Statewide Distribution of Virus Problems on Processing Beans

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Outline

Why do we care?

Viruses and vectors involved

Extent of the problem

Approaches/Methods

Data/Observations

Future directions

Snap Bean Industry

- In 2002,
  - ~317,000 tons of beans were produced
  - Over 72,000 acres were harvested
  - With a crop value >$35 million
  - Which represents >38% of total US production
- $8 million in losses recorded from 2000 to 2001
  - Appearance of the soybean aphid
  - Associated with the occurrence of virus
    - Alfalfa Mosaic Virus (AMV)
    - Cucumber Mosaic Virus (CMV)

“2003 was the fourth year in a row that virus introduced to our snap bean crop by the Chinese Soybean Aphid had a negative effect on the yield produced by the crop.”

“Of 6,350 acres that we planted …80% were affected by the disease.”

“…it would be safe to say that we had some 1,750 acres that experienced a 50% yield loss due to cucumber mosaic virus.”

“During the past season alone, our growers incurred yield losses of up to 3 tons of snap beans per acre due to bean viruses.”

“…writing to express our great concern over the bean virus disease complex that has been experienced recently by us and other processors and growers of snap beans in Wisconsin and elsewhere.”

“Applications of insecticides have proven ineffective in controlling the transmission of viruses to beans by controlling their vector, the soybean aphid.”

“…..up to 5% of the pods were damaged, which is the extreme limit for product suitability…we ended up abandoning 117 acres due to excessive pod……..”

Insect transmitters of plant viruses

Thrips

Whiteflies

Beetles

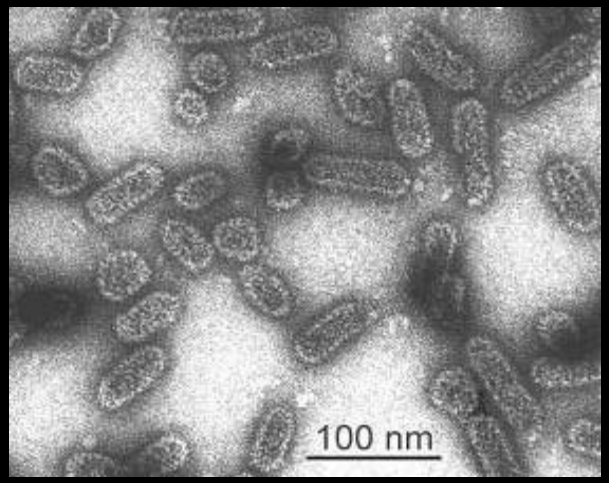
Aphids

Leafhoppers / Planthoppers

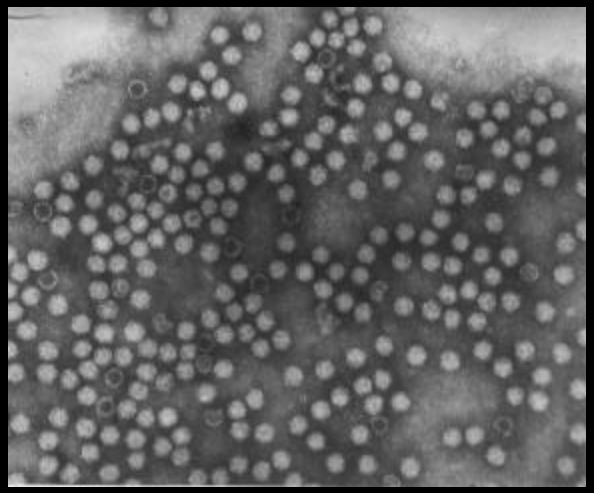
The Problem

Lee 2002

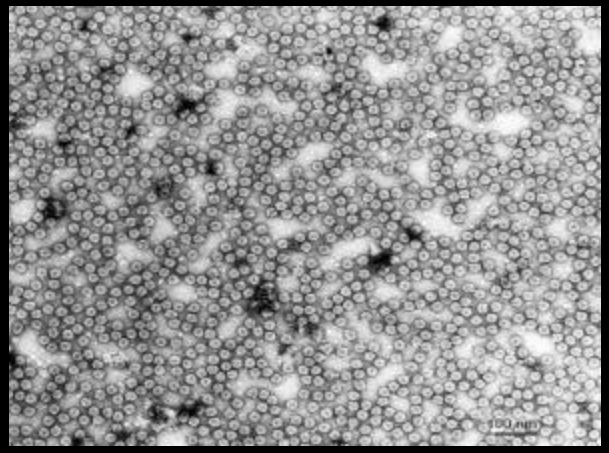
The Players



Alfalfa Mosaic Virus (AMV)



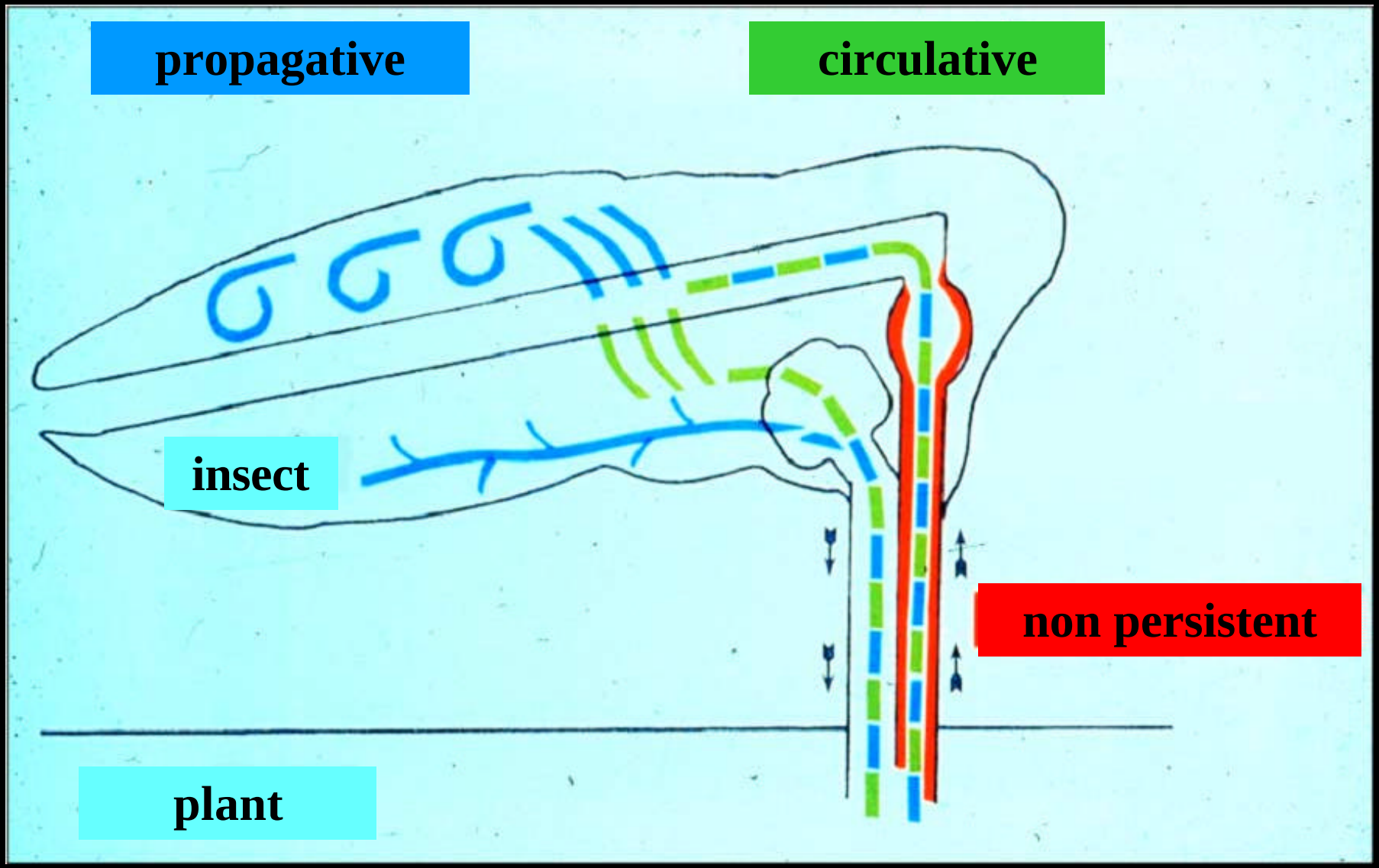
Bean Pod Mottle Virus (BPMV)

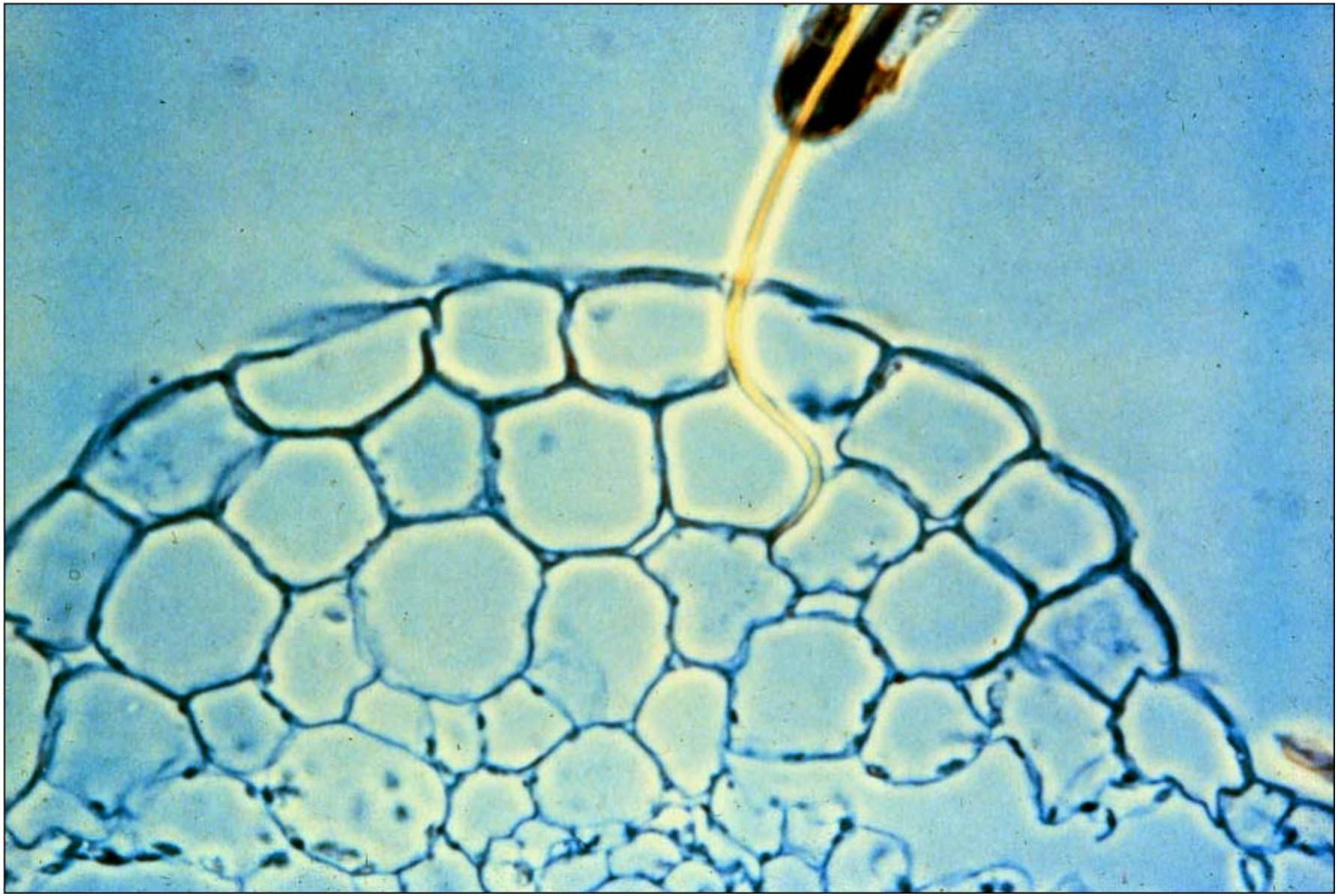


Cucumber Mosaic Virus (CMV)

Clover Yellow Vein Virus (CYVV)

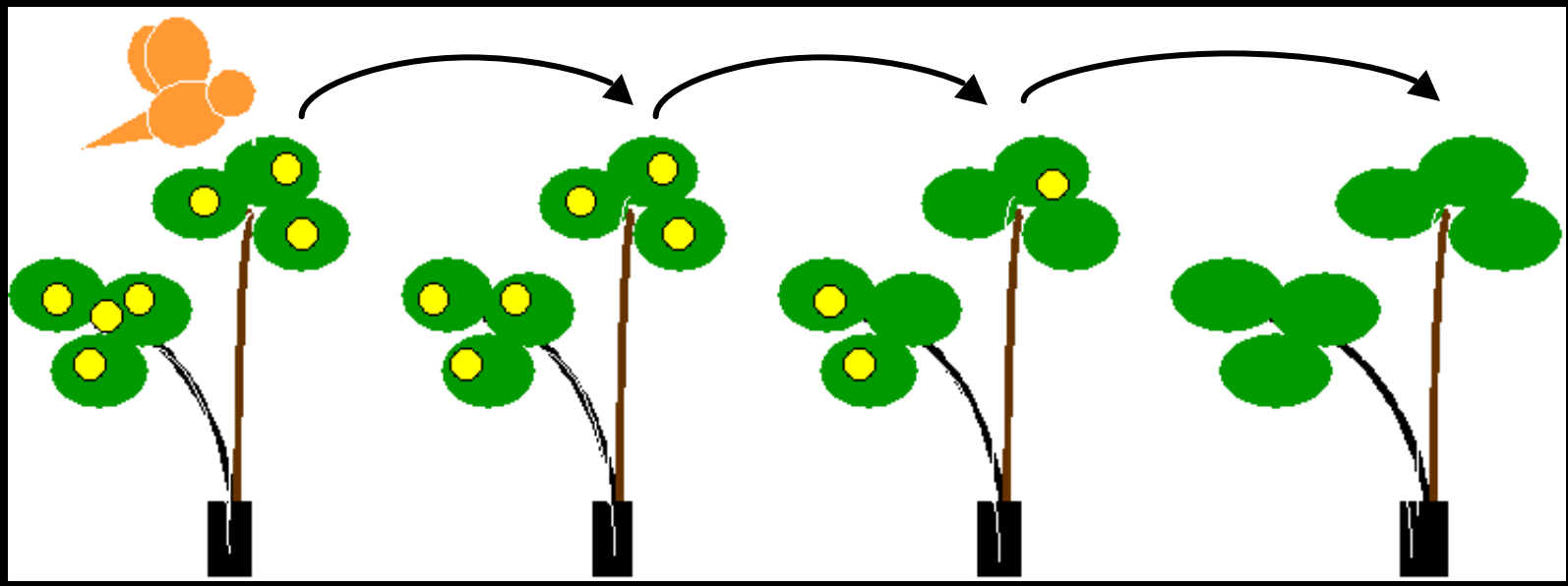
Transmission pathways



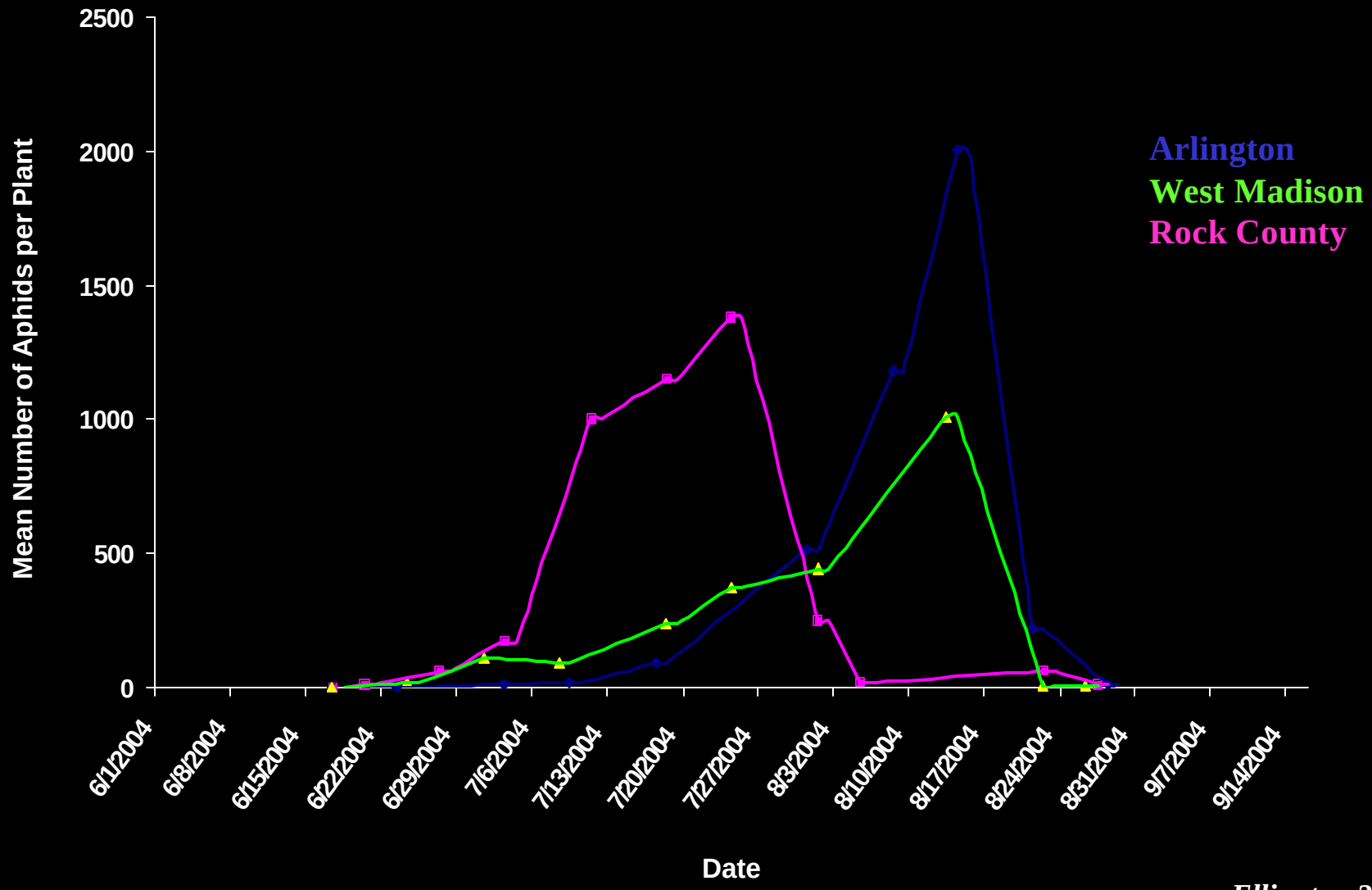


Non-persistent transmission

Acquisition	*Transmission*	*Retention*
seconds	**seconds**	**hours**

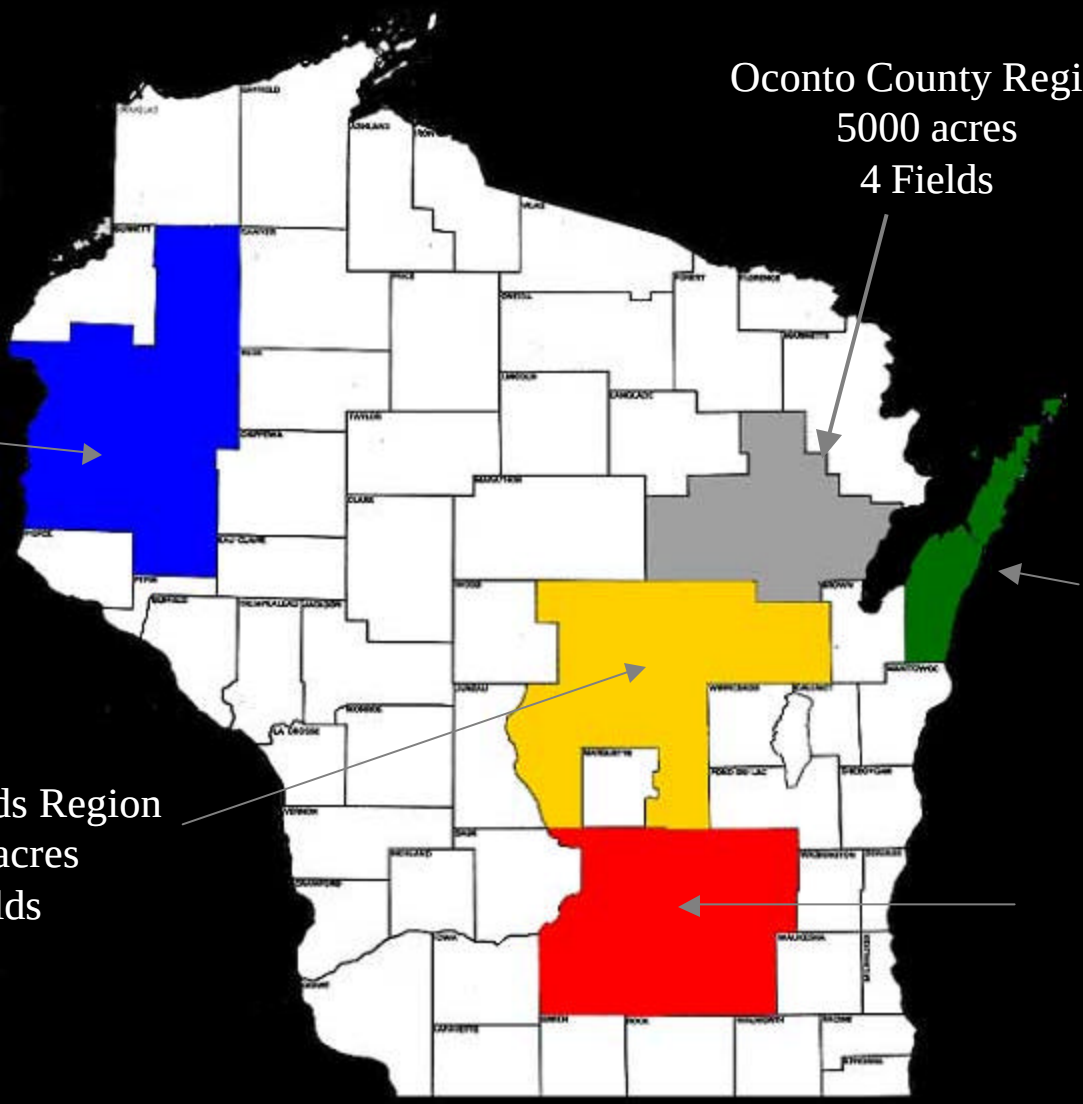


2003 Soybean Aphid Abundance



Ellington 2003

2003 Snap Bean Survey



Oconto County Region
5000 acres
4 Fields

New Richmond Region
8400 Acres
6 Fields

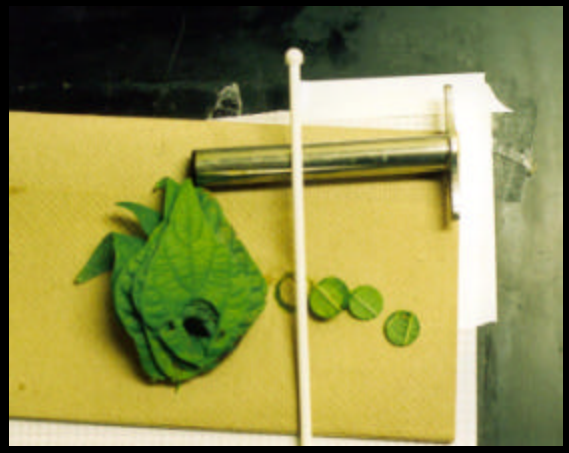
Door County Region
9000 acres
6 Fields

Central Sands Region
33000 acres
8 Fields

Beloit Region
4500 acres
5 Fields

The Process

Stacking samples

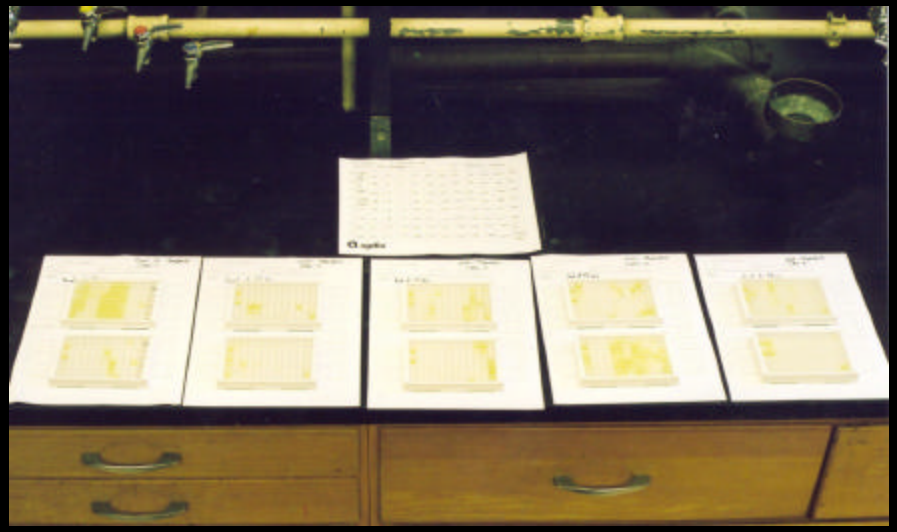


Cork-boring samples

Picking leaf samples

The Process

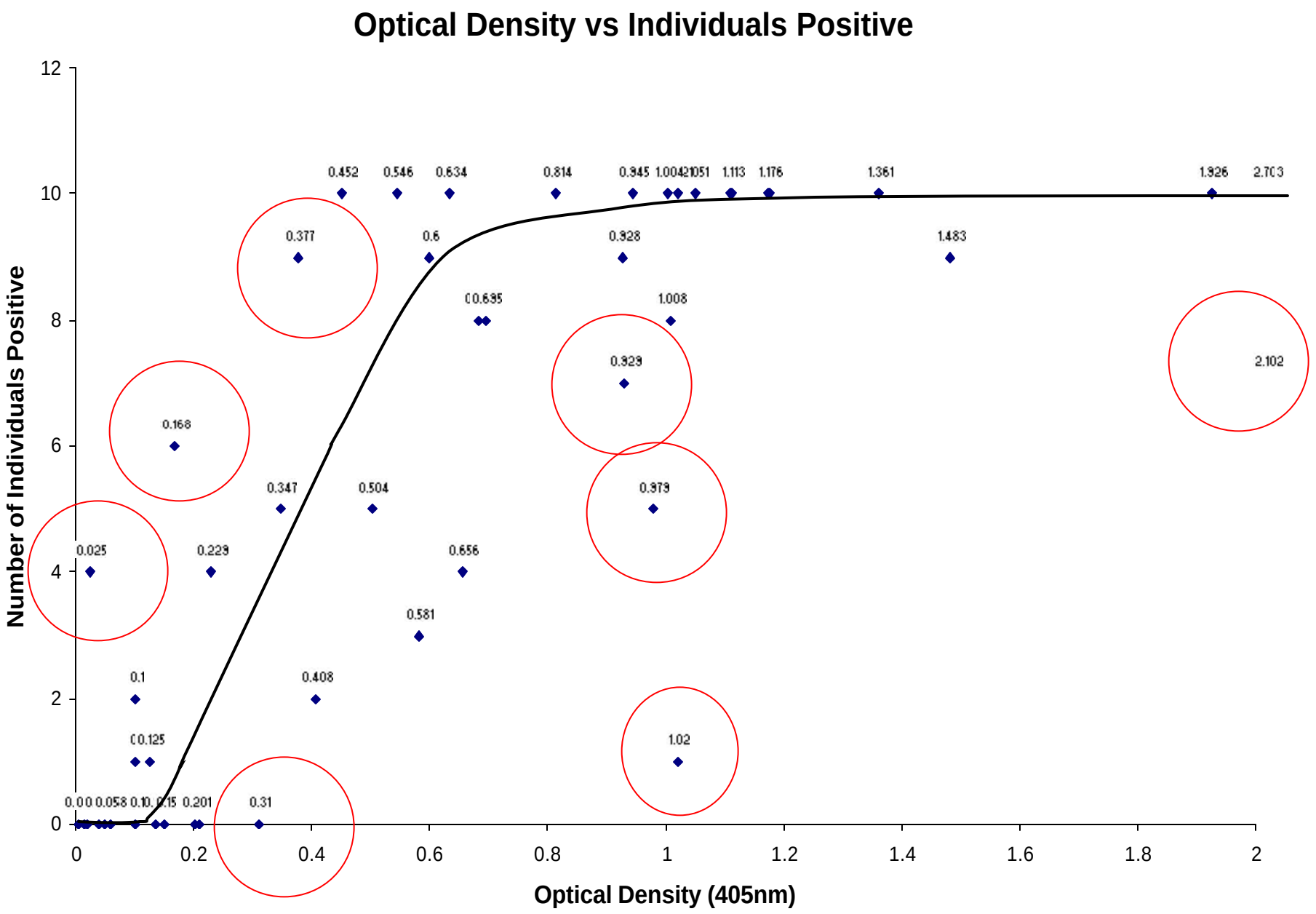
Grinding samples



Plating samples

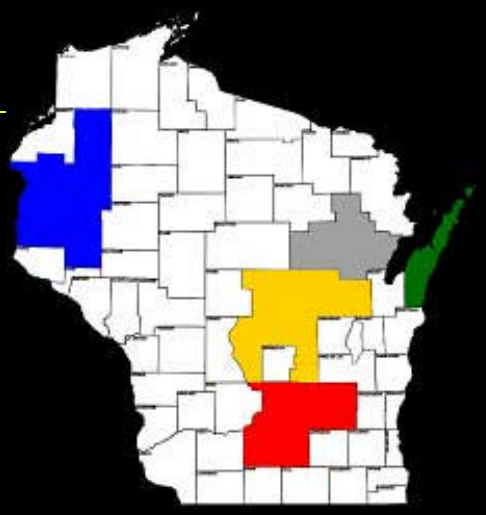
Snap Bean Survey Data

- ~65,000 total leaves tested
- Samples collected from all over the state
- **~25,000 total ELISA wells used**


Optical Density vs Individuals Positive
Number of Individuals Positive
Optical Density (405nm)
0
2
4
6
8
10
12
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0.452
0.546
0.634
0.814
0.945
1.00421051
1.113
1.176
1.361
1.926
2.703
0.377
0.6
0.928
1.483
0.635
1.008
0.929
2.102
0.168
0.347
0.504
0.979
0.025
0.229
0.656
0.581
0.1
0.408
0.125
1.02
0.31
0.201

Viral Reporters

Wisconsin Snap Bean Survey
2002



Percent Infection

100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%

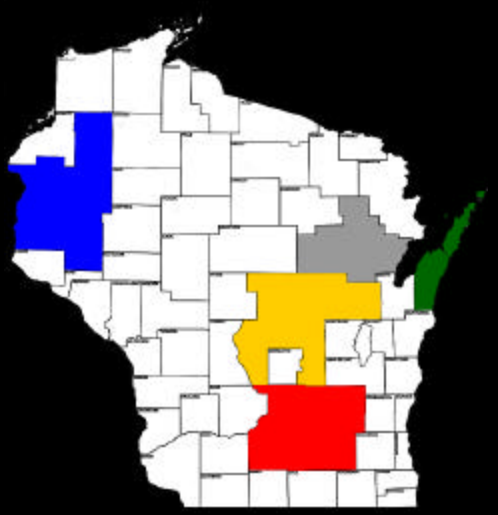
AMV
CMV

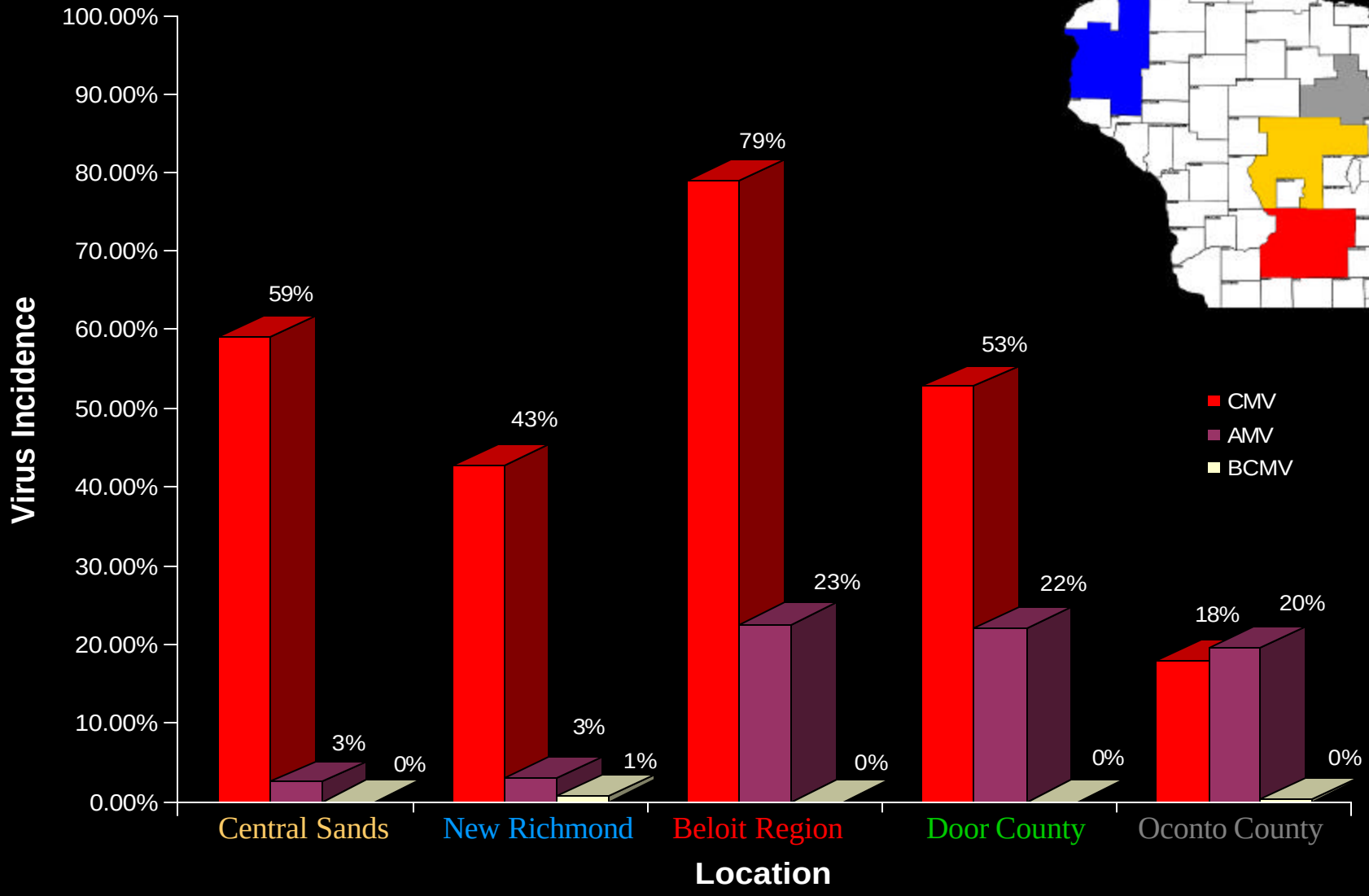
35%
2%
15%
7%
50%
9%
33%
8%
0%
11%

Central Sands
New Richmond
Spring Green
Door County
Oconto County

Location

Wisconsin Snap Bean Survey 2003





Current Research

- Pesticide Application
- Host Resistance
  - Existing Cultivars
  - PI lines & Crosses
- Seed Transmission

Additional Virus Players



- What other viruses are present?
  - Clover Yellow Vein Virus (CYVV)

Future Directions

- Determine the effects of virus on the yield and quality of beans
- Identify useful resistance to virus
- Identify inoculum sources

The Source of Virus Inoculum

- Do weeds that surround fields contain virus?
- Do aphids arrive with or without virus?
- Do seed borne viruses spread at a high rate?

Sow thistle infected with AMV

Future Directions

- Determine the effects of virus on the yield and quality of beans
- Identify useful resistance to virus
- Identify inoculum sources
- Characterize other viruses affecting snap beans

  Other viruses such as CYVV etc

  What the heck is CMV anyway?

  What combinations are affecting symptom expression?

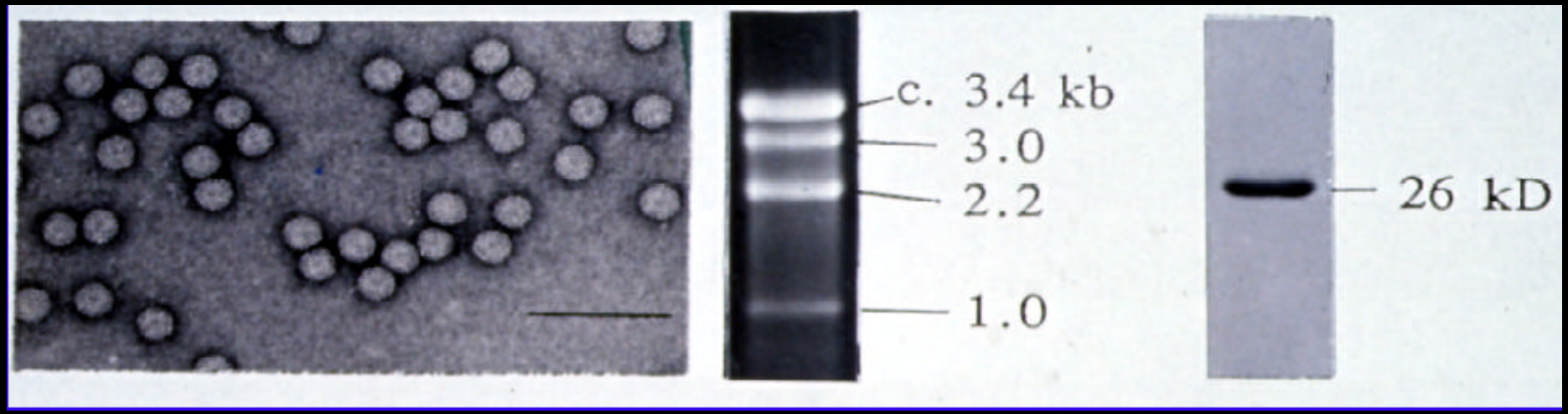
CYVV Symptoms

Cucumber Mosaic Virus

Isometric Virions

Three genomic RNAs

Single Coat Protein




Uninfected
CMV-Fny
CMV-M

CMV-Fny

CMV-M

CMV-M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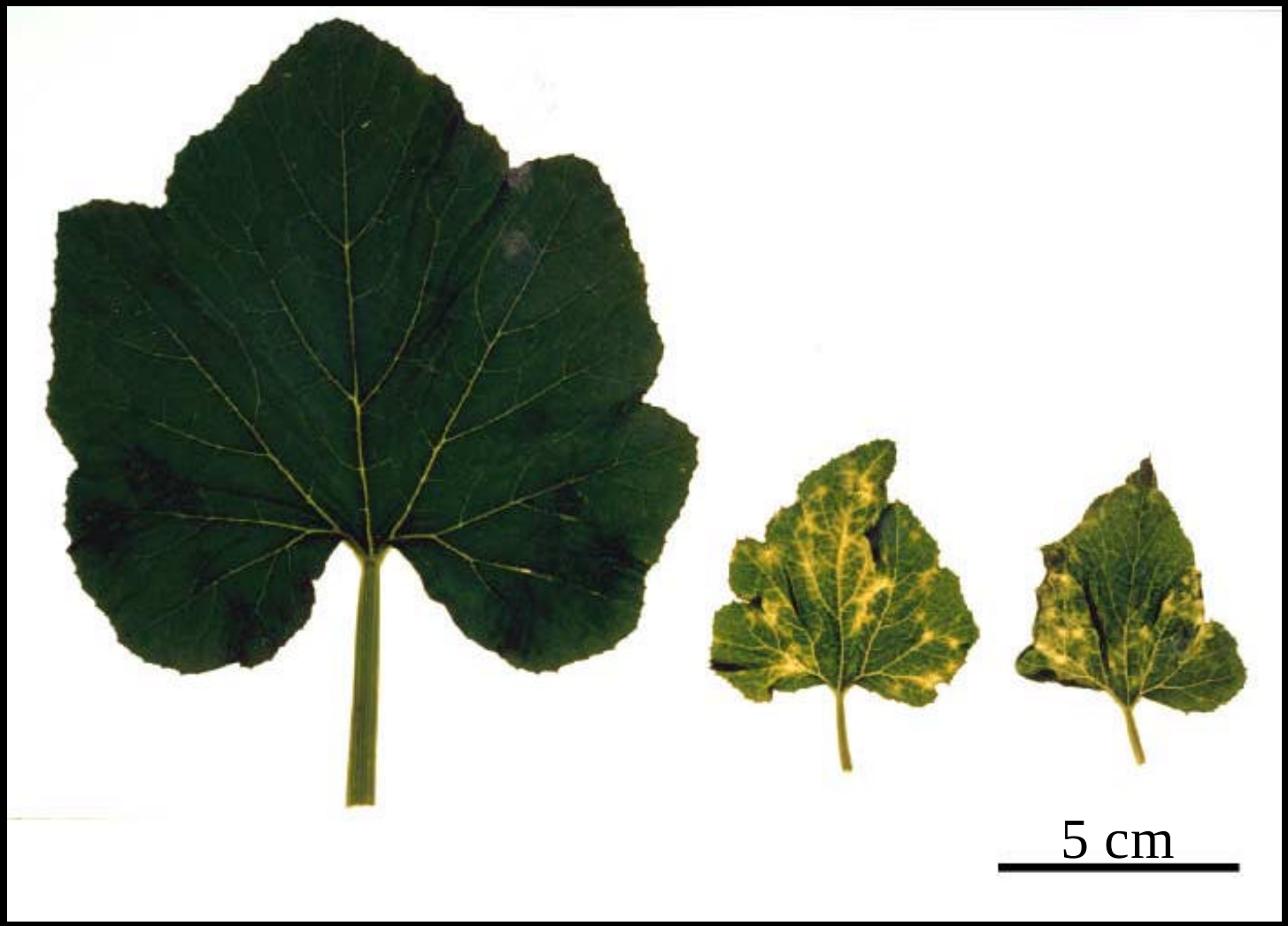
Symptoms on Squash



Future Directions

- Determine the effects of virus on the yield and quality of beans
- Identify useful resistance to virus
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- Characterize other viruses affecting snap beans

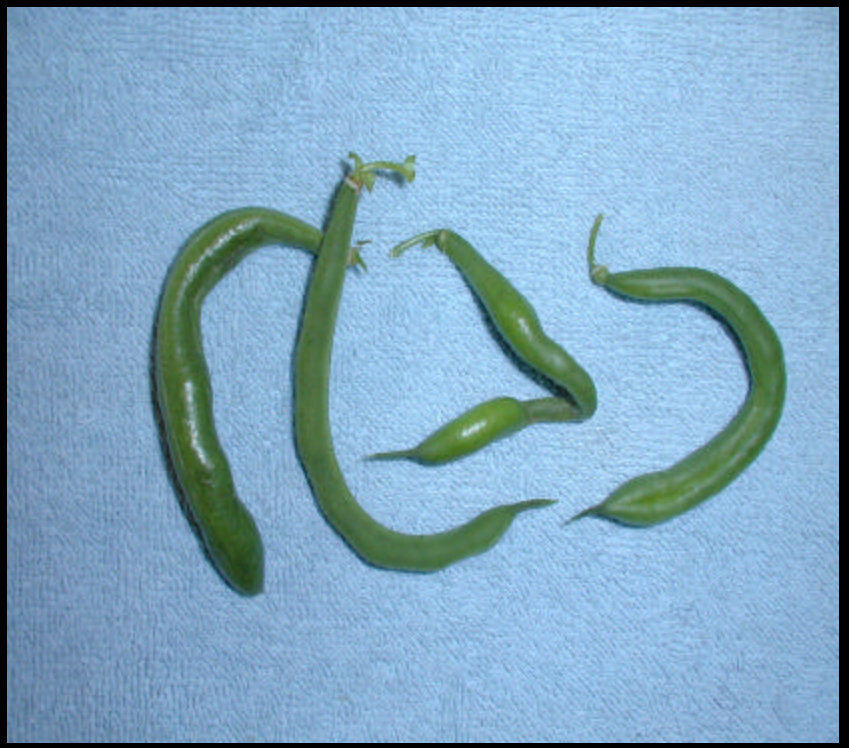
Other viruses such as CYVV etc

What the heck is CMV anyway?

What combinations are affecting symptom expression?

PVX & PVY PVY ONLY PVX ONLY

Brown Spot on Pods



General Summary

- AMV and CMV incidence was extrememely high in all regions of the state
- A general increase in both AMV and CMV from 2002 to 2003
- In both years, virus incidence followed the same trend
  - Highest in south central region
  - Lowest in north eastern region
  - CMV always higher than AMV
    - Except in north eastern region
- 2003 indicated low levels of BCMV in northern regions
- Samples from Illinois were positive for AMV, CMV, and BCMV
- Alternate hosts identified
  - CMV in Pigweed
  - AMV in Alfalfa

Future Directions

- Determine the effects of virus on the yield and quality of beans
- Identify useful resistance to virus
- Identify inoculum sources
- Characterize strains and other viruses affecting snap beans
- Develop IPM procedures
  - Planting date
  - Variety resistance
  - Weed management
  - Pesticide application

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Thank you.

Questions?

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