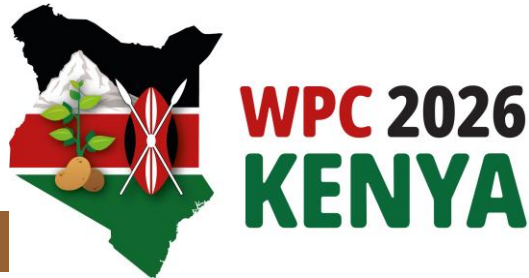


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Biology & Integrated Management of Potato Common Scab



**Dr. Amanda Gevens, Professor and Extension
Plant Pathology, University of Wisconsin-
Madison**



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Division of Extension
University of Wisconsin-Madison



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October 20, 2025



Importance of Potato Common Scab

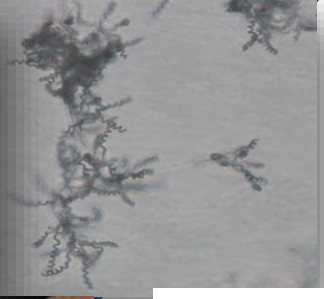


- Common scab has a substantial negative global impact
- Reduces profitability due to reduced marketability and quality
- Typically, scab doesn't impact total yields, rather it causes cosmetic blemishes and corky lesions on tubers
- Severe scab results in increased peeling losses in processing and decreased appearance in fresh-market
- Common scab is widespread worldwide and results in billions of dollars in losses
 - \$15-17 million in losses in Canada, no US economic measure



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Pathogens Causing Potato Common Scab



- Soilborne and seedborne, Gram-positive, filamentous *Streptomyces* bacteria of multiple species
- *Streptomyces* grows like a fungus and produces spores
- Produces a phytotoxin, thaxtomin, that induces scab and pit symptoms on potato tubers and other root crops (carrot, radish)
- Thaxtomin is a pathogenicity factor and is required to make a *Streptomyces* isolate plant pathogenic
- Symptoms vary but when severe, can render tubers unmarketable

Common Scab vs. Powdery Scab



- Common Scab caused by bacterium *Streptomyces scabies*
- Powdery Scab caused by plasmodiophorid *Spongospora subterranea*



Common Scab vs. Powdery Scab



- Common Scab favored by warm, dry soils
- Powdery Scab favored by cool, wet soils
- **Unique cultural management strategies**
- Both are seed- and soil-borne and challenging to manage with chemical inputs



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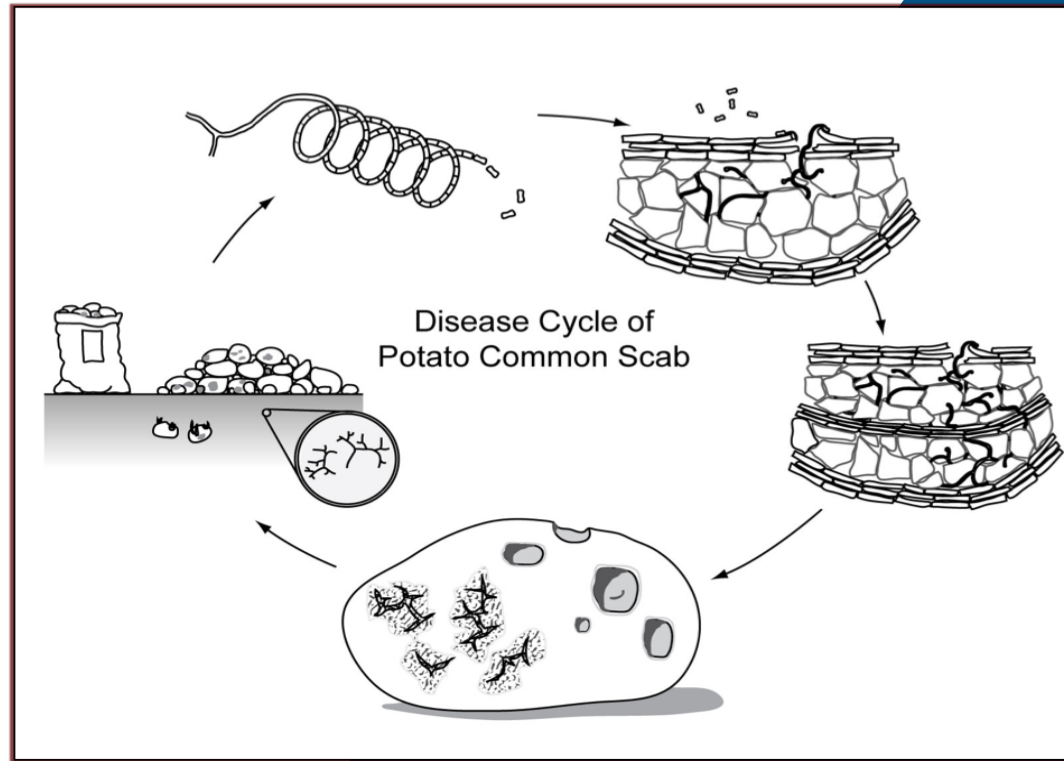


Potato Common Scab Disease Cycle

- Ideal conditions include low soil moisture (less than 65-70% soil moisture) during tuber initiation, soil pH between 5.2 and 8.0, and daytime temperatures above 70°F/21.1°C



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What Makes Common Scab Symptoms?

- Thaxtomin essential to make disease; virulence factors (genes associated are *nec1* and *tomA*) modify severity and character of disease

Virulence value	txtAB	nec1*	tomA
3	+	+	+
2	+	-	+
1	+	-	-
0 – no disease	-	-	-



What Makes Common Scab Symptoms?



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Netted lesion phenotype correlated with presence of thaxtomin (*txtAB*), and absence of virulence factors *nec1*, and *tomA*

Presence of the two virulence factors (*nec1* and *tomA*) was associated with more severe (raised or pitted) lesion phenotypes

Streptomyces Species Causing Common Scab

Streptomyces species

Reported geographic region(s) / distribution notes

Streptomyces scabiei (syn. *S. scabies*)

Worldwide; commonly isolated in North America, Europe, Asia, Africa. ([ACS Publications](#))

Streptomyces acidiscabies

Often in more acidic soils; reported in North America, Europe, Asia. ([PMC](#))

Streptomyces turgidiscabies

Reported in Europe and North America (and in scab-surveys). ([BSPP Journals](#))

Streptomyces europaeiscabiei

Western Europe, North America (especially in some surveys) ([APS Journals](#))

Streptomyces stelliscabiei

Reported in Europe and in North American potato scab surveys ([BSPP Journals](#))

Streptomyces niveiscabiei

Korea (described in Korea) ([Wikipedia](#))

Streptomyces puniscabiei

Korea (described in Korea) ([Wikipedia](#))

Streptomyces rhizophilus

Reported more recently (in a pathogenicity report) — e.g. potato scab disease in a region of Asia (Japan / East Asia) ([APS Journals](#))

Streptomyces bottropensis

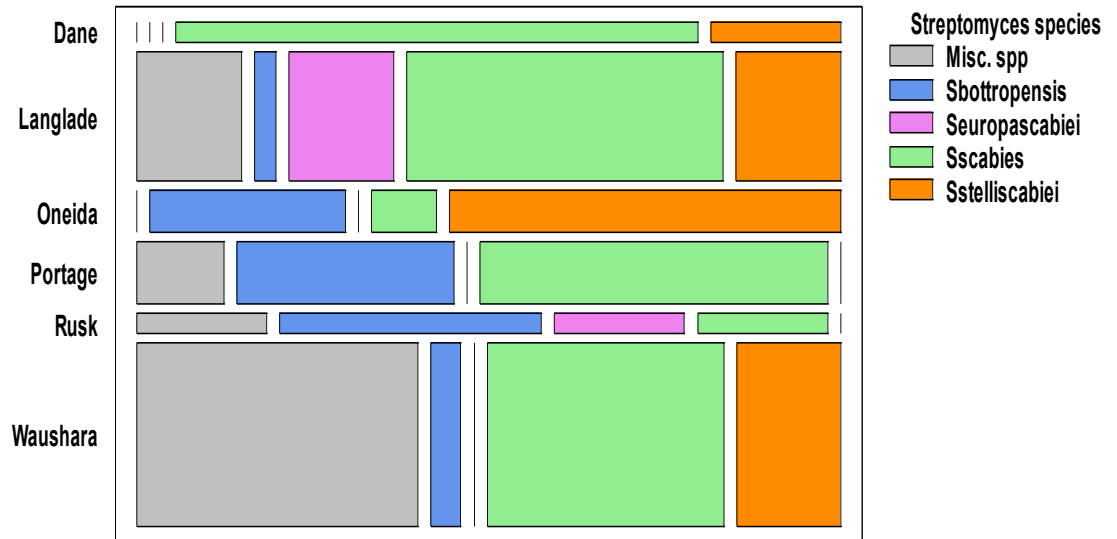
Occasional hits in molecular surveys of scab-causing *Streptomyces* (less common) ([PMC](#))



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Streptomyces Species Causing Common Scab

species composition by Wisconsin county



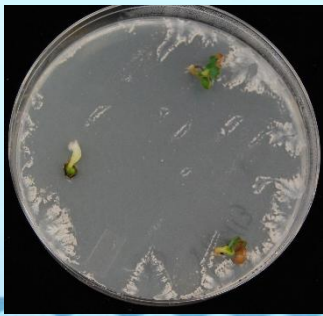
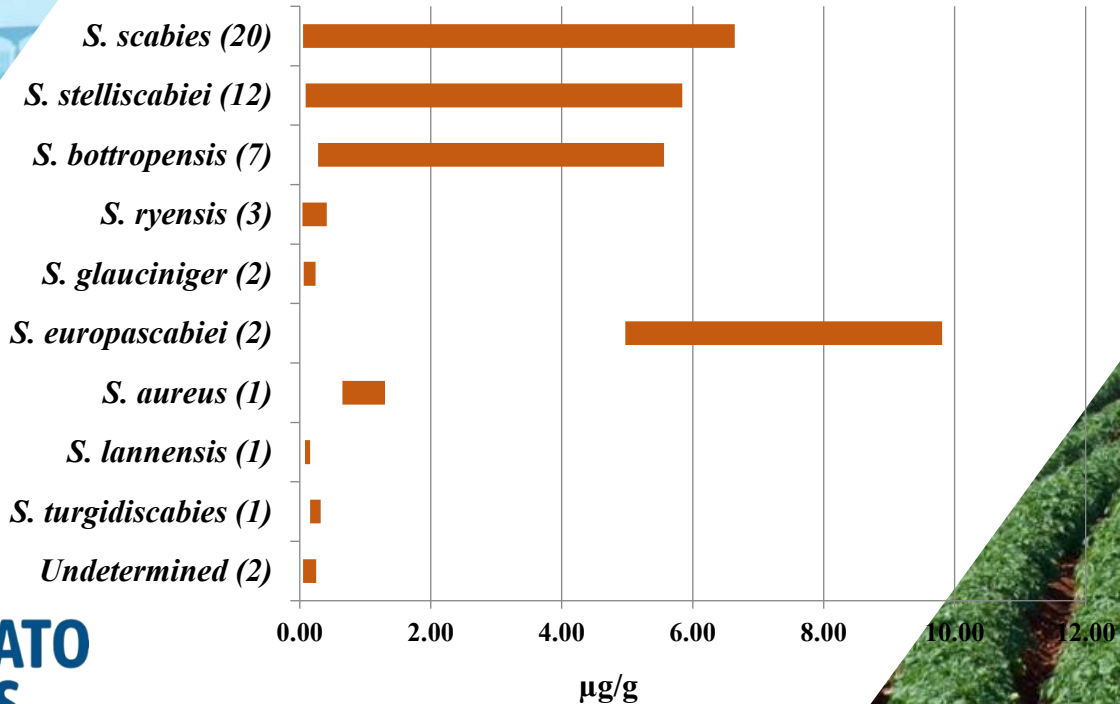
Webster,
Gevens, 2015



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- *S. scabies* was predominant pathogen
- *S. stelliscabiei* was second most common pathogen

Thaxtomin Production in Streptomyces



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Flores Gonzales, 2008; Webster, Gevens, 2015



What Makes Common Scab Symptoms?



Virulence value	txtAB	nec1*	tomA
3	+	+	+
2	+	-	+
1	+	-	-
0 – no disease	-	-	-



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Auxin Induced Resistance to Common Scab

- Thaxtomin essential to make disease; virulence factors (genes associated are *nec1* and *tomA*) modify severity and character of disease
- *Foliar-applied 2,4-D and other auxin or auxin-like compounds reduced severity and occurrence of common scab in some studies*
 - **How?**
 - Auxin induction makes the plant more resistant to symptom development
 - Direct interaction of auxin and pathogen in culture doesn't limit growth



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Auxin Induced Resistance to Common Scab

- 2019 Langlade Airport Research Area – Common Scab Trial (Jordan, Lubinski, Gevens)
 - ‘Yukon Gold’
 - Treatments applied in furrow and in furrow and to foliage
 - Compared PCNB (Blocker) as standard to 2 auxins:
 - Hortus (20% indole-3-butyric acid rooting hormone)
 - Rejuvenate (1-naphthalenacetic acid and K salt)

Treatment and Rate ^z	Application Type ^y	Emergence (%)	Total Plot Yield (cwt)	Common Scab Incidence (%)	Common Scab Severity (%)
Non-treated Control	NA	42.2 ^z	171.3	94.0	15.2
Blocker 4F 5.2 fl oz	In-Furrow	38.0	169.0	93.8	19.9
Blocker 4F 5.2 fl oz	In-Furrow				
Hortus 0.2 g/Liter	In-Furrow, Foliar 2X	35.5	137.3	92.2	14.3
Hortus 0.2 g/Liter	In-Furrow	51.1	197.4	87.3	14.6
Hortus 0.2 g/Liter	In-Furrow, Foliar 2X	42.2	166.4	88.8	10.9
Rejuvenate 0.105 fl oz	Seed trt, Foliar 2X	50.0	206.8	92.1	17.0
Blocker 4F 5.2 fl oz	In-furrow				
Rejuvenate 0.105 fl oz	Seed trt, Foliar 2X	50.5	156.9	87.0	18.7

^zTreatment rates applied in-furrow are given per 1000 row ft. Seed treatments are given per ton seed. Foliar rates are per acre.

^ySeed treatments and in-furrow treatments were applied at the time of planting. Foliar applications were applied on 11 Jul and 25 Jul.

^xNo significant differences were determined using Fisher's LSD at $\alpha=0.05$ (SAS Version 9.2).

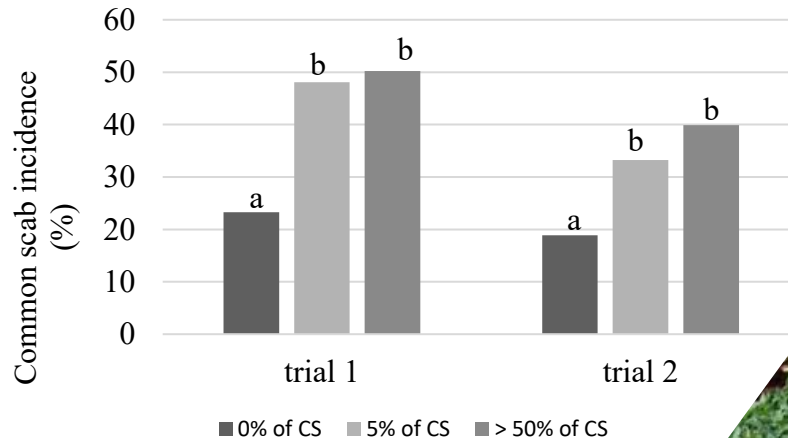


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Managing Potato Common Scab

- Plant seed potatoes with little to no symptoms of common scab (5 and 50% severity on seed resulted in similar incidence and severity of common scab on daughter tubers
- Infected cut vs. whole seed potatoes had no significant difference on resulting common scab severity in daughter tubers, but there was a trend of reduced common scab with cut seed (plant vigor, reduction in inoculum?)

Webster, Chen, Gevens, 2017



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Managing Potato Common Scab

- While potato resistance to common scab is not well understood, there are significant cultivar differences and use of resistance is best management
- Disease suppressive rotations with green manures, such as buckwheat, canola, oat, rye or millet can inhibit *Streptomyces*
- Management of soil moisture, pH, manure incorporation if used
- Most chemical and biological treatments have proven to be inconsistent in effectiveness in limiting common scab over time and space
 - Biological and biopesticides
 - Conventional fungicides
 - Elemental treatments (sulfur)
 - Fumigants (soil disruption post trt can negate effects)

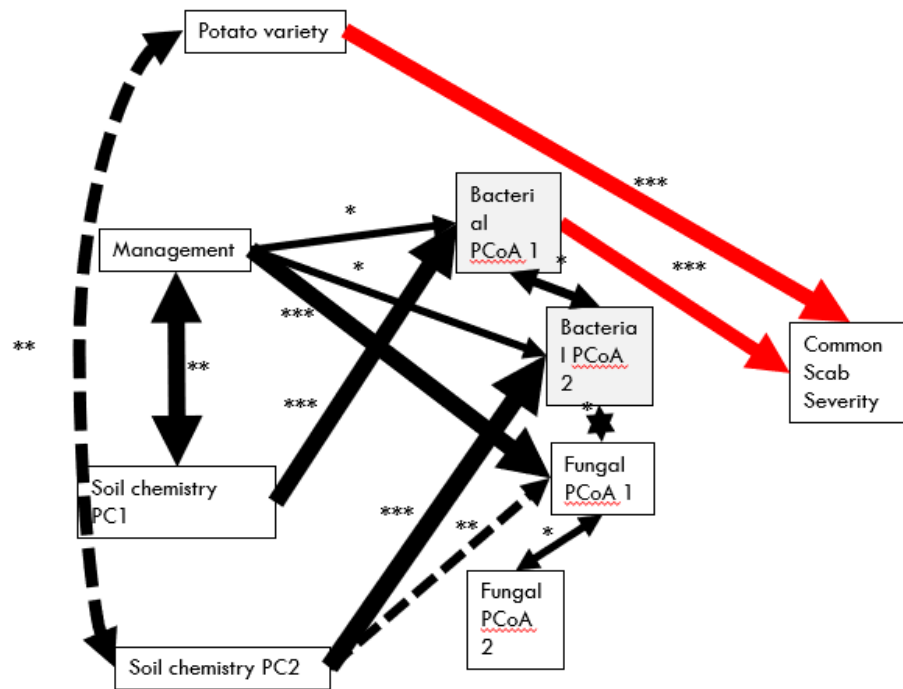


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Influencing Factors

Field survey of:

- 12 fields
- 33 sampling locations
- Across northern, central, and western WI
- Organically and conventionally managed
- Sand, loam, and silt loam soils



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How much does soil pH matter?

- Soil pH **can make a significant difference** in common scab severity, especially if you move from a neutral/alkaline state into more acidic state (toward ~5.2).
- **Not guaranteed** to fully control scab—especially under heavy disease pressure or when other favorable conditions exist.
- pH is a **risk modifier** rather than a standalone control; growers should combine pH management with moisture control, rotation, resistant varieties, and other cultural practices.
- The “magnitude” of the effect depends heavily on site, cultivar, local *Streptomyces* population, and management practices. In some trials it may reduce scab incidence or grade losses appreciably; in others the effect may be modest or inconsistent.



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How much does soil type matter?

The physical and biotic properties of each soil type interact with the common scab pathogen and potato plant to influence disease

- Moisture dynamics
- Temperature fluctuations
- pH buffering capacity and spatial variation
- Nutrient retention and fertility
- Soil microbial community / suppressiveness
- Physical access / root/tuber environment
- Interaction with management practices



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Fumigation Evaluations for Potato Common Scab ('Yukon Gold' Antigo WI 2009-2017)

Trade name	Active Ingredient	Time of Application	# years tested	General Comment on Efficacy
Untreated control	N/A	N/A	9	Poor
<u>Vapam</u>	metam sodium	Fall pre-plant	7	Poor/Variable
Pic Plus	chloropicrin (85%) + solvent	Fall pre-plant	1	Good (hi yield)
Pic Plus	Chloropicrin (85%)	Fall pre-plant	1	Good (hi yield)
Pic Plus + Serenade Soil	Chloropicrin (85%) + Bacillus subtilis	Fall pre-plant	1	Good (hi yield)
Pic Plus + Serenade Soil	Chloropicrin (85%) + Bacillus subtilis	Fall pre-plant	1	Good (hi yield)
C60 Pic	chloropicrin (60%)	Fall pre-plant	1	Good (hi yield)
C60 Pic + Regalia 5SC	Chloropicrin (60%) + Reynoutria sachalinensis extract	Fall pre-plant	1	Good (hi yield)
C60 Pic	Chloropicrin (60%)	Fall pre-plant	1	Good (hi yield)
C60 Pic + Regalia 5SC	Chloropicrin (60%) + Reynoutria sachalinensis extract	Fall pre-plant	1	Good (hi yield)



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Conventional Fungicide Evaluations for Potato Common Scab ('Yukon Gold' Antigo WI 2009-2019)

Trade name	Active Ingredient	Time of Application	# years tested	General Comment on Efficacy
Untreated control	N/A	N/A	9	Poor
<u>Quadris Flowable 2F</u>	azoxystrobin	At-plant	9	Highly variable
Quash 50WDG	metconazole	At-plant	1	Poor (lo yield)
Blocker 4F	pentachloronitrobenzene (PCNB)	At-plant	9	Good
Blocker 4F + Mocap 15G	PCNB + ethoprop (15%)	At-plant	2	Good
Mocap 15G	ethoprop (15%)	At-plant	3	Good
Blocker 4F + Rejuvenate	PCNB + naphthalenic acid (NAA)	At-plant	4	Good
Rejuvenate	<u>Naphthalenic acid (NAA)</u>	Seed trt	2	Good – highly variable
<u>Mocap 15G + NAA</u>	<u>ethoprop (15%) + NAA</u>	At-plant	2	Poor
Omega	fluazinam	At-plant	2	Good
Nimitz	fluensulfone	Pre-plant	2	Good



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Nimitz	fluensulfone	Pre-plant	2	Good



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Rejuvenate	<u>Naphthalenic acid (NAA)</u>	Seed trt	2	Good – highly variable
<u>Mocap 15G + NAA</u>	<u>ethoprop (15%) + NAA</u>	At-plant	2	Poor
Omega	fluazinam	At-plant	2	Good
Nimitz	fluensulfone	Pre-plant	2	Good



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Fludioxonil Demonstrates Some Common Scab Control

Study	Treatment	Effect on Scab	Notes
<i>Management of common scab using biopesticides, fungicides, etc. (Canada)</i>	Fludioxonil seed treatment	~ 35.4 % reduction in disease incidence; ~ 57.8 % reduction in tubers \geq 5% scab severity (i.e. unmarketable level)	Yield of marketable tubers increased ~24.6 % over untreated.
NDSU Potato Extension	Fludioxonil (Maxim)	~ 58 % reduction in common scab	Suggests fludioxonil gave substantial suppression under certain conditions
Spud Smart / grower guidance	Seed piece / chemical control	Fludioxonil (seed treatment) gave ~58 % reduction	But they note chemical treatments are supplemental to resistance, clean seed, etc.



Biological/Biopesticide Evaluations for Potato Common Scab 'Yukon Gold' Antigo WI 2009-2019)

Trade name	Active Ingredient	Time of Application	# years tested	General Comment on Efficacy
Untreated control	N/A	N/A	9	Poor
Colonize	mycorrhizal inoculant	At-plant	2	Poor
Colonize + Messenger	mycorrhizal inoculant + <u>harpin</u> protein	At-plant	2	Poor
Agzyme	bio-stimulant and foliar nutrients	At-plant	1	Poor (hi yield)
Serenade Soil	Bacillus subtilis strain 713	At-plant	5	Poor/Variable
<u>MycoApply</u>	mycorrhizae	At-plant	3	Poor
Regalia 5SC	Reynoutria sachalinensis extract	At-plant	4	Poor
<u>Tiger-Sul 90CR</u>	elemental sulfur	At-plant	4	Poor
<u>AmeGA SC</u>	iron, <u>phosphite</u> , plant oils, and surfactant	At-plant	1	Poor
Double Nickel	Bacillus <u>amyloliquefaciens</u>	At-plant	3	Good/Variable
<u>AmyProtec</u>	Bacillus <u>amyloliquefaciens</u>	At-plant	3	Good/Variable
EF-400	Blend <u>hort</u> oils	At-plant/post	3	Good
Nobactra blend	Antag bacteria+ hort oils	Seed trt/in-furrow	1	Good (low pressure)



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Summarizing Common Scab Management

Control practice	Effectiveness
Irrigation during tuber formation	Often fails
Lowering soil pH to <5.2	Limits crop rotation, can fail
Crop rotation	Inconsistent, can fail. <i>Streptomyces</i> spp. can survive as saprophytes, or on other host plants
Biological control	Can work under controlled conditions, but variable in the field. More investigation needed
Disease-free seed tubers	Not sufficient, <i>Streptomyces</i> spp. are soil-bourne
Chemical fumigation	Can work for a season; expensive, environmentally unfriendly
Seed treatments with fungicides	Results erratic
Sulphur fertilizer	Reported to reduce scab severity in some locations
Resistant potato cultivars	Most desirable and reliable method



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Dees and Wanner. 2012. In search of better management of potato common scab. *European Potato Journal* 55:249-268.

Soil and Pathology Labs Testing Soil for Common Scab Pathogens

Global directory

- **Diagnostic Laboratory Finder (DiagFinder.org)** — searchable by pathogen/common name; helpful for locating a nearby lab and checking capabilities.

Europe

- **Fera Science Ltd. (UK)** — explicitly offers “Scab testing: powdery (*Spongospora*) & common (*Streptomyces*)”, with listed turnaround.
- **SASA – Science & Advice for Scottish Agriculture (Scotland, UK)** — potato pathology service testing a range of blemish/rot pathogens; commercial testing available.
- **NAK – Dutch General Inspection Service (Netherlands)** — seed potato laboratory testing (viruses/bacteria/nematodes) as part of inspection; common scab considered in seed standards. (Confirm *Streptomyces* assay availability for non-EU submissions.)
- **Finnish Food Authority Plant Health Laboratory (Finland)** — official plant pest diagnostics; accepts paid plant examinations (contact to confirm *Streptomyces* methods).
- **Wageningen University & Research (Netherlands)** — plant pathogen diagnostics development and services (industry collaboration—confirm service scope).
- **Eurofins Agrosience/Agro (multiple EU sites)** — molecular plant disease diagnostics and crop/soil health services; inquire about *Streptomyces* panels/qPCR.
- **Agroscope (Switzerland)** — national plant protection/diagnostics for seed potatoes and plant health (contact for service access and *Streptomyces* testing routes).

Soil and Pathology Labs Testing Soil for Common Scab Pathogens

North America

- **University of Wisconsin–Madison Plant Disease Diagnostics Clinic (USA)** — accepts potato scab submissions; can advise on testing workflow (culture/PCR or referral).
- **Cornell University Plant Disease Diagnostic Clinic (USA)** — full-service plant pathology diagnostics; accepts out-of-state samples; contact about *Streptomyces* assays.
- **University of Minnesota Plant Disease Clinic (USA)** — routine diagnosis + culture; confirm *Streptomyces* testing or referral options.
- **Penn State Plant Disease Clinic (USA)** — plant disease diagnostics and consultation; inquire about soil/tuber *Streptomyces* testing.
- **USDA-ARS collaboration** — recent ARS project established a **soil qPCR assay for pathogenic *Streptomyces*** with three U.S. diagnostic labs (ask your clinic if they're part of that network).
- **University of Guelph – Agriculture & Food Laboratory (Canada)** — plant & soil health diagnostics; molecular platforms available (confirm *Streptomyces* panel/qPCR).
- **A&L Laboratories (Canada)** — Ontario project reported **PCR speciation & thaxtomin gene detection** for common scab in field soils (contact lab re: current service offering).

Asia / Oceania

- **MicroScan / CD BioSciences (China, global clients)** — *S. scabies* pathogen screening and related molecular services (more research/custom-assay oriented).
- **National/State plant diagnostic labs (Australia/NZ)** — many accept potato disease samples; specifics vary by state. (For broader potato pathology context/training networks see PotatoLink/CSIRO/State DPIs.)

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