

The background of the slide is a close-up photograph of green leaves, likely from a potato plant, showing significant damage from late blight. The leaves are covered in numerous dark brown, necrotic spots and larger irregular patches, indicating the presence of the pathogen. The overall color is a mix of vibrant green and sickly yellow-green, with the brown lesions being the most prominent feature.

Strengthening management of new late blight genotypes in the northcentral USA

Gary Secor

Viviana Rivera-Varas

Susie Thompson

Neil Gudmestad

Plant Pathology Department, North Dakota

State University, Fargo, ND, USA



Introduction

- ❖ Because of the resurgence of late blight, we have implemented a program to strengthen and improve the regional late blight management program
- ❖ In 2009 ND planted 83,000 acres of potatoes with a value of 175 million dollars; MN planted 47,000 acres of potatoes with a value of 160 million dollars.
- ❖ Cooperation with:
 - ✓ Growers groups of ND, MN, MB
 - ✓ State governments
 - ✓ Entire potato industry of ND, MN and MB - growers, processors, allied industries
- ❖ I want to tell you the history of our late blight from 2009-2011, our plan for late blight management, and how it worked
 - ✓ May generate ideas, discussion

Late blight history in north central region

- ❖ 1850-1991 late blight sporadic; old A1 US1 genotype
- ❖ 1992 introduction of new genotypes from Mexico
- ❖ 1993-1995 Mixture of genotypes and mating types
- ❖ 1995-2008 US-8 (A2) was dominant
 - ✓ mefenoxam resistant
 - ✓ more aggressive, more tuber rot, higher temperature tolerance
 - ✓ Complex races; many virulence genes
- ❖ 2009 new genotypes in US and our region
 - ✓ US 22, 23, 24
 - ✓ Need to evaluate?

What happened in our area in 2009?

- ❖ Localized outbreak of late blight in region
 - ✓ First significant late blight in five years
 - ✓ Found in mid August
 - ✓ In ND it was limited to one county; processing potatoes and garden tomatoes
 - ✓ Found in irrigated fields with volunteers (unusual for ND); may have been present in 2008 and not reported
 - ✓ Due to late blight on the east coast (big box tomatoes), premium fungicides were scarce; Gavel, Revus Top, Curzate, Ranman
 - ✓ Few storage issues due to late blight
 - ✓ New genotype US24 A1

What happened in 2010?

❖ Big news was late blight

- ✓ Late blight found on tomatoes in retail stores in Manitoba in early June
- ✓ Detected in ND potato field June 24; earliest found since 1994
- ✓ Reported in MB potato fields June 30
- ✓ Detected in MN potato fields July 21
- ✓ Became widespread in region

❖ New genotypes

- ✓ In ND only US-24 A1 mating type 2009 and 2010
- ✓ In MB US24 in 2009, US23 and US24 2010
- ✓ In MT US24 mating type 2010

2010 observations

- ✓ Severity values accumulated early and continued to climb all season
- ✓ The early appearance late blight caught growers by surprise even though we warned them
- ✓ Early appearance suggests seed-borne or cull pile source(s) of inoculum from previous year
- ✓ Organic field in ND acted as a source of inoculum in mid-season
 - Became a political problem
- ✓ Shortage of some fungicides
- ✓ Tuber infection found at harvest and in storage

- ❖ We knew we needed to get ready for late blight in 2011
- ❖ We told the growers they would have late blight
- ❖ We emphasized that late blight is a community disease
- ❖ To respond we strengthened a unified late blight management plan for 2011
 - ✓ Multi-state ND, MN, MB
 - ✓ Growers, allied industries, government, university

What happened in 2011?

- ❖ Weather late planting, heavy rain, late appearance of late blight end of July – surprising
- ❖ Only the new Pi genotype US24 found; A1 mating type; mefenoxam resistant
- ❖ No resistant varieties
- ❖ Growers sprayed early and often
- ❖ Tuber infection end of season

Management requires an integrated approach using multiple tactics

- ❖ Our 2011 approach included multiple components:
 - ✓ Grower and industry education
 - ✓ Early detection
 - ✓ Fungicide efficacy trials
 - ✓ Late blight forecasting
 - ✓ Development of late blight resistant varieties
 - ✓ Harvest/post harvest management

Grower and industry education

- ❖ Grower/industry meetings
 - ✓ Manitoba Potato Days January 26
 - ✓ ND/MN/MB International Crop Expo Seminar February 17
 - ✓ MN Area II Potato Growers meeting March 1
 - ✓ Grower only meeting April 21
- ❖ Wrote and distributed electronically a Plant Disease Alert for organic growers, home gardeners, farmer markets
 - ✓ Late Blight: A Plant Disease That Impacts the Community
- ❖ Special communications and workshops as necessary
- ❖ Fungicide field application demonstration (cancelled due to excess rain)

❖ Education

- ✓ Education of consultants, growers, company agronomists, farm workers, all allied industries
 - ✓ Technical training
 - ✓ Realize late blight is a community disease
 - ✓ Communicate!
 - Urge growers to submit samples to us for verification and typing
 - Some will not submit samples; feel affects seed sales or marketing
 - ✓ Field days, meetings –lunch always works
 - ✓ Literature
- ❖ **OUTCOME:** Education well received, good attendance, lots of questions – growers want to learn

Early detection

❖ Sentinel plots

- ✓ A small planting of untreated potatoes with no fungicide that will act as a biological trap of any late blight in the area
 - cv. Red LaSoda
- ✓ 10 locations in ND, 6 locations in MB including Potato Research Farm, NDSU campus, consultant offices and field sites, fungicide distributor sites, grower fields, etc.
 - Not in certified seed fields
 - Planted early and monitored frequently
 - If and when late blight found, potato plants are destroyed and late blight reported
 - NDSU Blightline
 - Removes grower identity but identifies location for additional searching and action

- ❖ Frequent and early scouting of fields to look for late blight
 - ✓ Retired potato specialist was hired
- ❖ Monitoring of retail tomato plants for late blight
 - ✓ Concentrate on big box retail stores, nurseries
- ❖ Devise a plan for home gardeners
 - State Departments of Agriculture very involved and provide regulatory authority for this
- ❖ **OUTCOME:** No late blight was found in either the sentinel plots or retail tomato plants

Late blight forecasting

- ❖ NDSU Blightline in operation for the 16th year to forecast weather conditions favorable for late blight and fungicide recommendations
 - ✓ Operates June 1 – August 30
 - ✓ Sponsored by Syngenta Crop Protection
 - ✓ Main source of late blight information for the region
 - ✓ Uses data from 29 NDAWN weather stations to forecast late blight severity and favorability
 - ✓ New report every Monday, Wednesday, Friday
 - Late blight locations and disease control recommendations
 - Reports available by phone, email, NDSU website

- ❖ OUTCOME: Effective communication with the industry; widely used
- ❖ This year most growers began spraying early before threshold severity value reached and continued on a 5-7 day regular schedule
 - ✓ high threat of late blight
 - ✓ Seed borne late blight
 - ✓ Favorable weather
 - ✓ Large acreages that take several days to spray
 - ✓ Don't want to get behind
 - ✓ Few resistant varieties; many very susceptible varieties
 - ✓ Spray early/spray often philosophy

Fungicide efficacy trials

- ❖ Locations in ND near NDSU
 - ✓ Conducted since 1994
 - ✓ Trials inoculated with prevalent genotypes
 - Have an untreated control
 - ✓ At least the same 5-10 “real life” grower fungicide programs at each location
 - ✓ Experimental fungicides
 - ✓ Biological fungicides
 - ✓ Foliar and tuber late blight infection
- ❖ OUTCOME: Fungicide trials identify effective fungicides
 - ✓ Fungicide trial lost to flooding in 2011 due to excessive rains in June

Late blight seed treatment trial

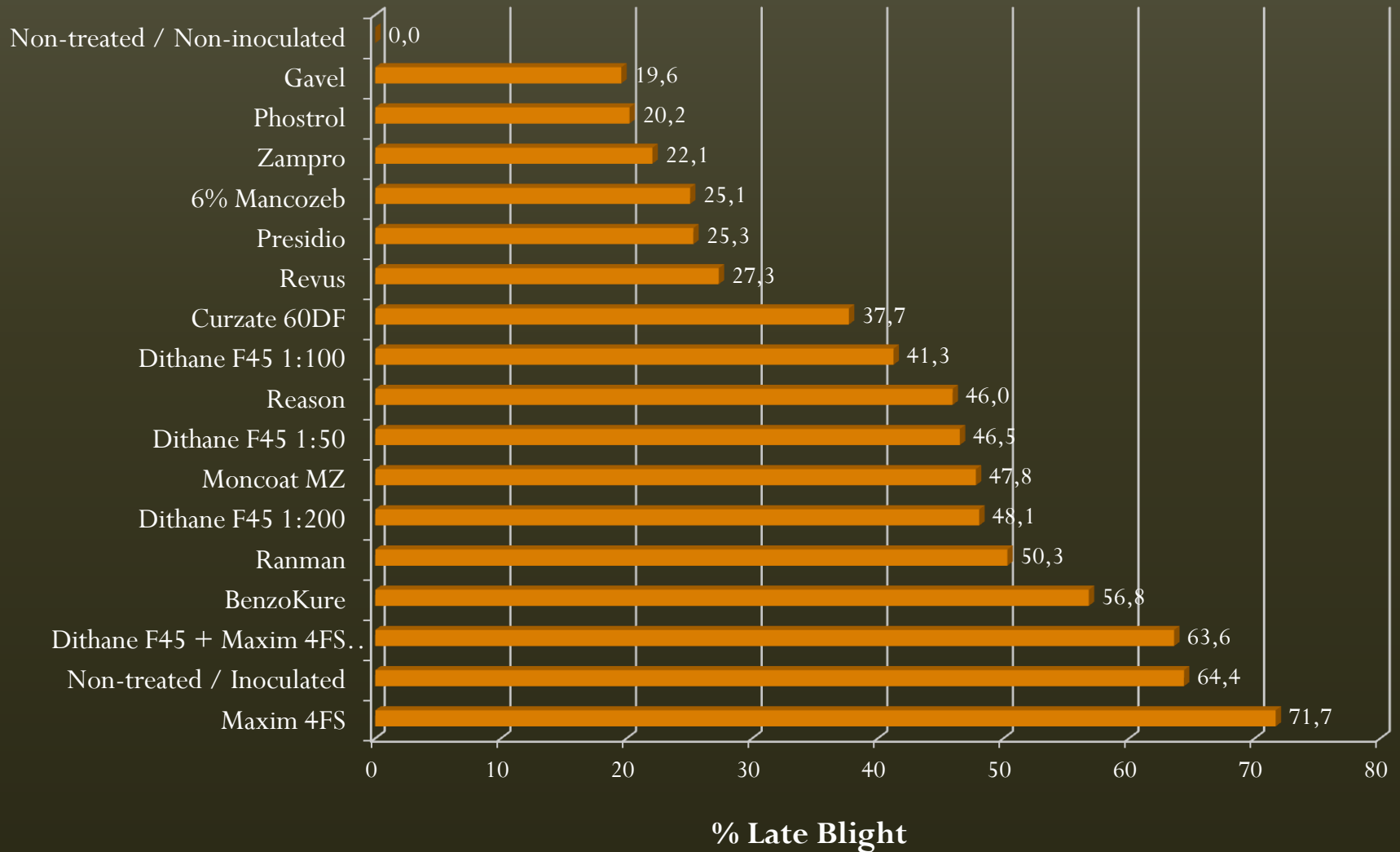
- ❖ There is a need for an effective seed treatment for late blight
- ❖ Cut seed of Red LaSoda (LB susceptible) tumbled with late blight infected seed and lab inoculum
 - ✓ 4 replications, 25 seed pieces/replcation
- ❖ Stored four weeks in paper bags at 12°C
- ❖ Evaluate late blight

Late Blight Seed Treatment 2011

Prosper, ND

Treatment		Rate	Schedule
1401	Non-treated / Non-inoculated	-	
1402	Non-treated / Inoculated	-	
1403	Presidio	4 fl oz	
1404	Gavel	32 oz	
1405	Phostrol	12.8 fl oz / ton	
1406	6% Mancozeb	1 lb / cwt	
1407	Curzate 60DF	3.2 oz	
1408	Maxim 4FS	0.08 fl oz / cwt	
1409	Revus	0.42 fl oz / cwt	
1410	Ranman	.275 fl oz	
1411	Moncoat MZ	0.75 lb / cwt	
1412	BenzoKure	2 qt	
1413	Dithane F45	0.25 fl oz / cwt	1:50
1414	Dithane F45	0.25 fl oz / cwt	1:100
1415	Dithane F45	0.25 fl oz / cwt	1:200
1416	Dithane F45 + Maxim 4FS	0.25 fl oz / cwt + 0.08 fl oz / cwt	1:100
1417	Zampro	14 fl oz	
1418	Reason	8.2 fl oz	

Late blight seed treatment



Development of late blight resistant varieties

- ❖ Dedicated crossing blocks with late blight resistant parents
 - ✓ Test seedlings from 40-60 crosses (families) for resistance 2005-2011
 - Test 100 seedlings/cross
 - 4000-9000 seedlings/year tested
 - Overall 5% of families with >60% of the seedlings with resistance
 - Selections made in the field based on agronomic traits from families with highest levels of resistance
 - ✓ Use greenhouse detached leaf assay

Detached leaf assay

- ✓ Detached leaf assay in the greenhouse used to screen
 - significant differences among genotypes
 - Comparable results across years; field testing was not
 - Modest correlations between detached leaf assay foliar field trials ($r = 0.55$ $P < 0.0001$)
 - Tuber resistance and field foliar resistance not correlated ($r = 0.25$ in 2007, $r = -0.09$ in 2008)
 - Detached leaf assay is adequate to screen large amounts of germplasm for foliar resistance, especially to eliminate susceptible material

Late blight testing

- ✓ Find new late blight resistant parents
 - Example Patagonia variety from Chile
 - May be a new source of resistance
 - Screening for late blight resistance in “papas nativas” from Chiloe Island in southern Chile, the center of origin of domesticated potatoes
 - Evidence that potatoes have been there for more than 12,000 years
- ✓ Field trials of new and advanced selections from the NDSU potato breeding program for late blight resistance
- ✓ Participate in National Late Blight Trial
 - Advanced selections from multiple US potato breeding programs
- ❖ **OUTCOME:** New genotypes may affect cultivar resistance; continuous screening necessary

Storage management

- ❖ Fungicide program to end of season
- ❖ Gavel, Omega, for tuber blight control
- ❖ Vines DEAD, DEAD, DEAD
- ❖ Phosphorous acid (Phostrol) into storage to reduce tuber late blight;
- ❖ Avoid wet harvest conditions
- ❖ Avoid bruises and injuries
- ❖ Do not store potatoes with $> 5\%$ late blight
- ❖ Cool and dry potatoes- maximum air volumes
- ❖ LB and pink rot often occur together

What happened in 2011

How did our program work?

- ❖ Producers applied fungicides religiously; paid attention; 5-7 day schedule full season; costly
- ❖ Widely scattered, low incidence of late blight August – September; some fields with high levels
 - ✓ Tuber infection found in September; moderate levels
- ❖ **CONCLUSION** : Late blight is a strong and clever disease and finds a way to win despite all the integrated management strategies and tactics we develop; it is a continuing battle



Focus on Potato

- An online educational resource for potato growers and consultants
- Developed to enhance the health, management and production of potato crops