

2021-2022 Potato Mop Top Virus and Powdery Scab Survey

Wisconsin Department of Agriculture, Trade and Consumer Protection – Bureau of Plant Industry

Background

Potato mop top virus (PMTV) was detected for the first time in Wisconsin-grown potato tubers in 2020, by University of Wisconsin-Madison plant pathologists. In response, the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP)'s Bureau of Plant Industry (PIB) began a two-year statewide survey for PMTV and its vector, *Spongospora subterranea f. sp. subterranea* (the pathogen that causes powdery scab). This report discusses the first year (2021-22) survey results.

PMTV is a serious disease of potatoes that is of concern to both commercial and seed potato growers. The virus can cause leaf mottling, shortened internodes, reduced yields, and disfiguring necrotic lesions in tubers (Figures 1 and 2). For commercial growers, the presence of these necrotic lesions can cause downgrading or complete crop rejection at retail. For seed potato growers, the presence of PMTV in tubers adds to the total virus load of the crop and will be tested for under the updated U.S. Department of Agriculture-Animal and Plant Health Inspection Service (USDA-APHIS) necrotic virus management plan.



Figure 1

Leaf mottle symptoms of PMTV infected potato leaf.

Photo Credit: William M. Brown Jr., Bugwood.org



Figure 2

Necrotic lesions of PMTV infected potato tuber.

Photo Credit: Owusu Domfeh, North Dakota State University.



Figure 3

Root gall symptoms of powdery scab infected potato roots

Photo Credit: Gerald Holmes, Bugwood.org



Figure 4

Lesion symptoms of powdery scab infected potato tuber.

Photo Credit: Sandra Jensen, Bugwood.org

The powdery scab pathogen, first detected in Wisconsin in 2002, is a fungus-like organism that causes root galls and round raised lesions on the skin of tubers (Figures 3 and 4). The root galls and lesions contain resting spore structures called spore balls, which can remain viable in the soil for many years, even after treatment and crop rotation. *S. subterranea* can impact plant productivity, tuber quality and storability, vector PMTV, and create infection opportunities for other diseases. Spore balls infected with PMTV allow the virus to persist in the soil for many years and potentially infect future potato crops.

Methods

In the winter of 2021-22, 103 lots of stored potato tubers from 16 collaborating seed and commercial potato growers were tested for the presence of PMTV and *S. subterranea* using the gene-based method real time polymerase chain reaction (real-time PCR). Real-time PCR was used because of its sensitivity and ability to detect minute amounts of pathogen in a sample.

Ten to 20 potato tubers per lot were collected from grower storage bins between November 2021 and January 2022. Tubers were collected from storage bins approximately two months after harvest to increase the likelihood of detecting the virus during the sample analysis process. PMTV infected tubers continue to increase in virus titer and symptomology in storage, making sampling stored tubers important for detection. Upon collection, tubers were transported to the PIB Lab for testing.

Once tubers arrived at the PIB Lab, they were washed to remove excess soil. Tubers from each lot were subsampled and prepared for RNA extraction for PMTV testing and for DNA extraction for *S. subterranea* testing. RNA subsamples composed of 4mm cores taken from the apical ends of the tuber. RNA extractions were performed using the automated nucleic extraction platform Maxwell RSC and the Promega 1330 Viral Total Nucleic Acid Purification kit. Extracted RNA from each lot was tested for PMTV by real-time, reverse transcription PCR (real-time RT-PCR). DNA subsamples were taken by scraping any suspect powdery scab lesions and asymptomatic regions from the surface of tubers. DNA extractions were performed using the automated nucleic extraction platform Maxwell 16 and the Promega 1030 tissue DNA purification kit. Extracted DNA from each lot was tested for the presence of *S. subterranea* using real-time PCR.

Results

All tubers from 103 potato lots tested negative for PMTV (Appendix A), and no tubers symptomatic for PMTV were observed in tested lots. Nine of 103 lots tested positive for the presence of low levels of *S. subterranea* (Appendix B). This low level of powdery scab detection is consistent with previous observations in the state and not unexpected. Powdery scab has been detected in 12 Wisconsin counties since 2002 (Appendix C). Counties included in this survey were Dunn, Langlade, Marinette, Portage, Shawano, Vilas, and Waushara counties (Table 1). Tested potato varieties included Atlantic, Caribou, Gold Rush, Lady Liberty, Lamoka, Manistee, Megachip, Norland Dark Red, Russet Burbank, Russet Norkotah, Silverton, and Snowden.

County	Number of lots tested
Dunn	10
Langlade	38
Marinette	10
Portage	30
Shawano	3
Vilas	10
Waushara	2
Total	103

Table 1
Number of lots tested by county.

Acknowledgements

We would like to thank the DATCP staff who provided support for this project, including Nick Clemens, Ian Gallo, Shanon Hankin, Stephanie Jentz, Jennifer Oestreich, and Sara Ott who made this project possible. We are grateful and thankful to the growers who participated in this survey. We would like to acknowledge the assistance of Dr. Alexander V. Karasez for providing PMTV positive control material, Dr. Kutay Ozturk for providing *S. subterranea* positive control material, and Dr. James Woodhall for providing assistance with PCR troubleshooting. A special thank you to Dr. Renee Rioux, Dr. Amanda Gevens, Tamas Houlihan, and John D. Schroeder for writing letters of support for this project. Lastly, we would like to thank the USDA Specialty Crop Block Grant program for funding this project.

References

- Mallik, I., Fulladolsa, A. C., Yellareddygar, S. K. R., Bittara, F. G., Charkowski, A. O., & Gudmestad, N. C. (2019). Detection and quantification of *Spongospora subterranea* Sporosori in soil by quantitative real-time PCR. *Plant Disease*, 103(12), 3189–3198. <https://doi.org/10.1094/pdis-05-19-1092-re>
- Mallik, I., Fulladolsa, A. C., Yellareddygar, S. K., Bittara, F. G., Charkowski, A. O., & Gudmestad, N. C. (2019). Detection and quantification of *Spongospora subterranea* Sporosori in soil by quantitative real-time PCR. *Plant Disease*, 103(12), 3189–3198. <https://doi.org/10.1094/pdis-05-19-1092-re>
- Mumford, R. A., Walsh, K., Barker, I., & Boonham, N. (2000). Detection of *potato mop top virus* and *tobacco rattle virus* using a multiplex real-time fluorescent reverse-transcription polymerase chain reaction assay. *Phytopathology*®, 90(5), 448–453. <https://doi.org/10.1094/phyto.2000.90.5.448>
- Pandey, B., Mallik, I., & Gudmestad, N. C. (2020). Development and application of a real-time reverse-transcription PCR and droplet digital PCR assays for the direct detection of *potato mop top virus* in soil. *Phytopathology*®, 110(1), 58–67. <https://doi.org/10.1094/phyto-05-19-0185-fi>
- van de Graaf, P., Lees, A. K., Cullen, D. W., & Duncan, J. M. (2003). Detection and quantification of *Spongospora subterranea* in soil, water and plant tissue samples using real-time PCR. *European Journal of Plant Pathology*, 109(6), 589–597. <https://doi.org/10.1023/a:1024764432164>

Authors

Sam Fieweger

Lab Director - DATCP Plant Industry Laboratory

sam.fieweger@wisconsin.gov

Elly Voigt

Plant Pathologist – DATCP Plant Industry Laboratory



Wisconsin Department of Agriculture, Trade and Consumer Protection

Division of Agricultural Resource Management

2811 Agriculture Drive, P.O. Box 8911, Madison, WI 53708-8911

<https://datcp.wi.gov>

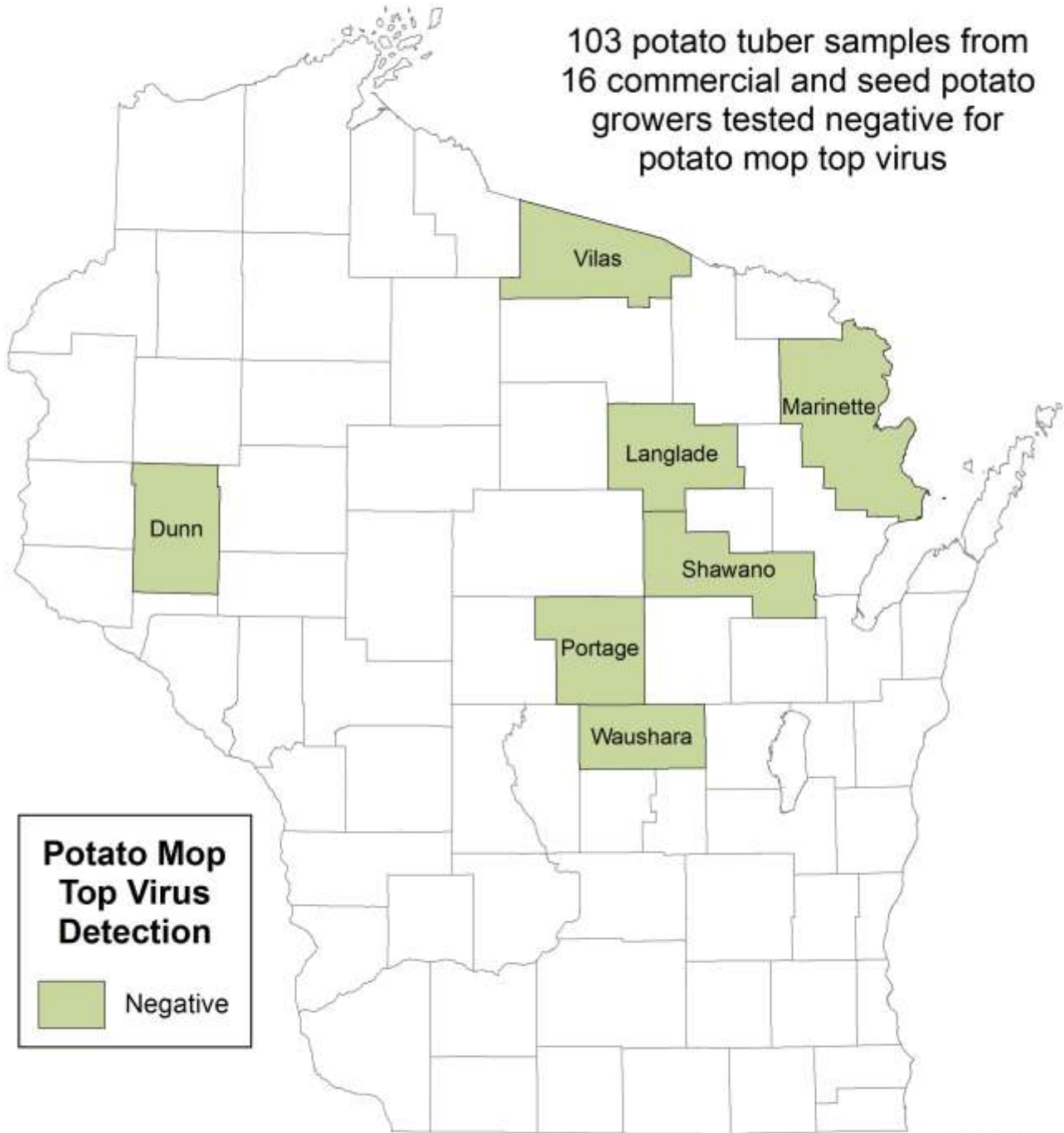
Appendix A

Wisconsin map showing the results of the 2021 PMTV survey



2021 Potato Mop Top Virus Survey

103 potato tuber samples from 16 commercial and seed potato growers tested negative for potato mop top virus



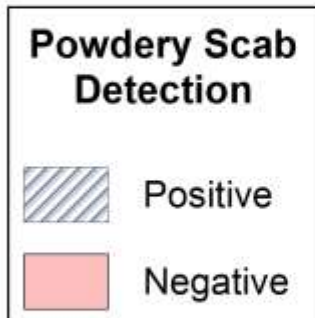
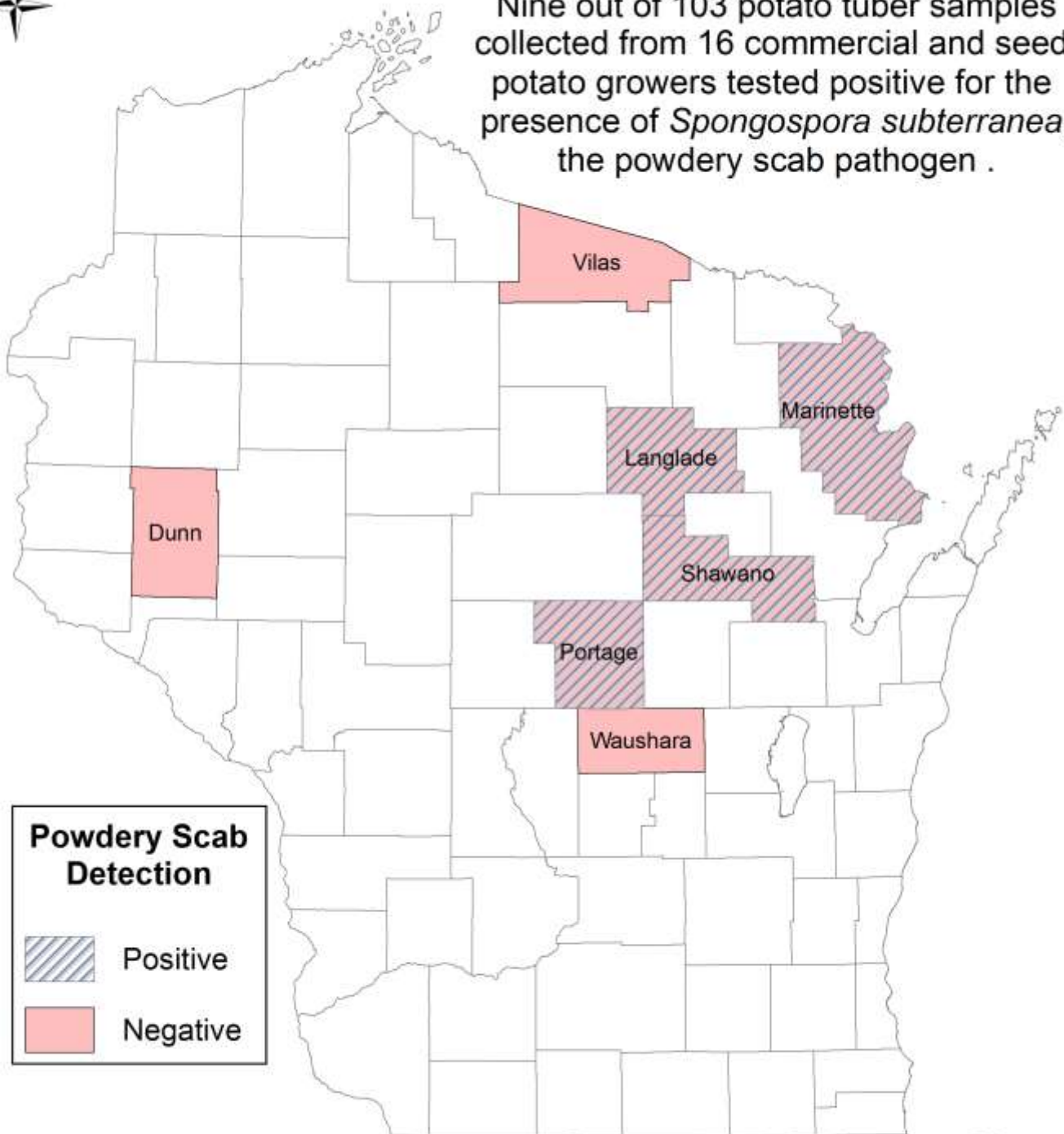
Appendix B

Wisconsin map showing the counties surveyed for Powdery Scab in 2021.

2021 Powdery Scab Survey



Nine out of 103 potato tuber samples collected from 16 commercial and seed potato growers tested positive for the presence of *Spongospora subterranea*, the powdery scab pathogen .



Appendix C

Wisconsin map showing the counties with Powdery Scab finds from 2002 to 2021.

Powdery Scab in Wisconsin 2002 - 2021



Spongospora subterranea has been detected in 12 Wisconsin counties since 2002.

