Challenges and New Insights into Powdery Scab Management

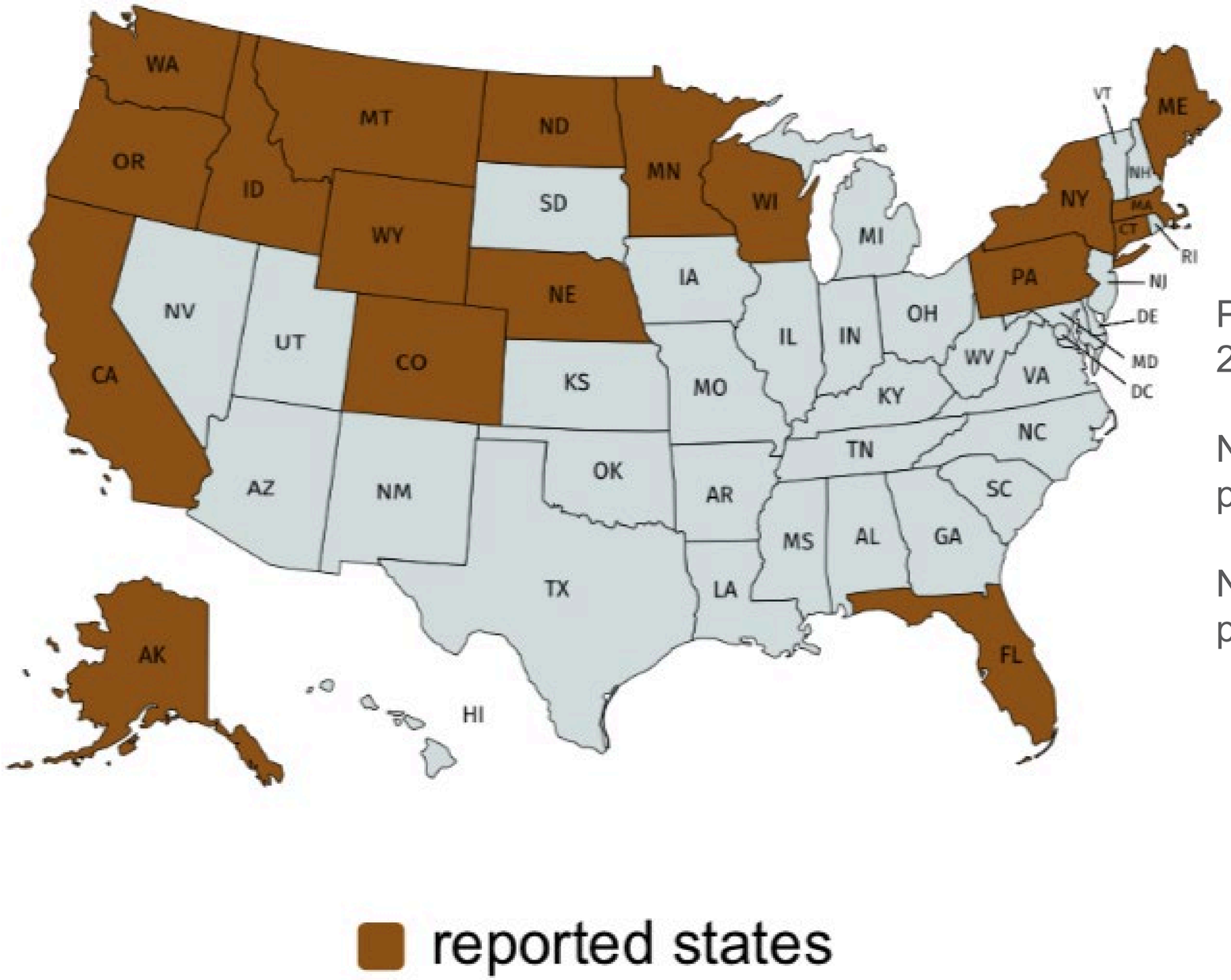




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University of Wisconsin
Lelah Starks Elite Foundation Seed Potato Farm

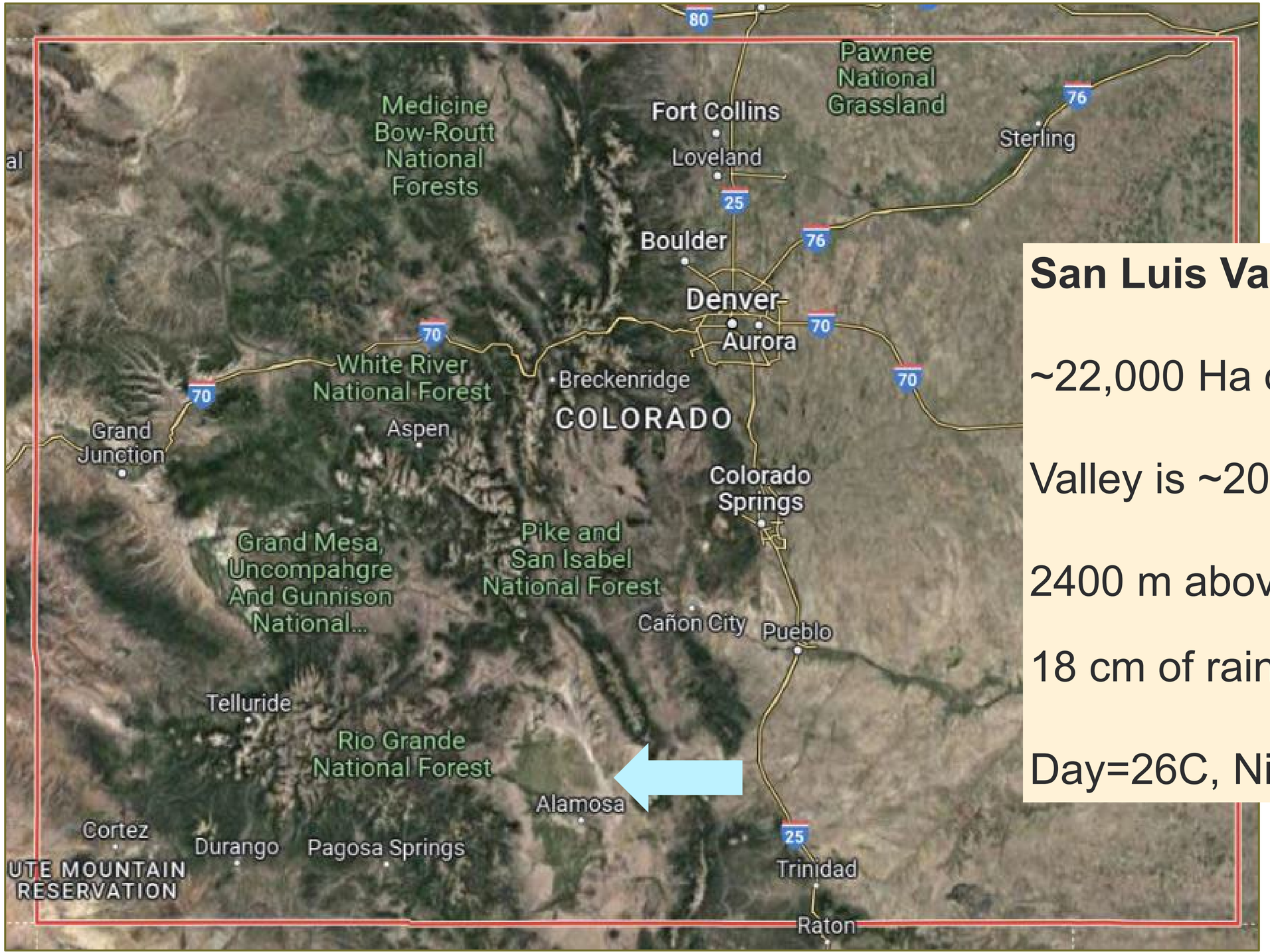




PMTV first reported in Maine in 2002 in multiple seed lots.

Not found in other seed potato producing states in 2002.

Now present in all major potato producing states.



San Luis Valley

~22,000 Ha of potatoes

Valley is ~20,000 km^2

2400 m above sea level

18 cm of rain per year

Day=26C, Night = 8C




112
112

Powdery Scab



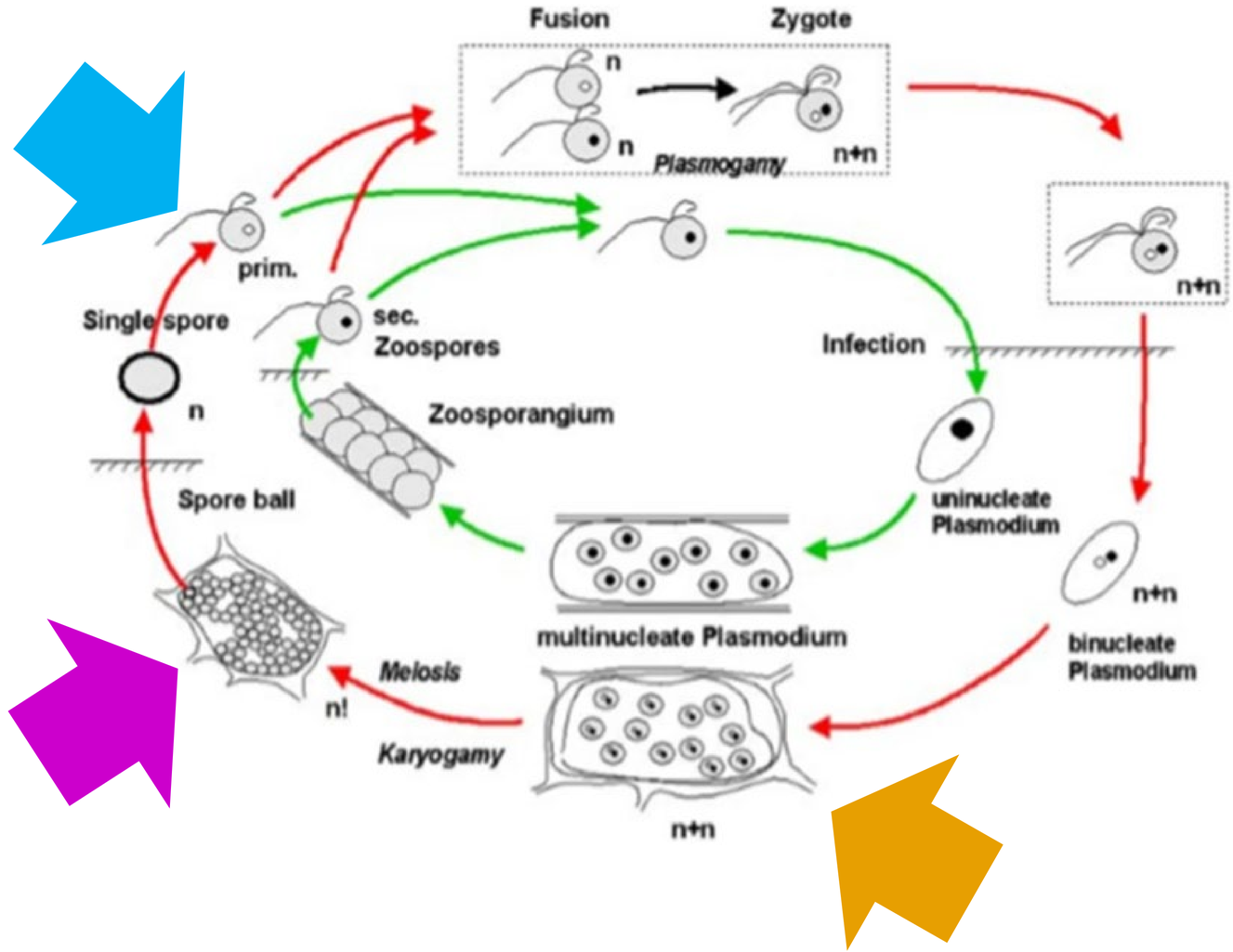


Caused by *Spongospora subterranea*

Symptoms on roots, tubers, stolons

Does not spread in storage, but can cause tubers to dehydrate

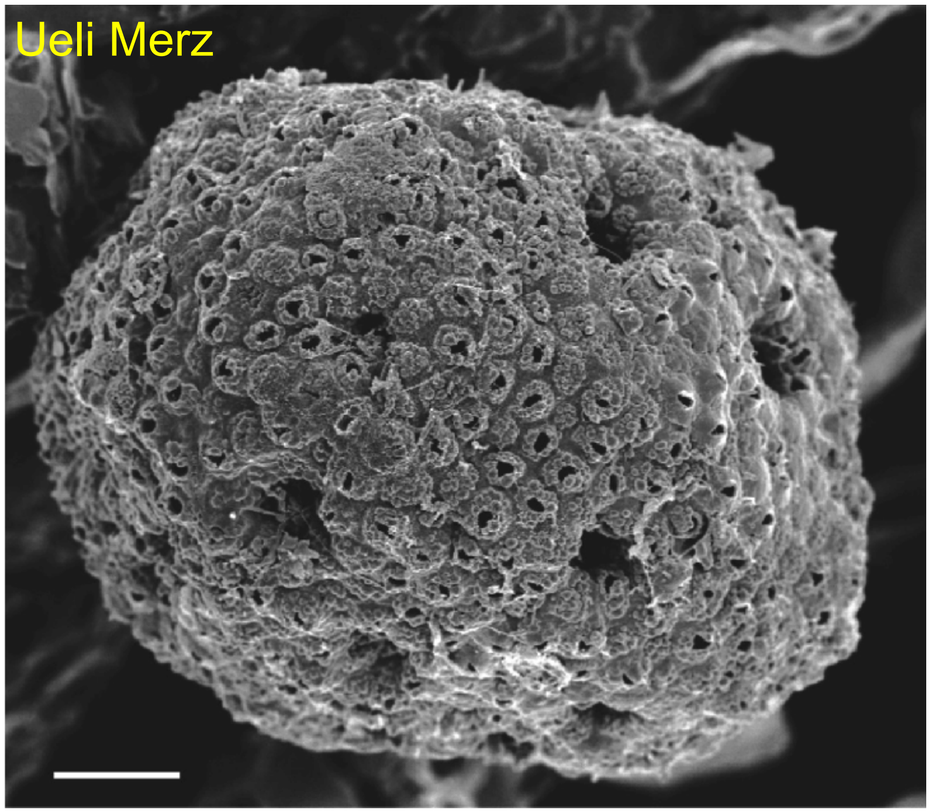
Vectors PMTV, which can cause spraing

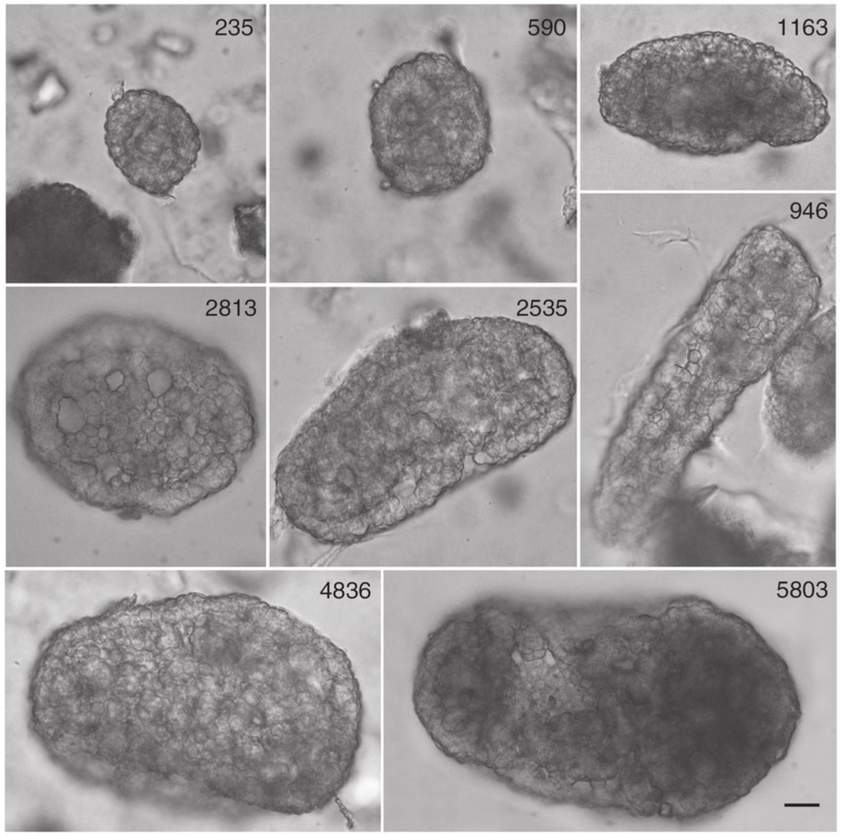


Obligate pathogen = needs a living plant cell to multiply

Polycyclic = several rounds of multiplication per year

Swimming spores require water to spread, are fragile and only live ~1 day





Spore balls last ~10 years in soil

Vary in shape and size = difficult to quantify soil inoculum

Uneven spore release

Resistant to pesticides

PMTV – “Spraing”





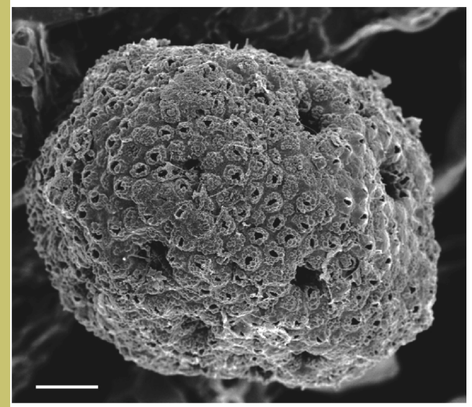
Leaves rarely show symptoms

Tubers often lack symptoms

Sometime a high percentage of tubers will have symptoms

Spongospora subterranea

Sporosori/g of soil



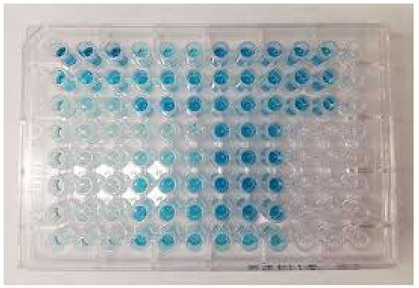
Root galls



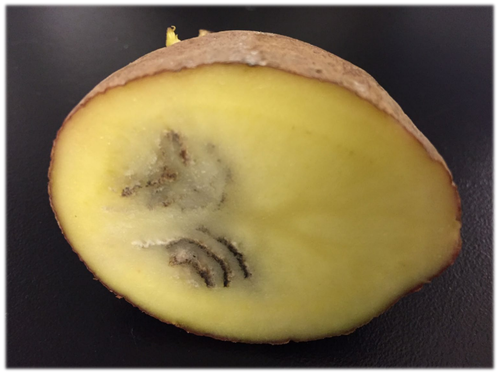
Tuber symptoms



PMTV detection



Spraing



Increased variability

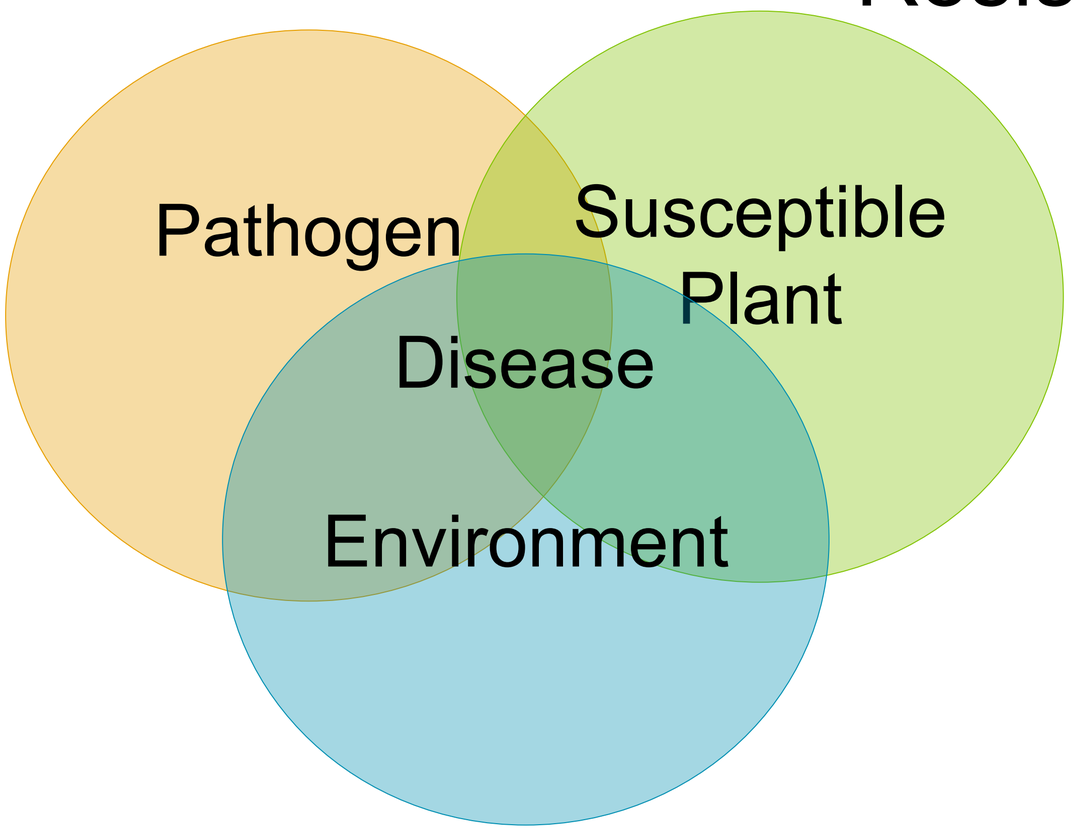
Resistant varieties

Clean seed

Germinate-to-Exterminate?

Rotation?

Fumigation?



Deficit irrigation

Warm temperatures

Soil microbes?





Plant Resistance

Resistance / tolerance is not well understood.

Some russet varieties have tuber resistance but still have many root galls.

Root galls can increase soil inoculum.


Dr. Yuan Zeng

Russet-skinned

Red-skinned

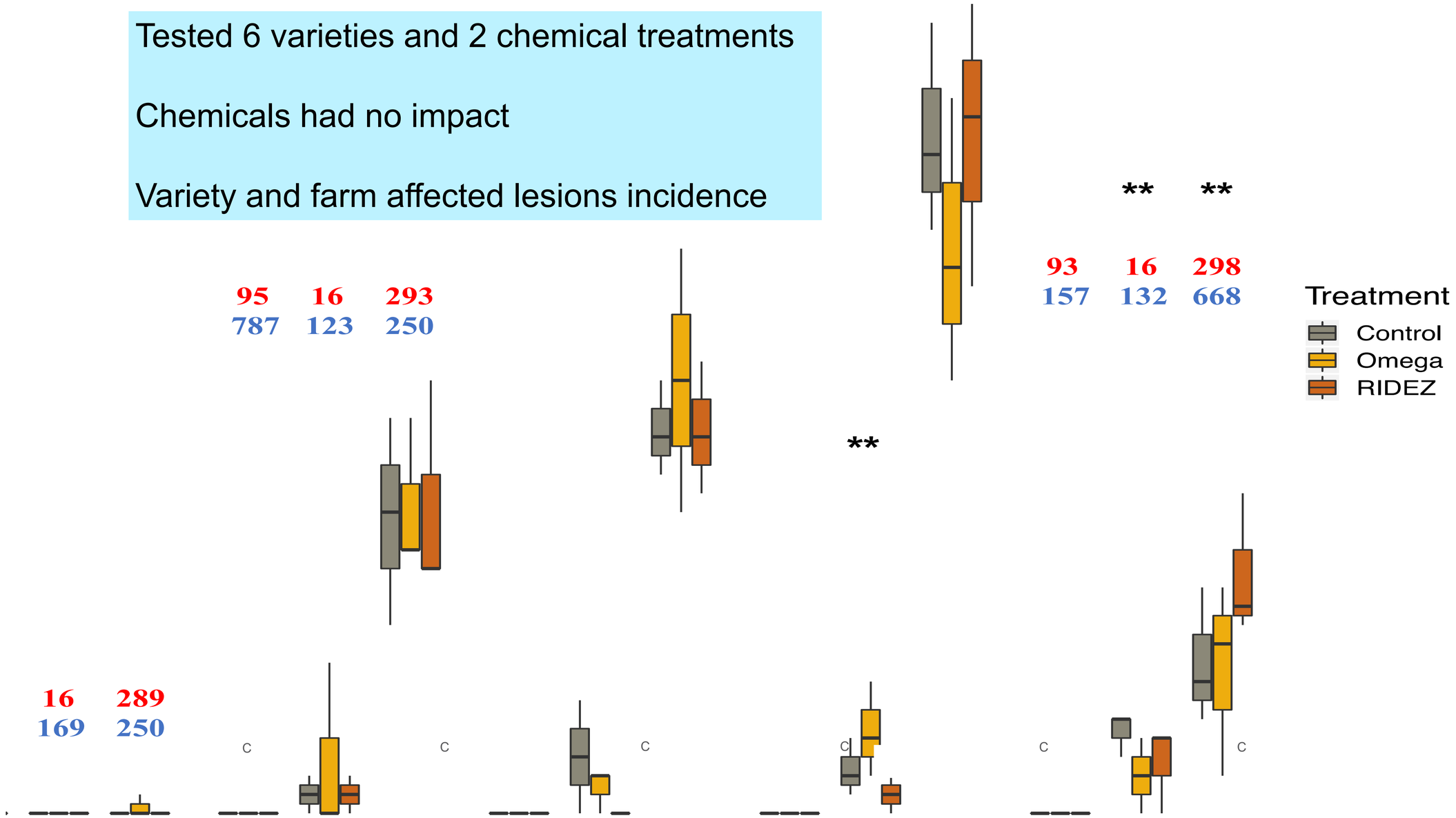
Yellow-skinned

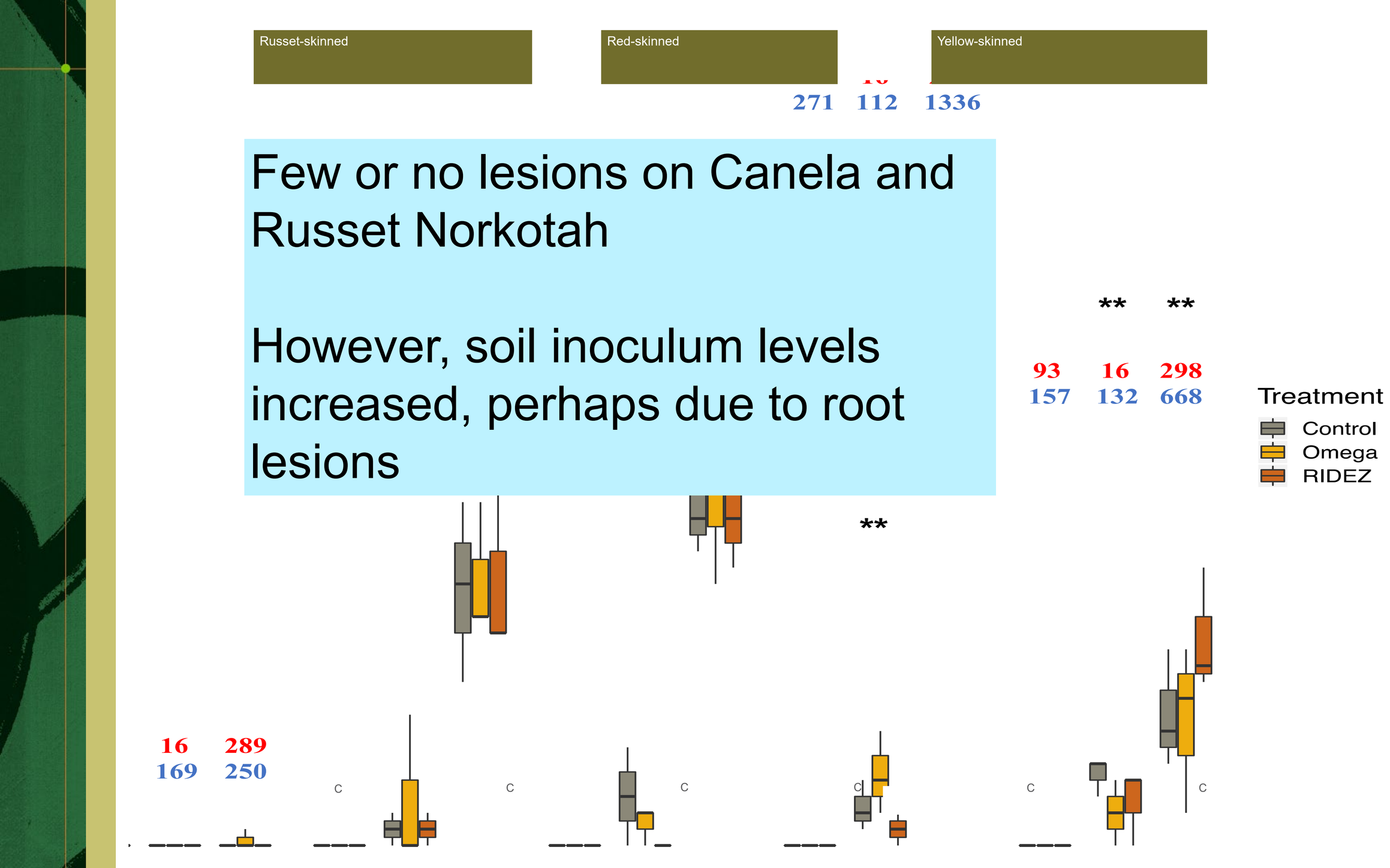
271 112 1336

Tested 6 varieties and 2 chemical treatments

Chemicals had no impact

Variety and farm affected lesions incidence




Russet-skinned
Red-skinned
Yellow-skinned
271
112
1336
Few or no lesions on Canela and Russet Norkotah
However, soil inoculum levels increased, perhaps due to root lesions
**
**
93
16
298
157
132
668
Treatment
Control
Omega
RIDEZ
**
16
289
169
250
c
c
c
c
c
c

Sporosori per gram of soil

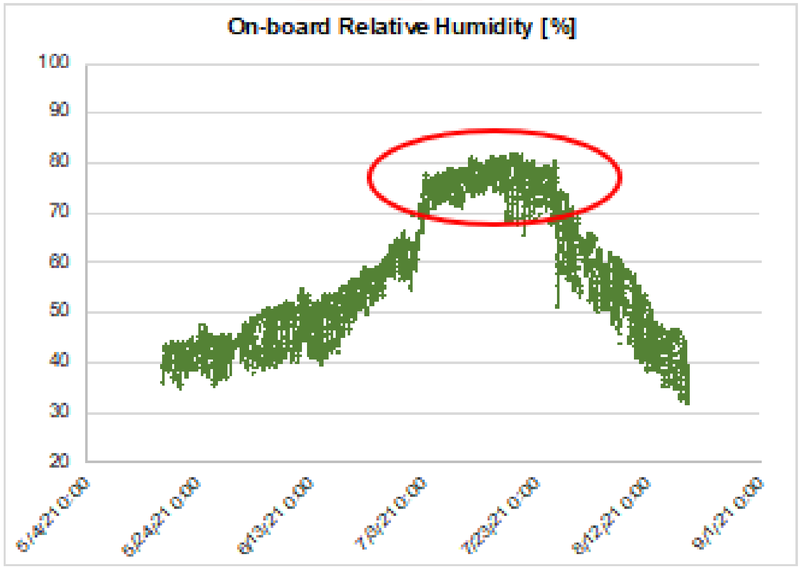
Farm	Start	End
A	93-96	141-787
B	16	112-169
C	289-298	250-1336

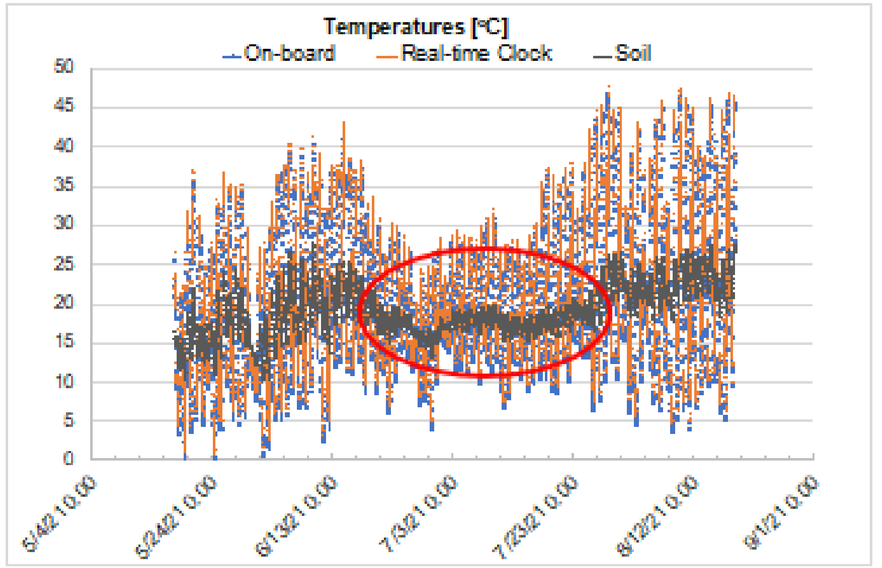
Farm A had a higher starting inoculum than Farm B, but no powdery scab lesions on tubers.

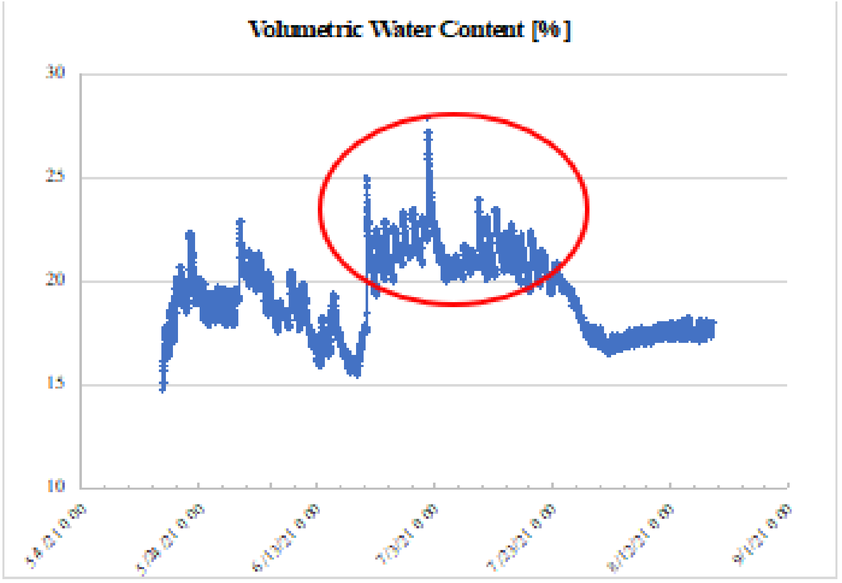
-deficit irrigation on Farm A
-over irrigation on Farm B
-soil microbes?

POTATO VIRUS INITIATIVE
DEVELOPING SOLUTIONS

Environmental factors that affect powdery scab development









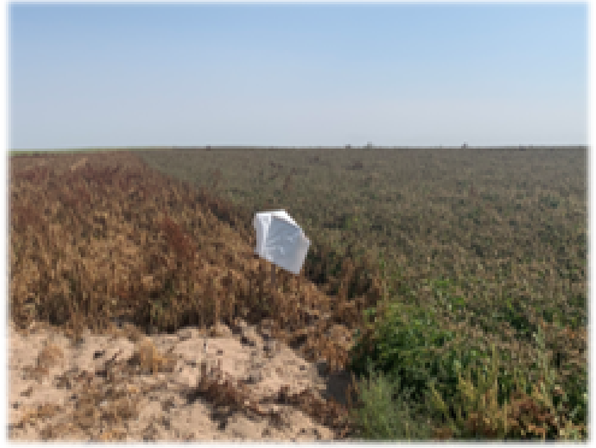
May



June



July



Vine-killing

Integrate environmental sensing to monitor relative humidity & temperature, as well as soil temperature & volumetric water content from plant emergence to vine-killing/senescence



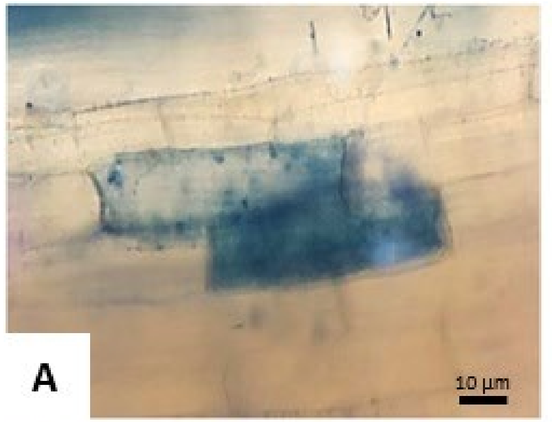
2022

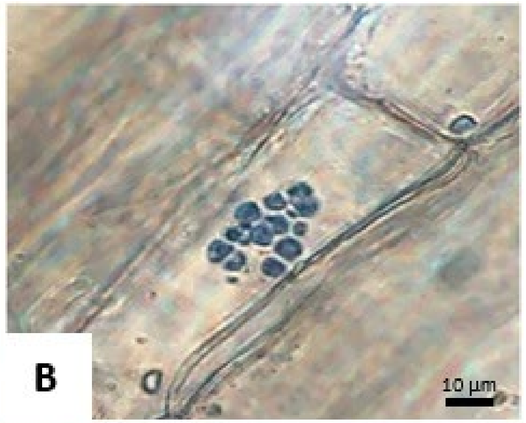
Potato breeder in US had powdery scab in tubers produced in a growth chamber.

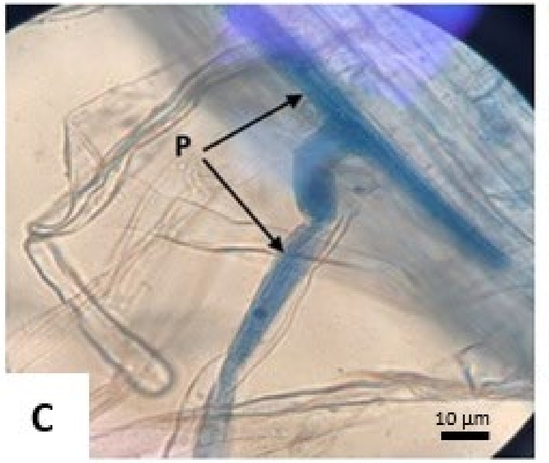
Where did it come from?

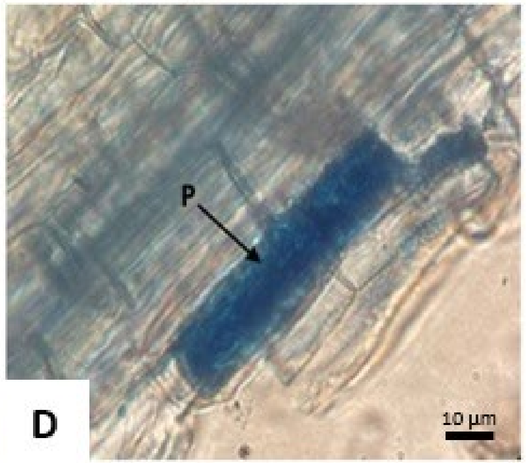


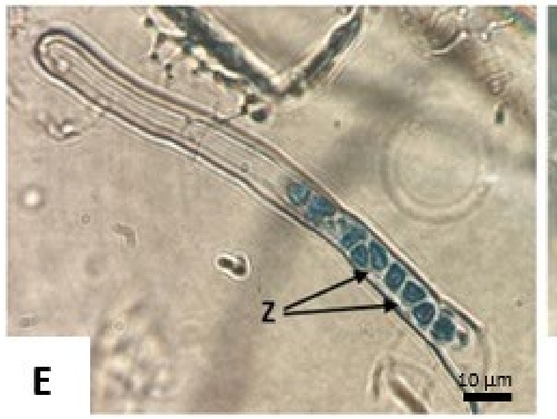


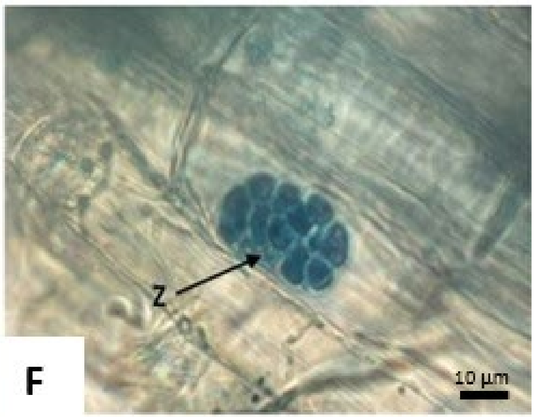

A
10 µm

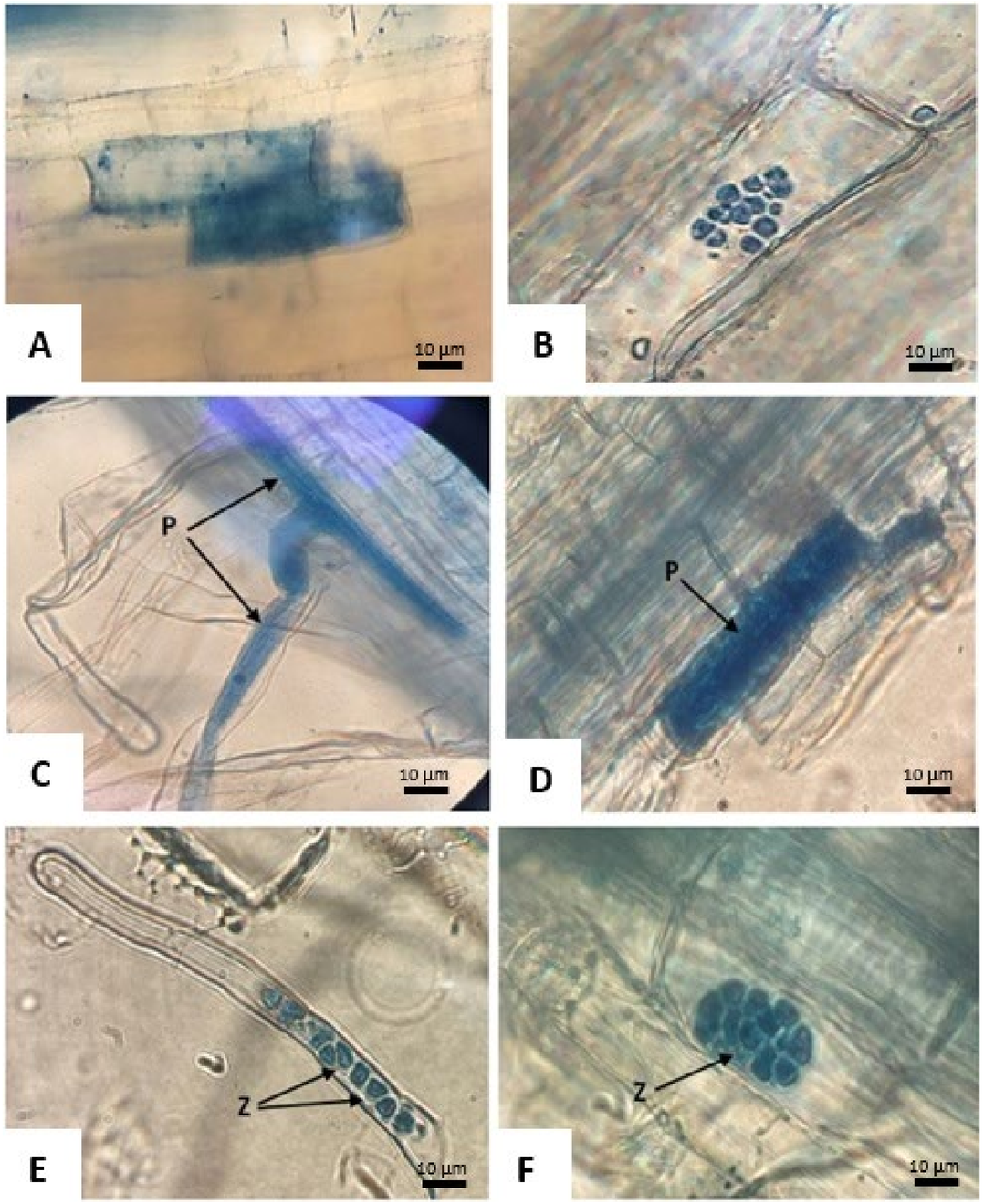

B
10 µm

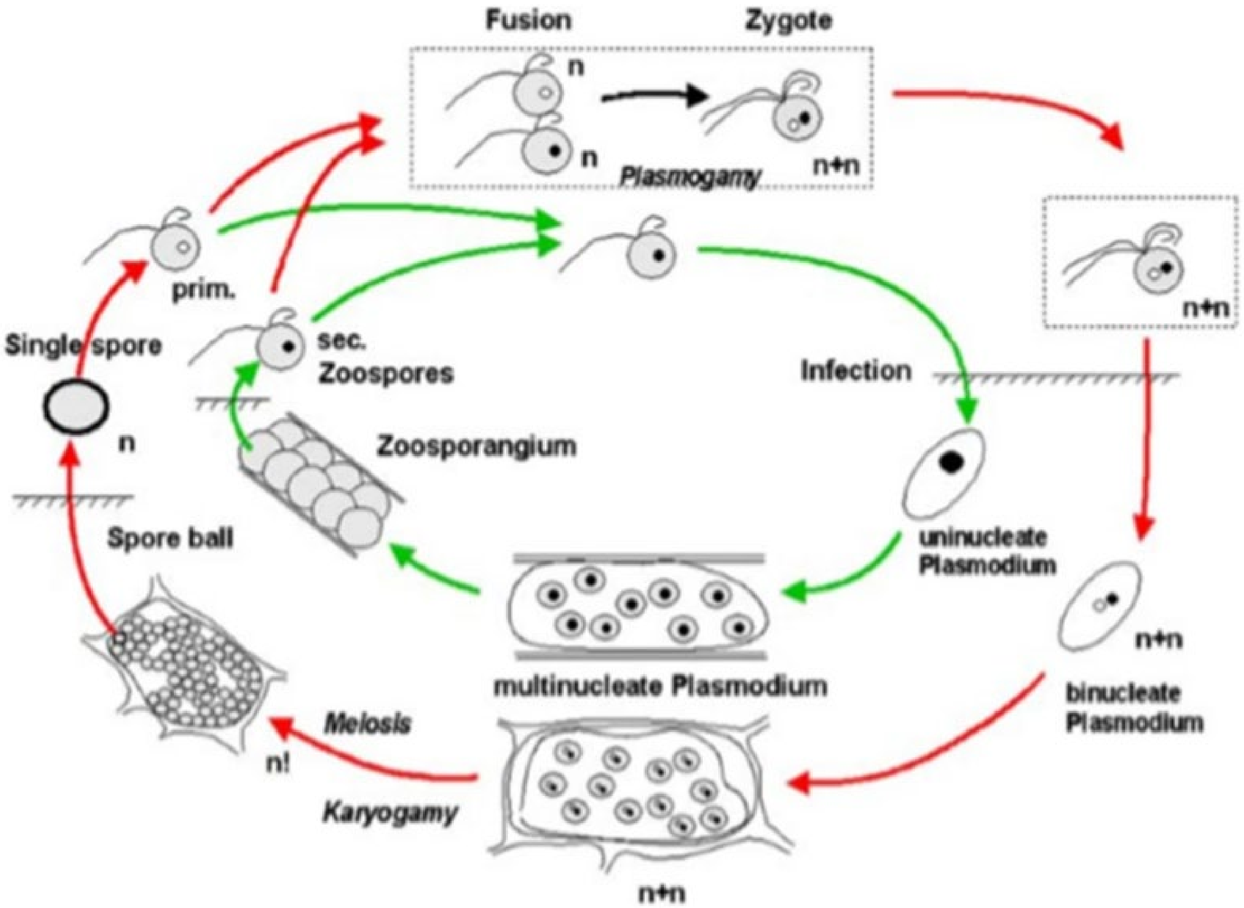

P
C
10 µm


P
D
10 µm


Z
E
10 µm


Z
F
10 µm


A
10 µm
B
10 µm
P
C
10 µm
P
D
10 µm
Z
E
10 µm
Z
F
10 µm


Fusion
Zygote
n
n
Plasmogamy
n+n
prim.
n+n
Single spore
sec.
Zoospores
Infection
n
Zoosporangium
Spore ball
uninucleate
Plasmodium
n+n
multinucleate Plasmodium
binucleate
Plasmodium
Meiosis
n!
Karyogamy
n+n



Spongospora subterranea is sometimes present in commercial peat and in potting mix.

Minitubers can be a source of powdery scab (and PMTV?)

Used potting mix should never be re-used or spread onto seed potato fields.

Plants grown in baked potting mix had more *Spongospora*

Loss of *Trichoderma* or other competing microbes?

Table 6. *Spongospora subterranea* detection following sanitation by dry heat and autoclaving

Treatment	No. of plants with plasmodia in roots	qPCR of roots, mean ± SD (sp/g)[a]	qPCR of potting mix, mean ± SD (sp/g)
Dry heat (105°C)			
2 days	3/3	173 ± 60	20 ± 32
5 days	3/3	474 ± 421	204 ± 184
8 days	2/3	316 ± 172	1,557 ± 1,437
Autoclaving at 121°C			
No autoclaving	3/3	nd[b]	30 ± 37.0
1 cycle	3/3	nd	2 ± 2.6
2 cycles	3/3	nd	2 ± 2.5
3 cycles	3/3	nd	0 ± 1.6

[a] SD = standard deviation; sp/g = sporosori/g of potting mix.
[b] nd = not determined.

Neilsen and Larsen

Two *Trichoderma harzianum*-*based* bio-control agents reduce tomato root infection with *Spongospora subterranea* (Wallr.) Lagerh., f. sp. *subterranea*, the vector of *Potato mop-top virus*

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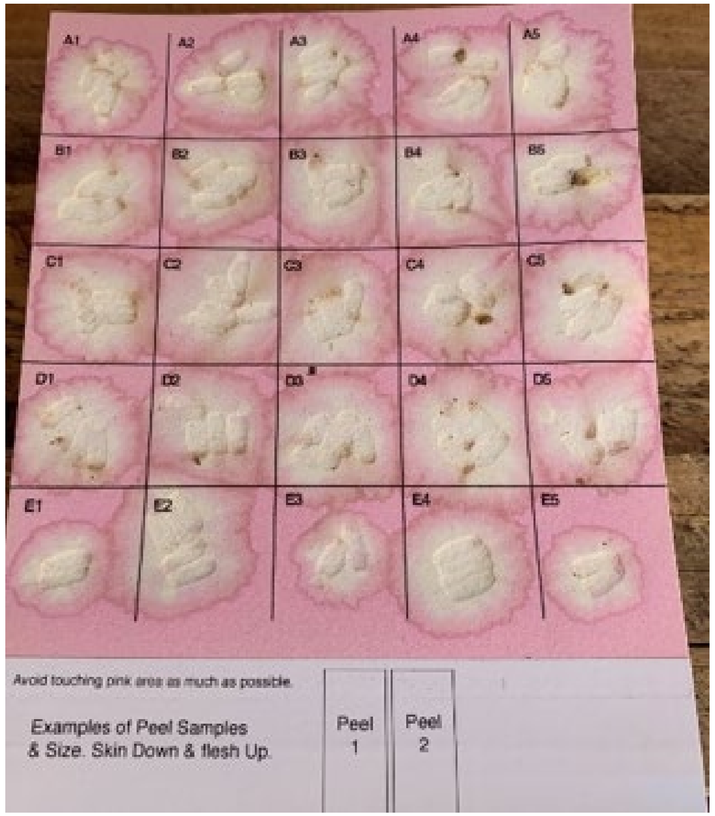
Tomato spotted wilt virus
Black dot (*Colletotrichum*)
Powdery scab

Tomato spotted wilt virus
Black dot (*Colletotrichum*)

Manage powdery scab in greenhouses:
-keep temperature warm (>25°C)
-don’t over-water
-test or avoid using potting mix

FTA card based diagnostic protocol

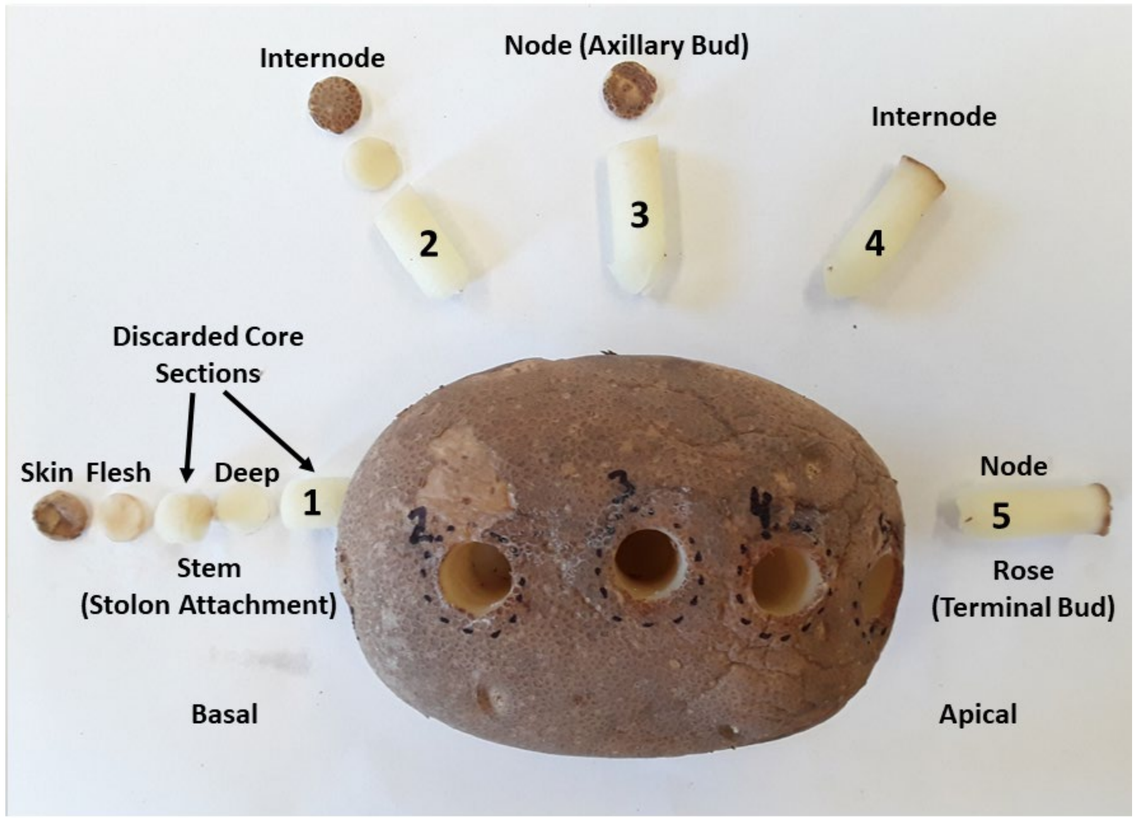






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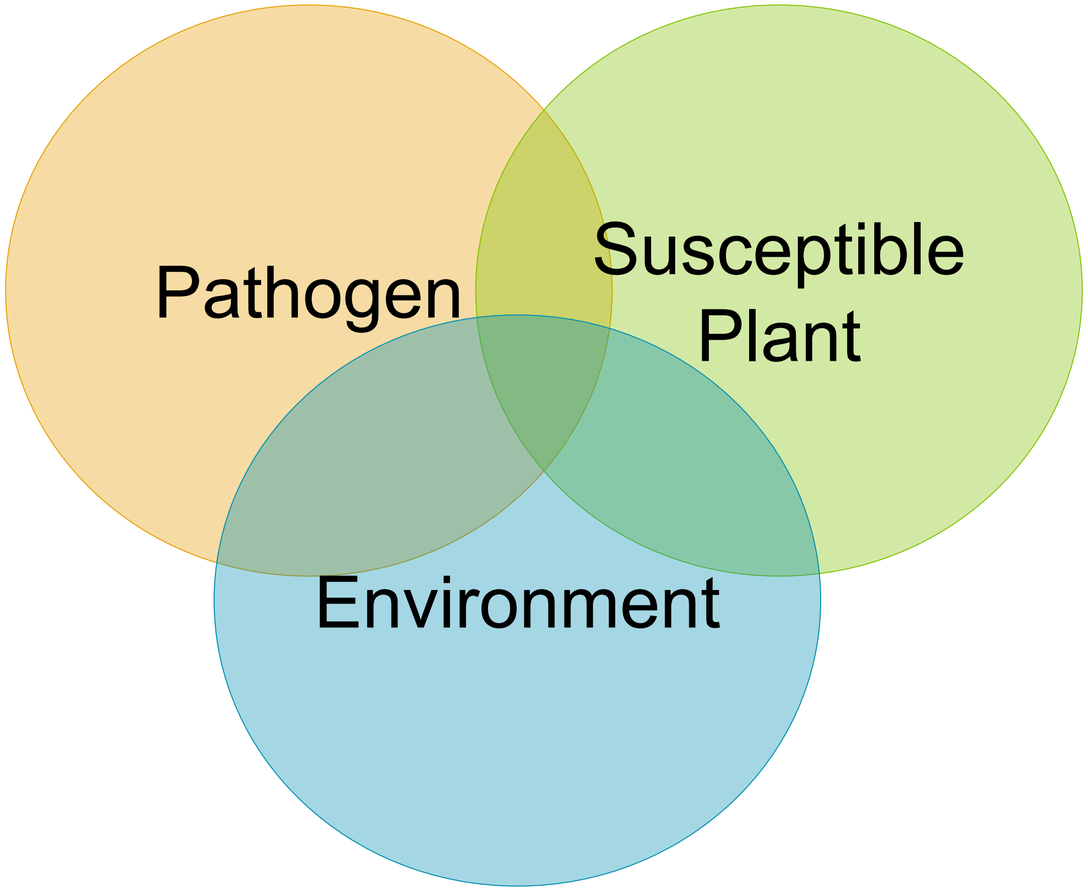
-Combine samples from bud end, stem end, and two internodes
-Use tuber skin and not samples from deeper into the tuber
-Detection increases as storage time increases
PMTV = 150 days post-harvest
PVY = 100 days post-harvest
TRV = 175 days post-harvest
-Roughly 10% of tubers with PMTV showed spraing symptoms



Dr. Chakradhur Mattupalli
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Resistant varieties

Clean seed
Rotation
Germinate-to-Exterminate?
Fumigation?



Deficit irrigation
Warm temperatures
Soil microbes?

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