MZ</b>	2.5 lb	Maximum 3 applications per season at 14 day intervals. Do not apply more than one foliar application following the use Platinum Ridomil Gold at planting.
<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: Metiram**

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 14 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Polyram 80 DF</b>	1.5 to 2 lb	Maximum of 14 lbs per acre per season. Do not feed potatoes to livestock.

**Chemical: Propamocarb**

Remarks: Fungicide Resistance Group 28. 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 pt	Use ONLY tankmixed with a protectant. No more than 6 pints (4.5 lbs a.i.) per acre per season can be applied.

**Chemical: Pyrmethanil**

Remarks: Fungicide Resistance Group 9. This is not a late blight material. Do not use more than 35 ounces of material per acre per season. The reentry interval is 12 hours and the preharvest interval is 7 days.

Trade Name	Rate per acre of product	Comments
Scala SC	7 oz	Use ONLY tankmixed with a protectant. No more than 6 pints (4.5 lbs a.i.) per acre per season can be <u>This is not a late blight material.</u> Do not use more than 35 ounces of material per acre per season.

#### 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.

Trade Name	Rate per acre of product	Comments
Quadris	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.
Tanos	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 applications per season can be applied.
Headline	6 to 12 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 2.25 quarts per acre per season can be applied. Use higher rate for late blight control.

**Chemical: Tin**

Remarks: Fungicide Resistance Group M1. Do not use tin products alone as phytotoxicity may result. Tin products should be used in conjunction with other protectants, namely EBDC or chlorothalonil products. Do not apply tin products with emulsifiable concentrate formulations or add sticker in tank mixes. GROUND APPLICATIONS MUST BE MADE WITH CLOSED CAB EQUIPMENT ONLY. PLEASE CONSULT THE LABEL FOR SPECIFIC INSTRUCTIONS ON PESTICIDE TRANSFER. The reentry interval is 48 hours and the preharvest interval is 7 days.

<b>Trade Name</b>	<b>Rate per acre of product</b>	<b>Comments</b>
<b>Agri Tin</b>	1.87 to 3.75 oz	Do not exceed 11.25 oz of product per acre per season
<b>Super Tin 80WP Agpak</b>	1.87 to 3.75 oz	Do not exceed 11.25 oz of product per acre per season

**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.

**Fungus Control Material Comparison Chart**

<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>
Agri Tin	M1	E	E	NL	NL	48 hours	7 days
Bravo Ultrex	M5	G	G	NL	NL	12 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 Formula 2 F	M1	P	F	NL	NL	24 hours	0 days
Champion WG	M1	P	F	NL	NL	24 hours	0 days
Curzate 60 DF	27	E	NL	NL	NL	12 hours	14 days
Dithane DF Rainshield	M3	G	G	NL	NL	24 hours	3 days
Dithane F-45 Rainshield	M3	G	G	NL	NL	24 hours	3 days
Echo 720	M5	G	G	NL	NL	12 hours	7 days
Equus DF	M5	G	G	NL	NL	12 hours	7 days
Equus 500 Zn	M5	G	G	NL	NL	12 hours	7 days
Equus 720 SST	M5	G	G	NL	NL	12 hours	7 days
Endura	7	NL	G	NL	NL	12 hours	10 days
Equus DF	M5	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 2000	M1	P	F	NL	NL	24 hours	0 days
Kocide 3000	M1	P	F	NL	NL	24 hours	0 days

<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>
Maneb 75 DF	M3	G	G	NL	NL	24 hours	3 days
<b>Fungus Control Material Comparison Chart (continued)</b>							
<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>
Manzate Flowable	M3	G	G	NL	NL	24 hours	3 days
Omega 500F	29	E	P	NL	NL	48 hours	14 days
Penncozeb 75 DF	M3	G	G	NL	NL	24 hours	3 days
Polyram 80 DF	M3	F	F	NL	NL	24 hours	14 days
Previcur Flex	28	E	P	NL	NL	12 hours	14 days
Quadris	11	P	E	NL	NL	4 hours	14 days
Quadris Opti	11	P	E	NL	NL	4 hours	14 days
Ranman	21	E	NL	NL	E	12 hours	7 days
Reason 500SC	11	F	G	NL	NL	12 hours	14 days
Ridomil Gold EC	4	NL	NL	G	G	48 hours	14 days
Revus Top	40+3	E	E	NL	NL	12 hours	14 days
Ridomil Gold MZ	4	NL	NL	G	G	48 hours	14 days
Super Tin 80WP Agpak	M1	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 + Dithane etc.	G	?	F	No	G	E	P	G	translaminar + contact
Dithane etc	G	No	P	No	G	No	No	F	contact
Forum + Dithane	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
Previcur Flex + Dithane 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.