

# POTATO MOP TOP VIRUS & POWDERY SCAB

PLANT INDUSTRY BUREAU LAB

WISCONSIN DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

## Survey Results 2021-2023



Figure 1

Leaf mottle symptoms of PMTV infected potato leaf.  
Photo Credit: Neil Gudmestad, North Dakota State University



Figure 2

Necrotic lesions of PMTV infected potato tuber.  
Photo Credit: Owusu Domfeh, North Dakota State University.

## 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's (DATCP) Plant Industry Bureau (PIB) began a two-year statewide survey for PMTV and its vector, *Spongospora subterranea f. sp. subterranea*, the pathogen that causes powdery scab.

Potato mop top virus was first described in 1966 in the United Kingdom. Since then, the virus has been found in Asia, Europe, North America, and South America. In the United States, PMTV has been documented since 2002 in Colorado, Idaho, Maine, New Mexico, North Dakota, Oregon, and Washington. On the other hand, *Spongospora subterranea f. sp. subterranea* has an earlier history, with its first description from Germany in 1841 and has since been found worldwide. Where *Spongospora subterranea f. sp. subterranea* is present in soils and has acquired PMTV, there is the possibility for spread of PMTV to future potato crops.

Potato mop top virus is an economically important disease of commercial and seed potatoes. The virus can cause leaf mottling, shortened internodes, reduced yields, and disfiguring internal necrotic tuber lesions (Figures 1 and 2).

For commercial potato production, the presence of necrotic lesions in tubers can cause downgrading or complete crop rejection at retail. For seed potatoes, the presence of PMTV in tubers adds to the total virus load of the crop and will be tested for according to the U.S. Department of Agriculture-Animal and Plant Health Inspection Service (USDA-APHIS) necrotic virus management plan. Seed potatoes with internal tuber necrosis scores greater than the tolerance levels established by this necrotic virus management plan are ineligible for recertification as seed or use in commercial production.



Figure 3

Root gall symptoms of powdery scab infected potato roots

Photo Credit: MillerResearch



Figure 4

Lesion symptoms of powdery scab infected potato tuber.

Photo Credit: Sandra Jensen, Bugwood.org

The powdery scab pathogen *Spongospora subterranea f. sp. subterranea*, first detected in Wisconsin in 2002, is a fungus-like organism that causes root galls (Figure 3) and round raised lesions on the skin of tubers (Figure 4). The root galls and lesions contain resting spore structures which can remain viable in the soil for many years, even after treatment and crop rotation. Powdery scab can impact plant productivity, tuber quality, and storability. It can also vector (acquire and transmit) PMTV between plants and create secondary infection opportunities for other diseases. Resting spore structures (spore balls) that acquire PMTV allow the virus to persist in the soil for more than 10 years and potentially infect future potato crops with PMTV.



Figure 5

Spore balls of *Spongospora subterranea*.

Photo Credit: Sandra Jensen, Bugwood.org

This survey, conducted over the 2021 and 2022 growing seasons, included testing of stored tubers grown in 2021 and soil samples collected after harvest in 2022. Each sample was tested for the presence of PMTV and powdery scab. Additional objectives of the survey were to determine if PMTV has been introduced to potato production areas in Wisconsin, determine if Wisconsin powdery scab populations have acquired PMTV, and to improve our understanding of the current distribution of powdery scab in the state. This report presents the results of first-year tuber testing (2021-22) and second-year soil testing (2022-23) surveys.

**Once established in fields, PMTV can survive for over 10 years in the absence of a potato crop.**

## **METHODS**

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### **TUBER TESTING**

From November 2021 to January 2022, DATCP inspectors visited 16 collaborating seed and commercial potato grower sites and sampled 103 lots of potato tubers from grower storage bins. A total of 10-20 potato tubers per lot were collected from grower storage bins. Sampling was conducted approximately two months post-harvest, when virus titer and symptomology would be expected to reach detectable levels in stored tubers.

Once tubers arrived at the PIB Lab, they were washed to remove excess soil. Tubers from each lot were subsampled and prepared for RNA and DNA extraction. RNA subsamples were composed of 4mm cores taken from the apical end and eyes of the tuber. RNA extractions were performed using the automated nucleic extraction platform Maxwell RSC and Promega's 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 composed of any suspect powdery scab lesions and symptomatic regions from the surface of tubers. DNA extractions were performed using the automated nucleic extraction platform Maxwell 16 and Promega's 1030 Tissue DNA purification kit. Extracted DNA from each lot was tested for the presence of powdery scab using real-time PCR.



## SOIL TESTING

Soil sampling was conducted between August 24 and October[OJL1] 14, 2022. DATCP inspectors collected 206 soil samples from 40 fields totaling approximately 2,250 acres. Large fields (greater than 20 acres) were subdivided into 10-acre sections for sampling. For each sample, a minimum of 15 soil cores were collected and individual cores were separated by at least 30 paces.

In preparing the material for DNA and RNA extraction, each soil sample was thoroughly mixed and subsampled. Soil was stored at 8°C until DNA and RNA extraction could be completed. DNA extraction was performed with 250 mg of soil using Qiagen’s DNeasy PowerSoil Pro kit. Extracted DNA was then tested for the presence of powdery scab using the same real-time PCR used for tuber testing. An additional RNA extraction was performed on all soil samples collected from fields testing positive for powdery scab using 2 grams of soil and Qiagen’s RNeasy PowerSoil Total RNA kit. Extracted RNA was subsequently tested for the presence of PMTV using the same real-time RT-PCR from tuber testing.

## RESULTS

### TUBER TESTING

All tubers sampled 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 powdery scab (Appendix B). The detection of powdery scab at low levels is consistent with previous observations in the state and was not unexpected.

Counties included in the 2021 tuber testing were Dunn, Langlade, Marinette, Portage, Shawano, Vilas, and Waushara

(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	Lots Tested	Lots Positive for Powdery Scab	Lots Positive for PMTV
Dunn	10	0	0
Langlade	38	1	0
Marinette	10	1	0
Portage	30	5	0
Shawano	3	2	0
Vilas	10	0	0
Waushara	2	0	0
<b>Total</b>	<b>103</b>	<b>9</b>	<b>0</b>

Table 1.

Number of tuber lots tested and the number of lots positive for powdery scab and PMTV by county in 2021.

## SOIL TESTING

Seventy of the 206 soil samples tested positive for the presence of powdery scab (Appendix C) and none of the 103 soil samples collected from fields testing positive for powdery scab tested positive for PMTV (Appendix D). Powdery scab was detected in 17 of the 40 fields sampled. Counties included in soil testing were Langlade, Marinette, Portage, Vilas, and Waushara (Table 2).

County	Fields	Soil Samples	Positive for Powdery Scab	Positive for PMTV
Langlade	17	83	3	0
Marinette	7	45	25	0
Portage	7	46	36	0
Vilas	8	26	0	0
Waushara	1	6	0	0
<b>Total</b>	<b>40</b>	<b>206</b>	<b>70</b>	<b>0</b>

**Table 2.**  
Number of fields, soil samples, and samples positive powdery scab and PMTV soil samples by county in 2022.

## CONCLUSIONS

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Results of this survey indicate that PMTV is not present in Wisconsin-grown tubers or in the regional populations of powdery scab found in Wisconsin's potato growing areas. The 2020 detection of PMTV likely represents an isolated case and the virus was not detected with subsequent statewide tuber and soil sampling survey efforts in 2021 and 2022.

In contrast since the 2002 detection, the number of counties with fields found positive for powdery scab has increased to 12 and includes Adams, Dane, Dunn, Juneau, Langlade, Marinette, Oconto, Pepin, Portage, Shawano, Vilas, and Waushara (Appendix E). Survey results show a higher rate of powdery scab in soil samples from fields versus tuber samples from storage bins, with soil samples from 43% of fields (17 of 40) testing positive and only 9% of tubers samples testing positive.

In summary, results of the 2021-2022 survey found no PMTV in potato growing areas of Wisconsin. Continued use of best management practices for PMTV and powdery scab is encouraged to prevent future introductions and to help slow the spread of powdery scab within the state.

## ACKNOWLEDGMENTS

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## PEST SURVEY PROGRAM

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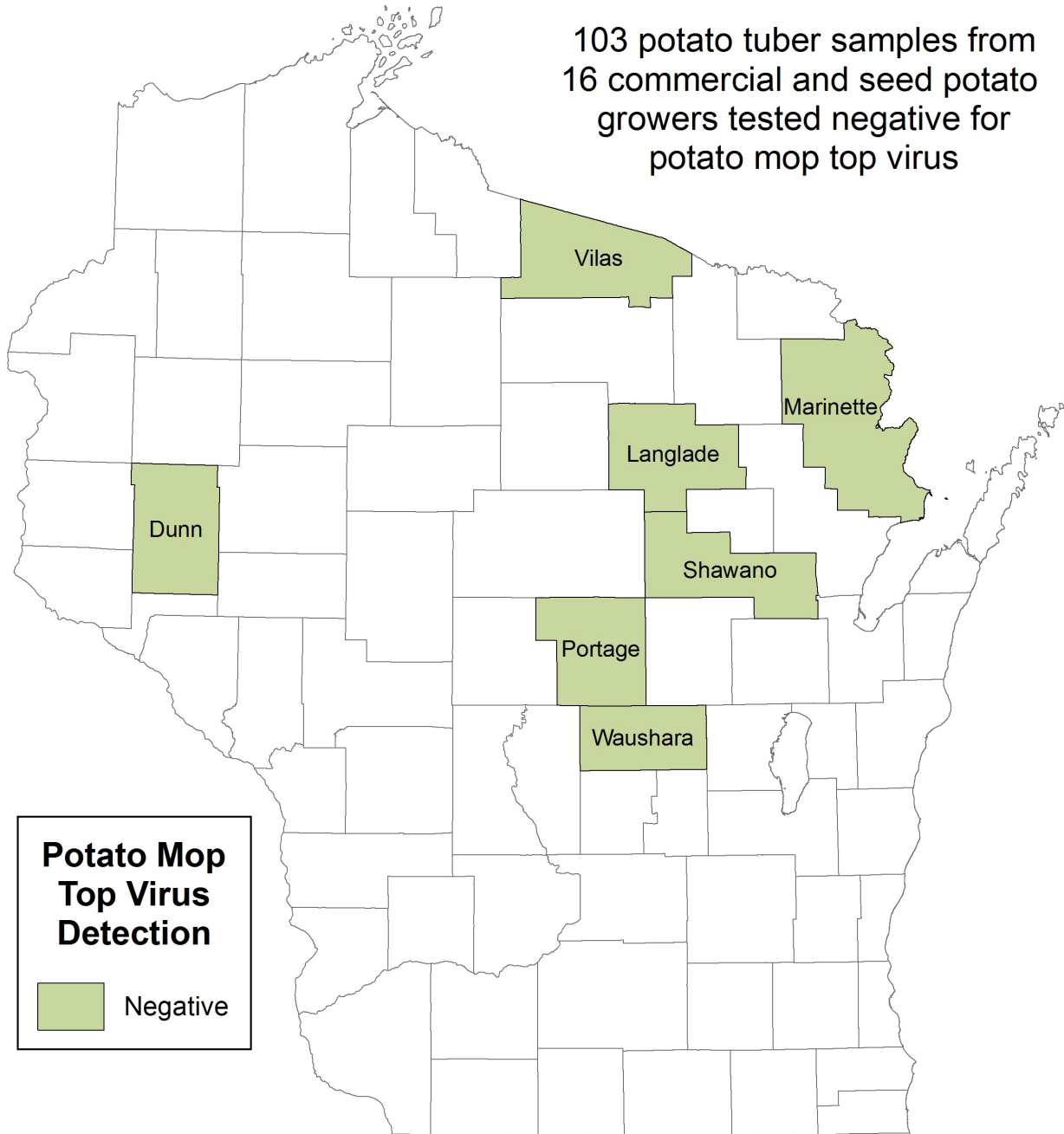
 <https://www.pestsurvey.wi.gov>  pest hotline: 866.440.7523



Wisconsin map showing the results of the 2021 Potato Mop Top Virus 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



Wisconsin Department of Agriculture, Trade and Consumer Protection

SF 1/18/2023

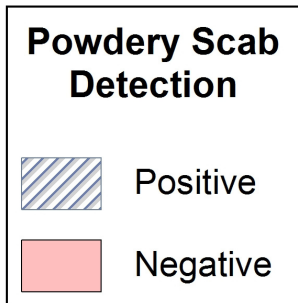
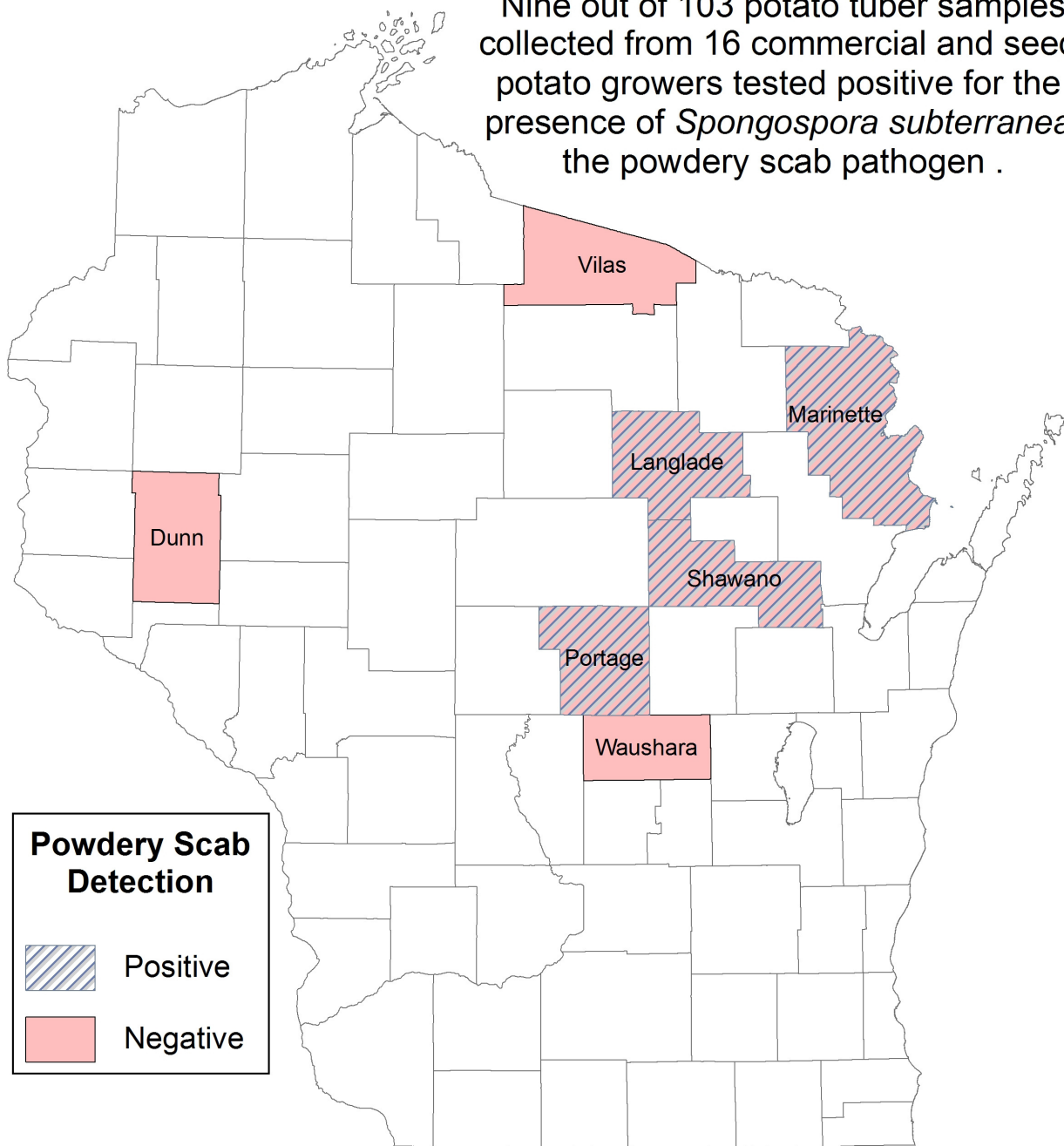


## APPENDIX B

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 .



Wisconsin Department of Agriculture, Trade and Consumer Protection

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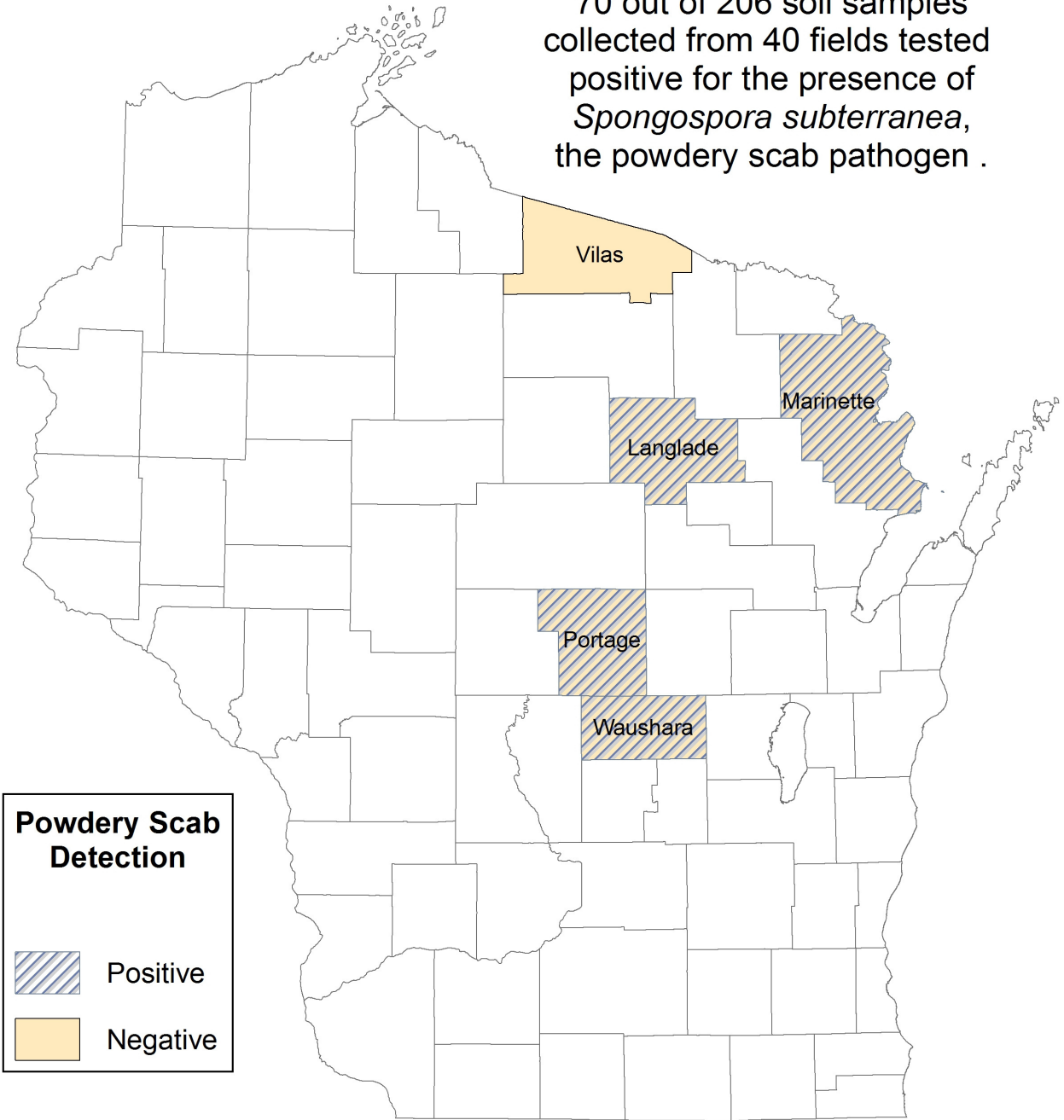




Wisconsin map showing the counties surveyed for Powdery Scab in 2022

# 2022 Powdery Scab Survey

70 out of 206 soil samples collected from 40 fields tested positive for the presence of *Spongospora subterranea*, the powdery scab pathogen .



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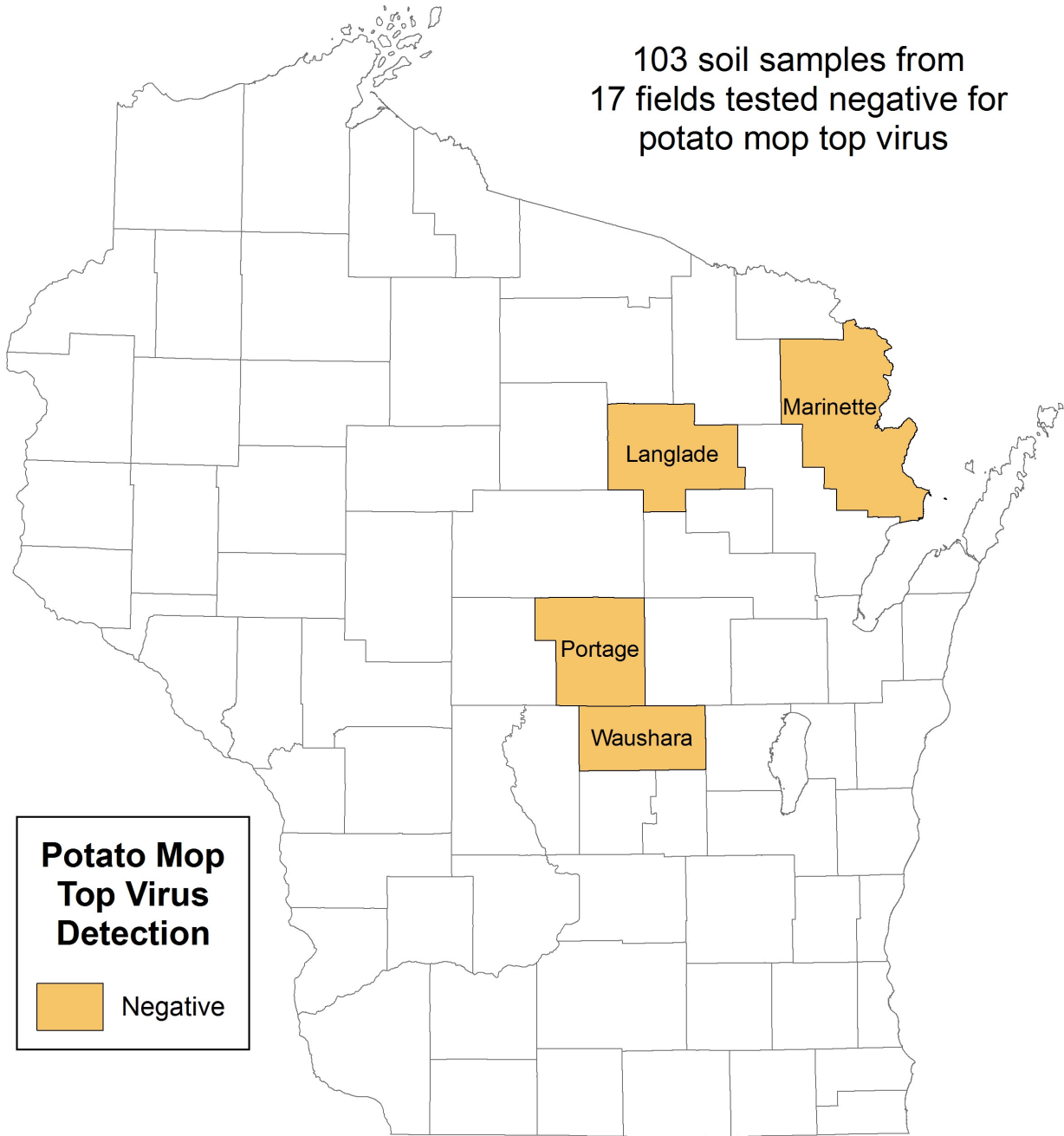


APPENDIX D

Wisconsin map showing the results of the 2022 Potato Mop Top Virus survey

# 2022 Potato Mop Top Virus Survey

103 soil samples from  
17 fields tested negative for  
potato mop top virus



Wisconsin Department of Agriculture, Trade and Consumer Protection

SF 1/13/2023

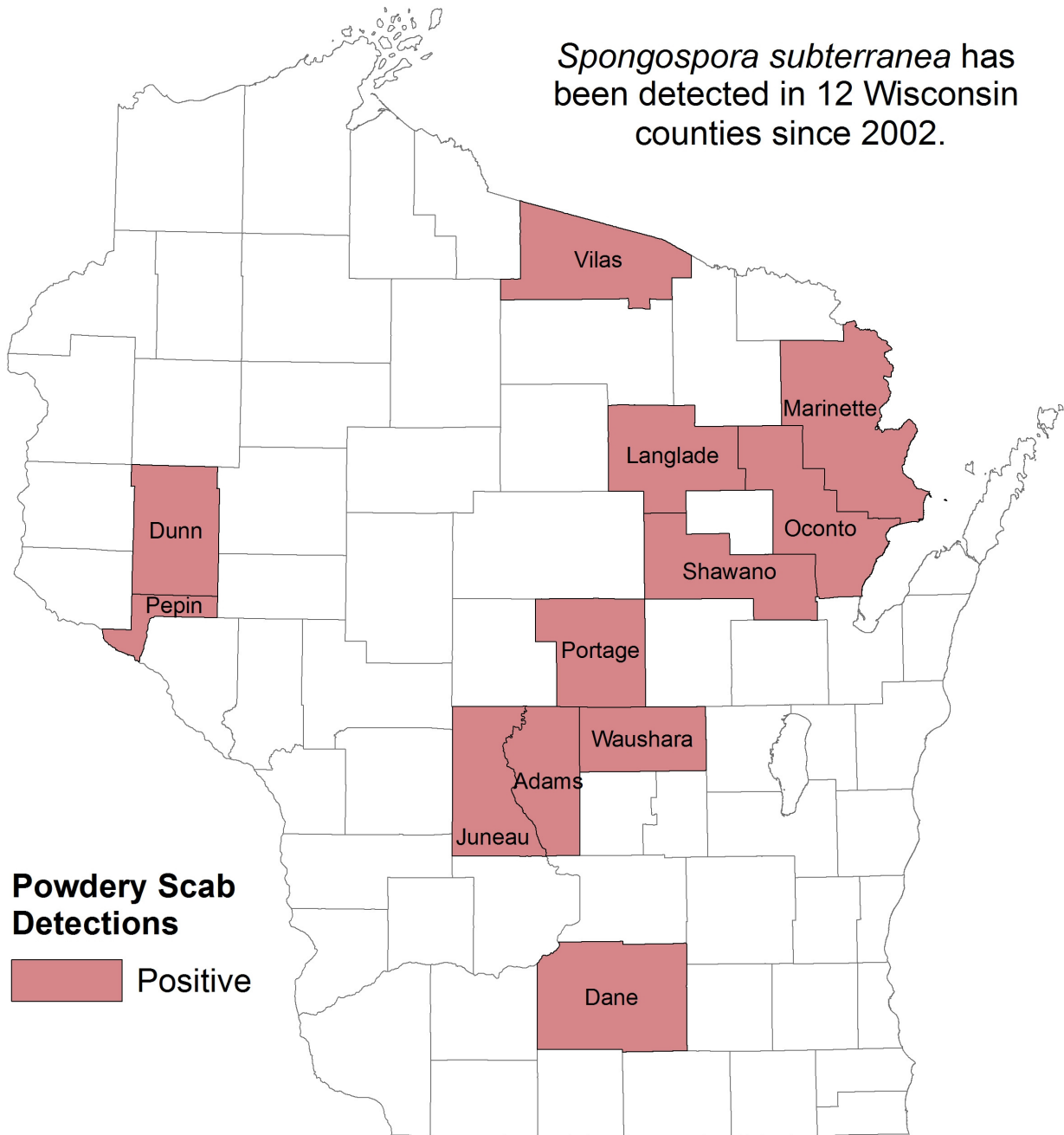


# APPENDIX E

Wisconsin map showing the counties with Powdery Scab finds from 2002 to 2022

## ***Powdery Scab in Wisconsin 2002 - 2022***

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



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