

## ***INTEGRATED MANAGEMENT OF LATE BLIGHT ON POTATOES***

Late blight has been a problem for potato growers in North America since the 1840s. The recent arrival of a new form of the late blight fungus, the “A2 mating type”, is resulting in many new strains of the fungus. These new strains are sometimes more aggressive pathogens and some may have overcome genetic resistance in some potato cultivars or be resistant to some fungicides. For example, strains have been found in North America that differ in their response to the fungicide metalaxyl: some strains are sensitive and some strains are insensitive.

### ***KEY POINTS***

For effective control of late blight, integrated management **MUST** be adopted by all producers, large and small, including organic farmers, home gardeners and other specialized growers, by pesticide and equipment manufacturers and suppliers, and by government agencies, extension specialists and crop consultants.

Fungicides cannot be used alone for effective control of late blight, but must be used as one tool in an integrated management strategy. Cultural practices are the first line of defense, and forecasting techniques and proper application technology are essential for efficient, targeted applications of fungicides.

All fungicides, existing or new, must be used as protectants, that is, before late blight is established. Attempting to use any fungicide to eradicate the disease after it is well established promotes the selection and spread of new resistance.

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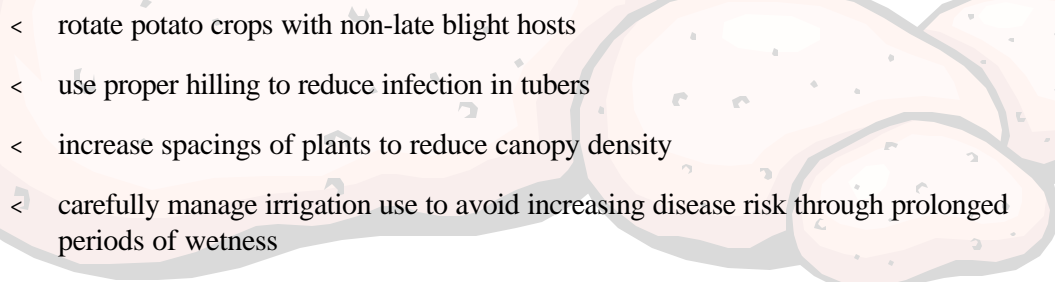
## LATE BLIGHT PREVENTION AND CONTROL

**Healthy Seed:** Obtain seed from sources with effective disease management practices. The use of certified seed is highly recommended. Grade seed carefully while cutting and discard suspicious looking tubers and seed pieces.

**Crop Varieties and Resistant Cultivars:** Select varieties with resistance to late blight wherever practical. Various publications available through agriculture extension specialists provide information on resistant varieties. Where practical, use of short season varieties may help reduce the period of use for fungicides.

**Sanitation and Cull Clean-up:** Follow a program of sanitation for storage facilities and equipment to eliminate sources of the disease. Avoid leaving tubers, including debris or slivers from seed cutting, in cull piles for any length of time. Avoid uncovered cull piles during the growing season. Check with local authorities for methods of disposal.

**Cultural Practices and Rotation:** Use proper cultural practices, including the following, as the first line of defence:

- 
- < rotate potato crops with non-late blight hosts
  - < use proper hilling to reduce infection in tubers
  - < increase spacings of plants to reduce canopy density
  - < carefully manage irrigation use to avoid increasing disease risk through prolonged periods of wetness
  - < identify and destroy hot spots of infection in a field to reduce production and spread of spores by bagging and destruction of individual plants, or chemical destruction and fungicide treatment of larger areas
  - < avoid fields that cannot be easily sprayed with fungicide
  - < control weed hosts, such as hairy nightshade
  - < promptly remove or destroy volunteer potatoes found in other crops grown in rotation or elsewhere

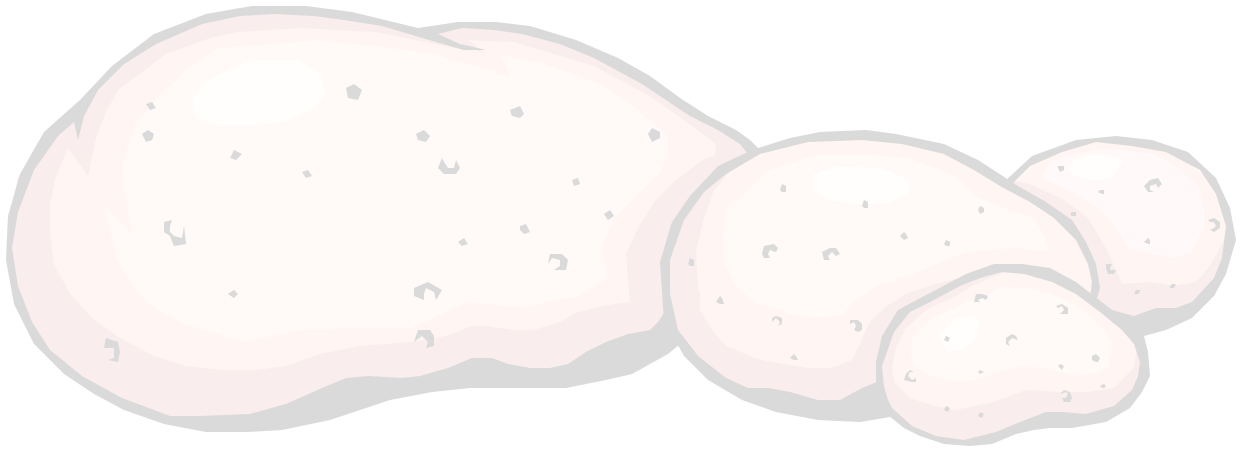
**Forecasting Techniques and Scouting Systems:** Use forecasting based on local weather conditions to identify conditions conducive to disease development in order to effectively schedule preventative fungicide applications and eliminate unnecessary fungicide use. Scout fields to identify hot spots and other sources of disease.

**Scheduled Fungicide Programs:** Use fungicides as part of a **preventative program**. No fungicide is effective in eradicating disease that has already set in. Attempting to use fungicides as curatives can promote the spread of fungicide resistance.

- < Begin a fungicide program early in the season, always before disease develops, and continue through until harvest. Scouting programs, forecasts based on local weather conditions and stage of crop development should be used to determine when to begin applications and to adjust the timing of applications during the growing season.
- < Follow label instructions for application rates, spray intervals and limitations on numbers of sprays. Do not exceed labelled application rates. Spray intervals are generally 7-10 days for contact fungicides and 10-14 days for systemic and some other fungicides. When disease potential is high, e.g., during rapid plant growth or heavy rains, the shorter labelled spray intervals should be used. When disease potential is lower, e.g., extended hot dry weather, the longer labelled spray intervals are appropriate.
- < When the maximum number of applications of a fungicide is reached, switch to an unrelated alternate product.
- < Crops should be monitored throughout the growing season (spring culls to harvested crops) for late blight. Pathogen populations should be monitored for sensitivity to metalaxyl or other fungicides for which resistance may be a problem. Rapid screening services for fungicide sensitivity, where available, are valuable in this regard. Where resistance to a fungicide is identified in a field, use of that fungicide should be discontinued.
- < Rotate between different fungicide groups or use tank mixtures of different fungicides, particularly when using fungicides that enter plant tissues or have single or limited-site activity against the fungus.
- < Organic farmers may be able to use copper-based fungicides as part of an integrated disease management plan and maintain organic certification.

**Application Technology:** When applying fungicides, complete coverage of the foliage (stems and leaves, top to bottom of canopy) with fungicide is necessary to enable disease prevention, regardless of the application method (ground or air, traditional or newer technology sprays). To ensure adequate coverage of plants, use equipment designed for and appropriate to fungicide applications. Do not over-extend acreage beyond what a sprayer can cover in the **minimum** time available, including bad weather, e.g., no more than two to three days acreage capacity per machine. Use adequate water volumes and increase water volume as the crop grows. Ensure regular and proper equipment calibration.

**Harvesting, Grading and Storage Monitoring:** Harvest only when vines, both leaves and stems, are completely dead. Harvest suspect, shaded or wet areas after the rest of the harvest is complete. Grade potatoes and remove infected tubers **before** they are put in storage. Monitor storage facilities for “hot spots” which indicate the start of storage breakdown due to rots. Carefully manage air flow, humidity and temperature to reduce storage losses.



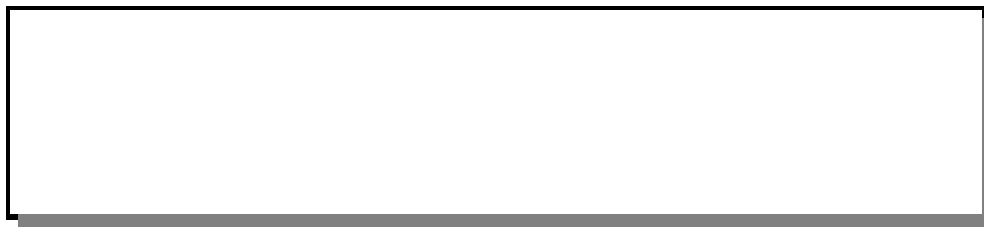
## CREDITS

This fact sheet and a related overview document were produced by a working group consisting of representatives of grower groups, pesticide manufacturers, provincial governments, research scientists, the Canadian federal government and the United States Environmental Protection Agency. The project was coordinated by the Pest Management Regulatory Agency, the Canadian Horticultural Council and Agriculture and Agri-Food Canada.

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Canadian Horticultural Council Potato Executive	Manitoba Agriculture Ministère de l'Environnement et de la faune (Québec)
Canadian Federation of Agriculture / Canadian Horticultural Council Crop Protection Advisory Committee	Ministère d'Agriculture, Pêcheries, Alimentation (Québec)
AgrEvo Canada Inc.	New Brunswick Environment
BASF Canada Inc.	New Brunswick Agriculture
Ciba-Geigy Canada Ltd.	Newfoundland Dept. of Environment
Cyanamid	Nova Scotia Dept. of the Environment
DuPont Canada Inc.	Nova Scotia Dept. of Agriculture and Marketing
ISK Biosciences Ltd.	Ontario Ministry of Agriculture, Food and Rural Affairs
Rohm and Haas Canada Inc.	Pest Management Regulatory Agency
United Agri-Products	Prince Edward Island Dept. of Agriculture, Fisheries and Forestry
Zeneca Agro	Saskatchewan Agriculture and Food
Agriculture and Agri-Food Canada	U.S. Environmental Protection Agency
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Additional copies of this fact sheet and of the overview document, *Integrated Management of Late Blight on Potatoes*, are available from:



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## ACTIVE INGREDIENTS REGISTERED IN CANADA AGAINST LATE BLIGHT<sup>1</sup>

Active ingredient	Mode of action	Spray interval	Max. sprays / year	Special instructions
Anilazine	contact	7-10 days	n/a	4-5 day interval in extended cool wet weather
Chlorothalonil <sup>2</sup>	contact	7-10 days	n/a	
Copper sulphate	contact		n/a	Use in Bordeaux mixture with hydrated lime; can be phytotoxic if used on its own.
Copper sulphate, tribasic <sup>2</sup>	contact	7-10 days	n/a	
Copper hydroxide	contact	7-10 days	n/a	Combine application with mancozeb.
Copper oxychloride <sup>2</sup>	contact	7-10 days	n/a	
Dimethomorph		7-10 days	3	Available only in pre-pack mixtures with contact active.
Mancozeb	contact	7-10 days	n/a	
Maneb	contact	7-10 days	n/a	
Metalaxyl	systemic	10-14 days	3	Apply a contact fungicide between applications. Available only in pre-pack mixtures with contact active.
Metiram	contact	7-10 days	n/a	Can use 5-7 day interval at low rate after row closure.
Propamocarb		10-14 days	3	Apply a contact fungicide between application. Available only in pre-pack mixtures with contact active.
Zineb <sup>2</sup>	contact	7-10 days	n/a	

<sup>1</sup> Commercial registration unless noted. Contact local extension specialists and provincial grower guides for specific information, including application rates and pre-harvest intervals.

<sup>2</sup> Also available in Domestic products. Spray interval may vary for Domestic products: check the label.

## PRODUCTS REGISTERED IN CANADA AGAINST LATE BLIGHT

Active ingredient	Registered product (Commercial)
Anilazine	Dyrene Solupak 50% Wettable Powder Dyrene 50% Wettable Powder Foliage Fungicide
Chlorothalonil <sup>1</sup>	Bravo W-75 Agricultural Fungicide Bravo 500 Agricultural Fungicide
Copper sulphate	Triangle Brand Copper Sulphate Instant Powder
Copper sulphate, tribasic <sup>1</sup>	Griffin Basicop Fungicide Clean Crop Copper Wettable Powder
Copper hydroxide	Kocide 101 Agricultural Fungicide
Copper oxychloride <sup>1</sup>	Guardsman Copper Oxychloride 50 W.P. Fungicide Clean Crop Copper Spray Fixed Copper Fungicide
Dimethomorph	Acrobat MZ (combined with mancozeb)
Mancozeb	Dithane F-45 Fungicide Agricultural Dithane DG Agricultural Fungicide Manzate 200DF Dry Flowable Fungicide Dithane WSP 80% WP Fungicide Dithane M-45 80% W.P. Fungicide
Maneb	Clean Crop Maneb 80W Fungicide Dithane M-22 80% W.P. Fungicide
Metalaxyl	Ridomil MZ 72WP Agricultural Fungicide (combined with mancozeb) Bravo / Ridomil Twin-Pak Fungicide (combined with chlorothalonil)
Metiram	BASF Polyram 80W Fungicide BASF Polyram 7 Dust Polyram DF Fungicide Water Dispersible Granular Polyram 16D Fungicide Dust
Propamocarb	Tattoo C (combined with chlorothalonil)

<sup>1</sup> Also available in Domestic products.

Zineb <sup>1</sup>	Dithane Z-78 Wettable Powder Fungicide Clean Crop Zineb 80W Fungicide Thiodan-2 Zineb-5 Endosulfan-Zineb Insecticide/Fungicide Dust Zineb 80W Fungicide Wettable Powder Clean Crop Zineb 80 WP
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