MANAGEMENT OF BLACK DOT ROOT ROT

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(Alaska and Hawaii)
not shown on this map
Canada
Hudson Bay
LARGER MAP HERE
Gulf of St. Lawrence
Great Lakes
Washington
Montana
North Dakota
Minnesota
Oregon
Idaho
South Dakota
Wisconsin
Michigan
Wyoming
Nebraska
Iowa
New Hampshire
Vermont
Maine
New York
Massachusetts
Rhode Island
Connecticut
New Jersey
Delaware
Maryland
Washington, DC
Pennsylvania
Illinois
Ohio
Indiana
Nevada
Utah
Colorado
Kansas
Missouri
West Virginia
Kentucky
Virginia
United States of America
Bozeman, MT
California
Arizona
New Mexico
Oklahoma
Arkansas
Tennessee
North Carolina
South Carolina
Atlantic Ocean
Pacific Ocean
Mississippi
Georgia
Alabama
Texas
Louisiana
Florida
worldatlas
UNITED STATES
LOW / HILLS / MOUNTAINS
350 mi
350 km
Gulf of California
Mexico
Gulf of Mexico
Bahamas
Straits of Florida
TROPIC OF CANCER
Cuba
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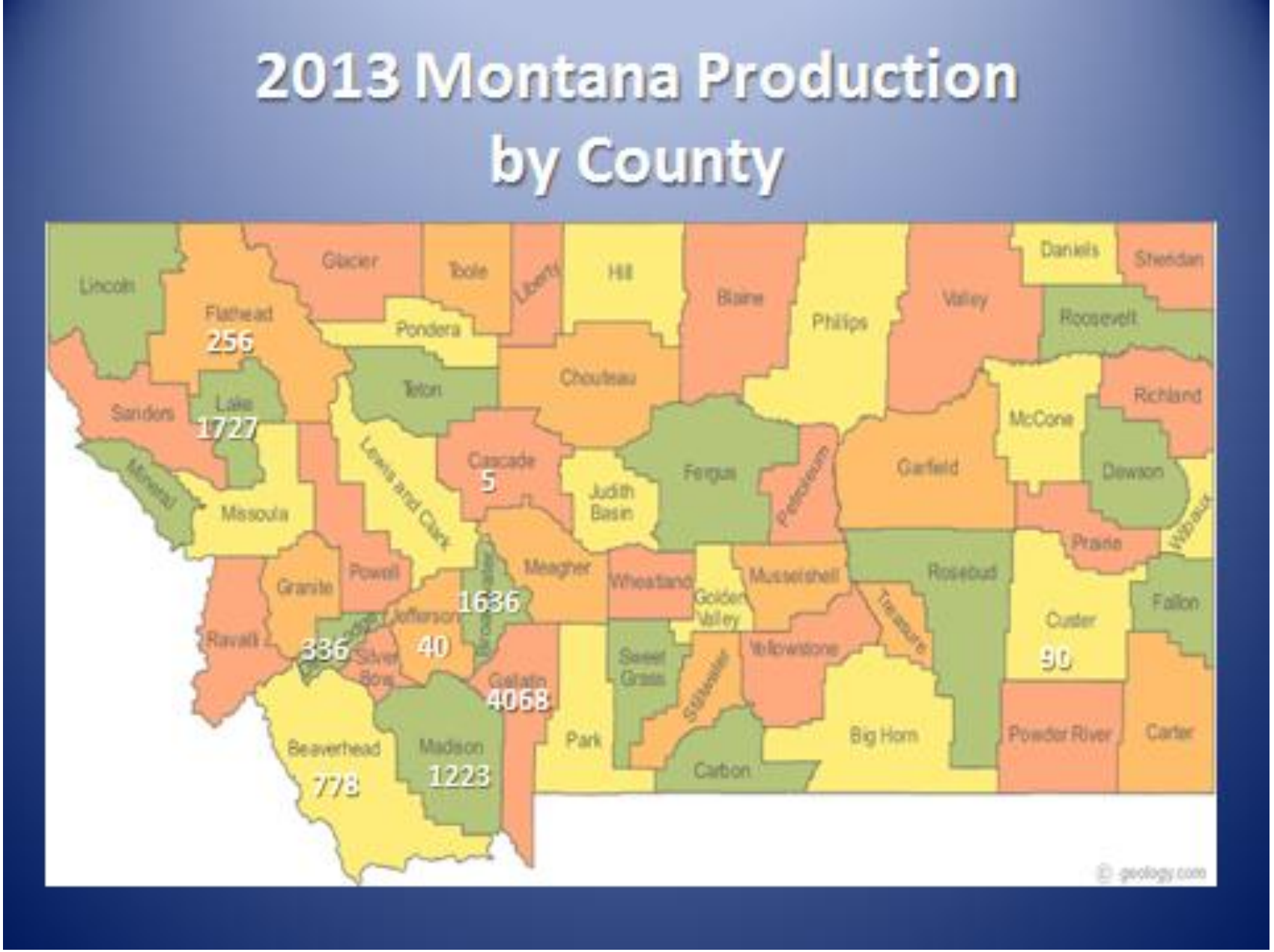
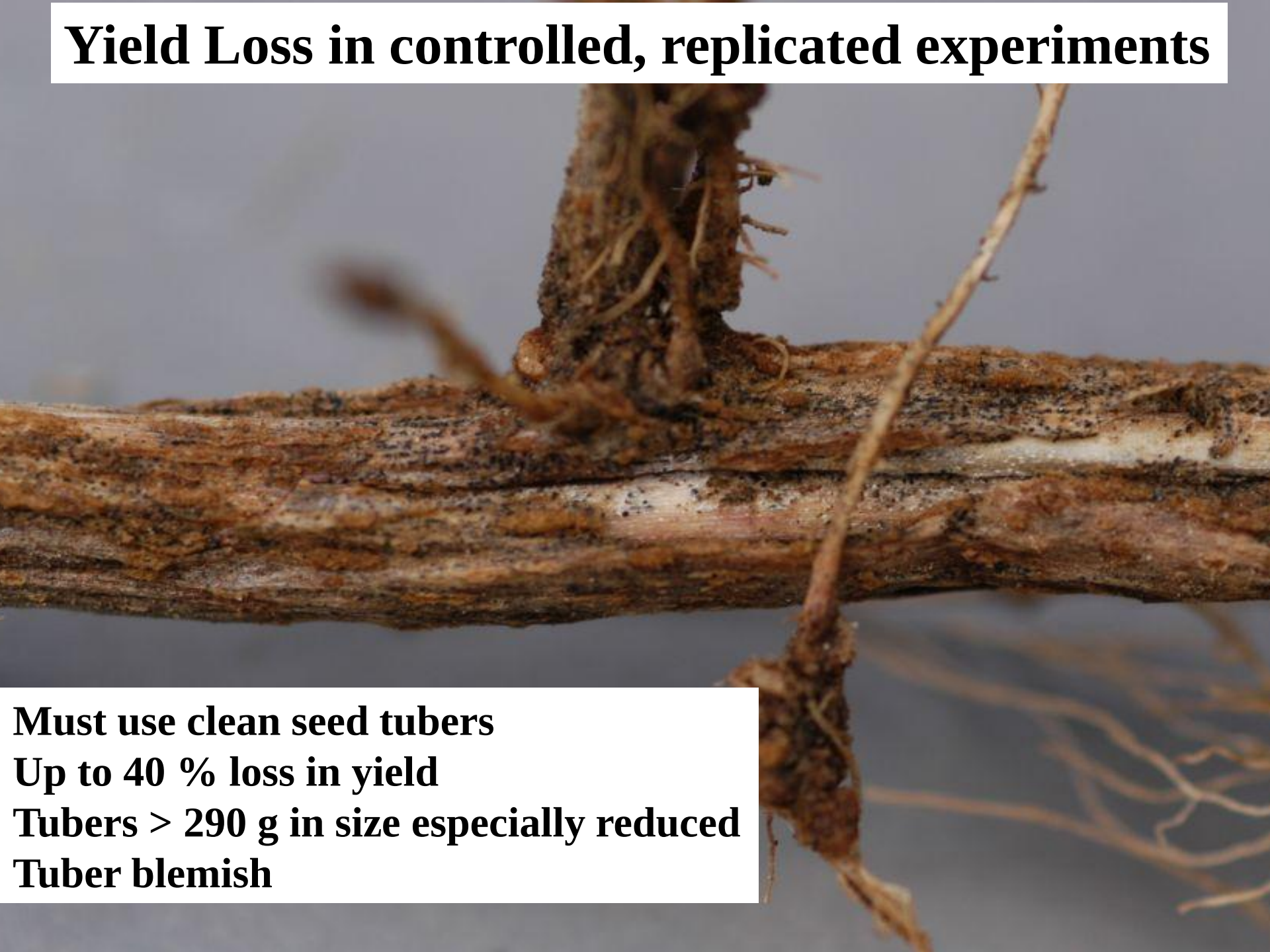


Montana Seed Potato Production by County

Black Dot

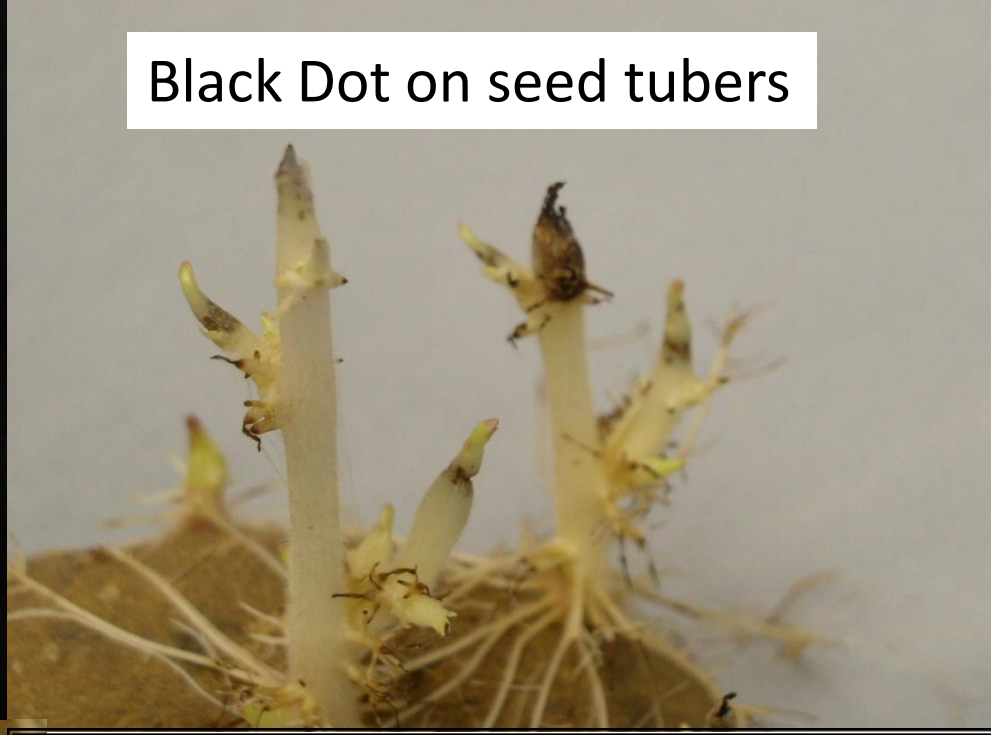
Colletotrichum coccodes

Yield Loss in controlled, replicated experiments



Must use clean seed tubers
Up to 40 % loss in yield
Tubers > 290 g in size especially reduced
Tuber blemish

Black Dot on seed tubers



Foliar symptoms

Why is Black Dot important to the Potato Industry

- Cosmetic blemish on tubers-storage/fresh market
- Yield reduction
  - Premature dying is becoming a more and more important pathogen in the Pacific Northwest
    - Role of seedborne vs soilborne inoculum- both appear to be important
  - Difficult to control: little known about resistance- producers rely on soil fumigation with metham sodium or metham potassium ~$400-700/a- new environmental restrictions
    - ~75% control with azoxystrobin applied as seed treatment plus in furrow at planting followed by mancozeb, chlorothalonil, etc appied when plants are 8-12”-Jacobsen et al, Nitzan et al.
  - Reduces nutrient and water up-take
  - Increase susceptibility other diseases

What is Black Dot

- Soilborne fungus :*Colletotrichum coccodes*
  - Primarily a root rot disease but can cause foliar symptoms
  - most notable as early dying of plants and discolored stems at vine kill on dead or dying plants
  - Produces conidia can be spread by splashing water
  - Survives long periods in soil as small black sclerotia
  - Can be spread on infected seed tubers
  - Wide host range

Elusive Pathogen

- Damage not readily detected
- Yield loss with little symptom expression
- Symptoms expressed late in growing season
- Symptoms confused with natural senescence, Verticillium wilt, Early Dying Complex
- Latent infections
- Relatively little research on varietal resistance: UK (Read ,1991), Israel (Tsor, 1999) Washington (Nitzan, 2009), Montana
  - Demonstrate yield losses of 0-40% depending on variety
  - Demonstrate differences in infection, colonization, yield loss

Cultivars with Resistance (<10% yield loss) to Black Dot-Plantlets (2007) and tubers (2008)-Field Inoculated

- Alpine Russet
- Atlantic
- Bannock Russet
- Cal White
- Chipeta
- Defender
- Gallatin Russet
- Gem Chip
- Gem Star Russet
- Gem Russet
- Ranger Russet
- Russet Norkotah
- Red LaSoda
- Shepody

1.Inoculum grown on sterile barley- ground and applied infurrow @ 1g/m row.
Experiment done in soil where potatoes never grown- no detectable *C.coccodes* by QPCR
2.Comparison is inoculated vs plants exposed to plants inoculated with only sterile barley
3. Range of yield loss 0-9%

Very Susceptible (Yield loss >10%) Cultivars Black Dot-Plantlets 2007 and tubers 2008-Field Inoculated

- Cal Red
- Caribe
- Cherry Red
- Frontier
- Gem Russet
- Gem Star Russet
- Highland Russet
- Mazama
- Dark Red Norland
- Red Norland
- Red Gold
- Russet Burbank
- NDB 14
- Summit Russet
- Viking
- Yukon Gold

1.Inoculum grown on sterile barley- ground and applied infurrow @ 1g/m row.
Experiment done in soil where potatoes never grown- no detectable *C.coccodes* by QPCR
2.Comparison is inoculated vs plants exposed to plants inoculated with only sterile barley
3. Range of yield loss 10-45%

Potato Cultivars with low inoculum < 600 cfu/ gram of stem (range 23-600)

- Gallatin Russet
- Highland Russet
- Atlantic
- Bannock Russet
- Cal Red
- Cherry Red
- Chipeta
- Defender
- Eva
- Gem Chip
- Gem Russet
- Gem Star Russet
- German Butterball
- Kennebec
- Mazama
- Premier Russet
- Ranger Russet
- Russet Nugget
- Sangre
- Umatilla russet
- Yukon Gold

Greenhouse inoculated 1 x 10e4/g soil
70 days post inoculation
Dilution plating on Farley's medium

Potato Cultivars with High Inoculum > 1000 cfu/gram of stem (range1010-2650)

- Alpine Russet
- All Blue
- All Red
- Alturas
- Amisk
- French Fingerling
- Purple Viking
- Red LaSoda
- Red Pontiac
- Russet Burbank
- Shepody
- White Rose

Greenhouse inoculated 1 x 10e4/g soil
70 days post inoculation
Dilution plating on Farley's medium

% Yield Loss Due to Black Dot 2006-2012

Russet Norkotah							
2006	2007	2008	2009	2010	2011	2012	Average
5.7	7.8*	8.1*	6.7	nd	nd	nd	7.1*
Russet Burbank							
nd	nd	nd	12.7*	nd	19.6*	12.9*	15.1*

Nd= not done

Comparison of yields of Quadris infurrow + either mancozeb or clorothalonil applied @~20 cm with untreated

* Significantly different from untreated @P<0.05

The effect of in-furrow (IF) application of azoxystrobin (Quadris, Syngenta) and foliar(F) applications @ 20 cm of azoxystrobin (Quadris, Syngenta) and chlorothalonil (Bravo, Syngenta) on yield and colony forming units of underground stem sections of Russet Burbank potatoes

Treatment Product/ha	Yield MT/ha		CFU/g stem *C. coccodes*	
Untreated	22.7	D	33,500	B
Quadris 639ml (IF)	23.0	CD	22,000	AB
Quadris 639ml (IF)/1135 ml Bravo (F)	24.0	A	14,500	A
Quadris 639ml (IF)/1277ml Quadris (F)	23.4	BC	27,000	AB
Quadris 1277ml (IF)	23.8	AB	20,000	AB

2005-2008 Manhattan, MT

Fungicides used

QoI-strobilurin	
Common name	Trade Name
azoxystrobin	Quadris (Syngenta)
pyraclostrobin	Headline (BASF)
SDHI -carboximids	
penthiopyrad	Vertisan/Frontelis (DuPont)
SDHI-carboximid + QoI	
fluxapyroxad +pyraclostrobin	Priaxor (BASF)

2012 Black Dot Control Trial

Treatment IF =infurrow F=foliar @20 cm	Product/ha	Visual % black dot- lower 10cm of stem	C. coccodes ng DNA/g potato stem	Yield MT/ha
Quadris IF	639 ml	48.2 ab	1798.4 ab	58.68 ab
Quadris IF Mancozeb F	639 ml 2.2 kg	41.0 b	900.7 cd	62.52 a
Quadris IF Priaxor F	639 ml 426 ml	31.7 c	622.1 d	54.36 bc
Priaxor IF	480 ml	50.0 a	1542.6 ab	54.72 bc
Priaxor IF Bravo ZN F	480 ml 1135 ml	35.8 bc	892.6 cd	54.60 bc
Priaxor IF Quadris F	480 ml 639 ml	25.6 cd	1332.0 ab	60.00 ab
Priaxor IF Headline F	480 ml 426 ml	28.3 cd	789.0 cd	65.76 a
Untreated		51.5 a	2072.9 a	51.96 c

Russet Burbank, Manhattan , MT

2012 Black Dot Control Trial cont.

Treatment IF =infurrow F=foliar @20 cm	Product/ha	Visual % black dot- lower 10cm of stem	C. coccodes ng DNA/g potato stem	Yield MT/ha
Quadris IF Mancozeb F	639 ml 2.2 kg	41.0 b	900.7 cd	62.52 a
Quadris IF Fontelis F	639 ml 1.1 kg	22.7 d	595.1 d	56.04 bc
Vertisan IF Quadris F	1646 ml 639	35.5	2249 a	57.36 bc
Untreated		51.5 a	2072.9 a	51.96 c

Conclusions

- Varieties differ in yield loss and in infection level no immunity identified. For two commonly grown russet cultivars losses are estimated at 7-15%.
- Yield loss varies by year-environment. All plots were irrigated so no moisture effects noted.
- Over 7 years, yield increases occurred when plots received infurrow application of azoxystrobin followed by application of either mancozeb or chlorothalonil when plants were 20 cm (~50 days post plant)
- Infection measured by cfu by dilution plating or qPCR shows reduction in infection with azoxystrobin applied infurrow followed by application of either mancozeb or chlorothalonil when plants were 20 cm. Planting time only treatments were ineffective.
- Priaxor (fluxapyroxad +pyraclostrobin) applied either infurrow or post emergence is equal to azoxystrobin.
- Penthiopyrad is not effective as a planting time treatment but is superior to mancozeb as a post emergence treatment.
- Post emergence treatments of pyraclostrobin, chlorothalonil, mancozeb and penthiopyrad when combined with planting time treatments of azoxystrobin or fluxapyroxad +pyraclostrobin (Priaxor) provided optimal disease control