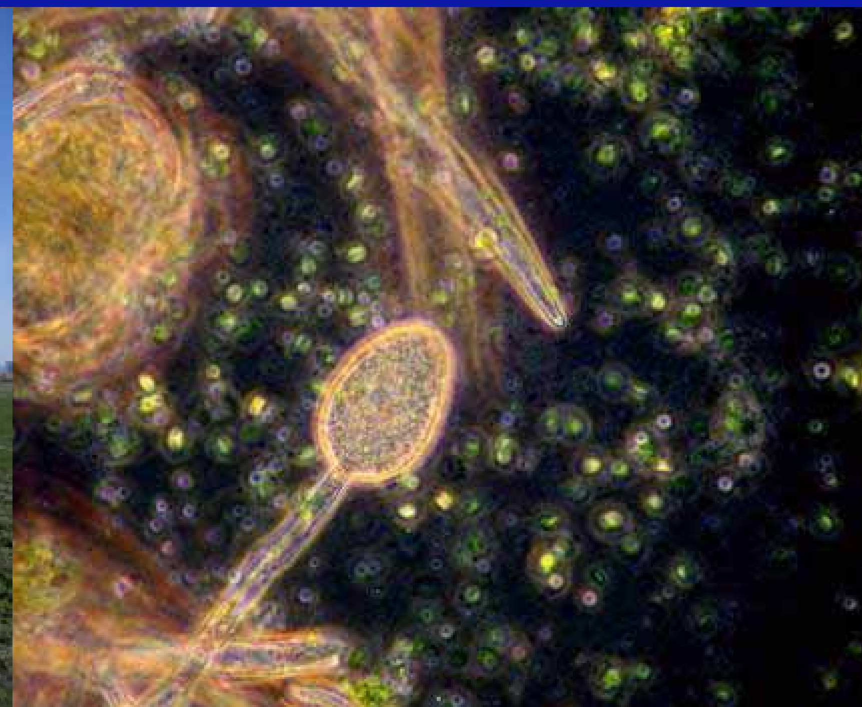
# Plant Diseases of Local and National Concern

*What's wrong with my plants?!*



# Most Common Diseases of Alfalfa In Utah

Spring Black Stem

Verticillium Wilt

Alfalfa Stem Nematode-*Ditylenchus dipsaci*

# Distribution of alfalfa stem nematode in the U.S.

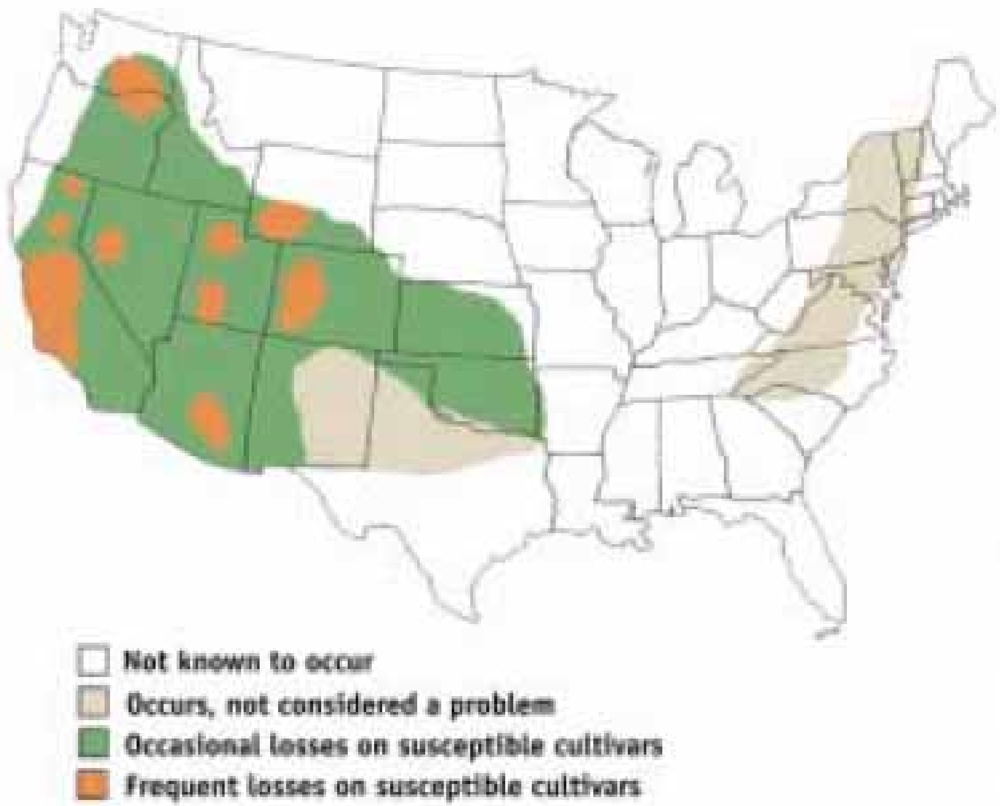
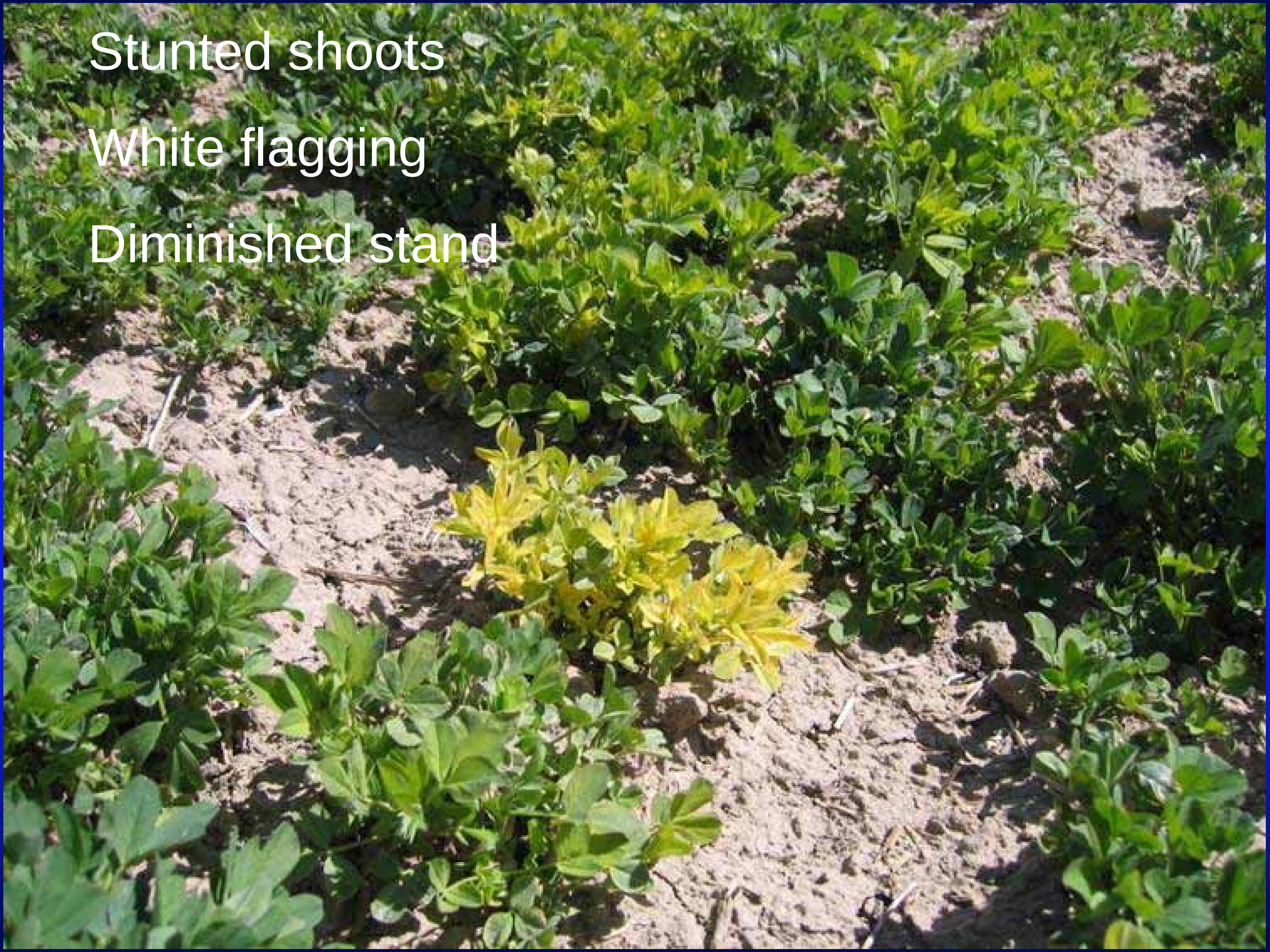



**Figure 1.** Distribution of the alfalfa stem nematode (*Ditylenchus dipsaci*) in the United States.

(Source: Standard Tests to Characterize Alfalfa Cultivars, NAAIC)

# Alfalfa stem nematode symptomology



# Chlorotic white flagged shoots

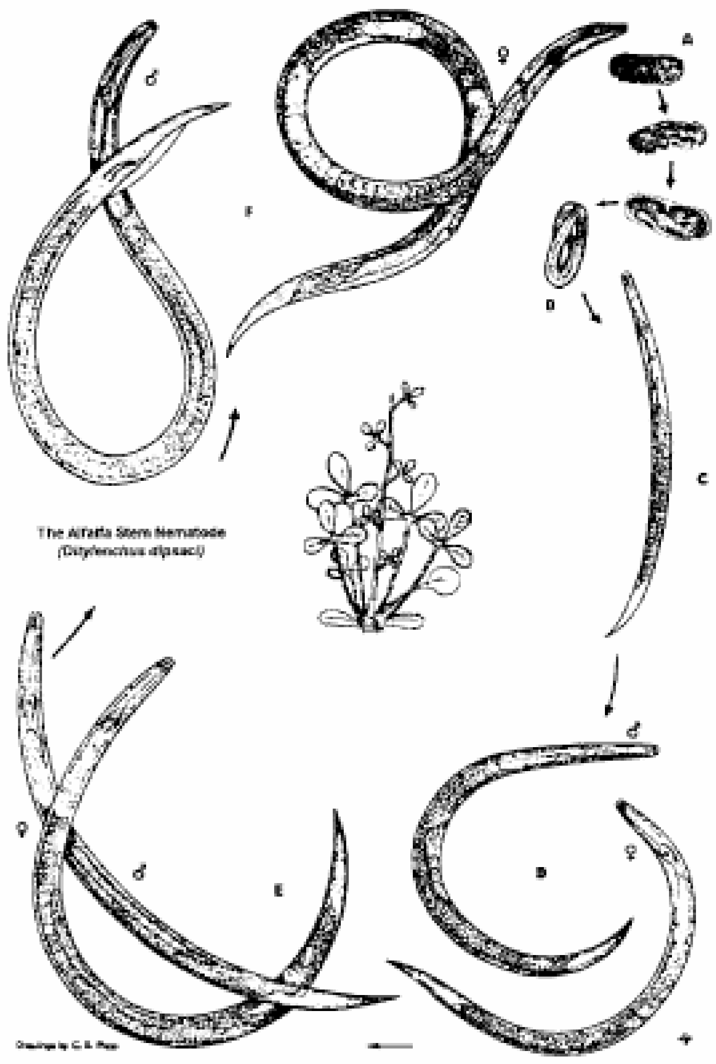



**Figure 2.** Life cycle of the alfalfa stem nematode (*Ditylenchus dipsaci*). A, egg; B, larvae within egg membranes; C,D, and E, second, third, and fourth stage larvae, respectively; F, mature adult male and female.

Completes life cycle in 19-30 days under optimum conditions.

After hatching….all stages are infective.

Fourth stage juvenile survives anhydrobiosis best.

Very small….live mostly inside plants although they will exit to soil for survival if plant is dying.

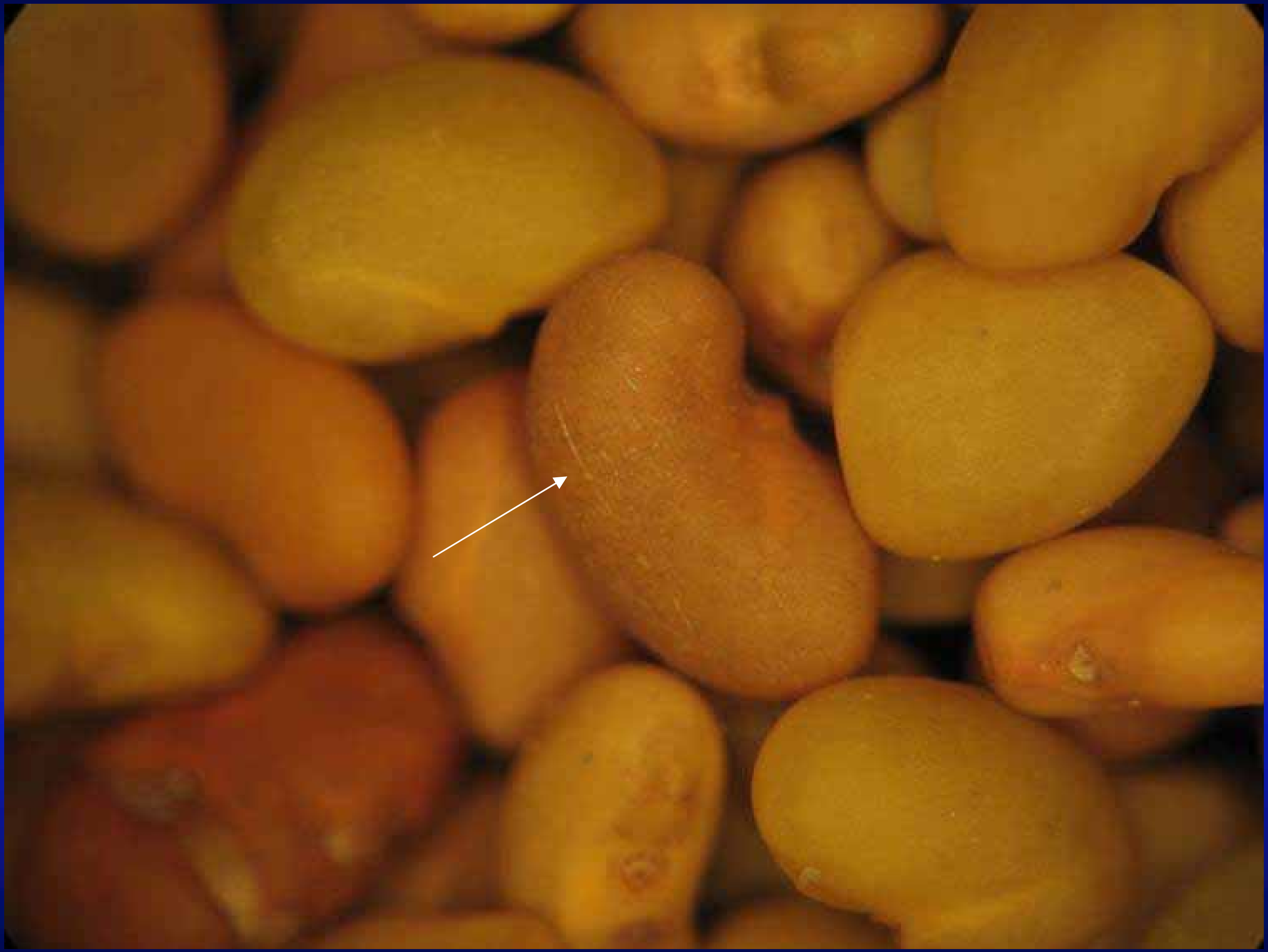
A clean seed sample with sound seed
(no cracked/discolored seed, no debris)

Poorer quality seed, notice color and cracked seeds and debris.

Closer examination shows alfalfa stem nematode dried onto surface of seeds (in a state of anhydrobiosis), see arrow below.

# Same seed sample, more nematodes!

Scarified seed (scratched) looks different, notice straight lines.

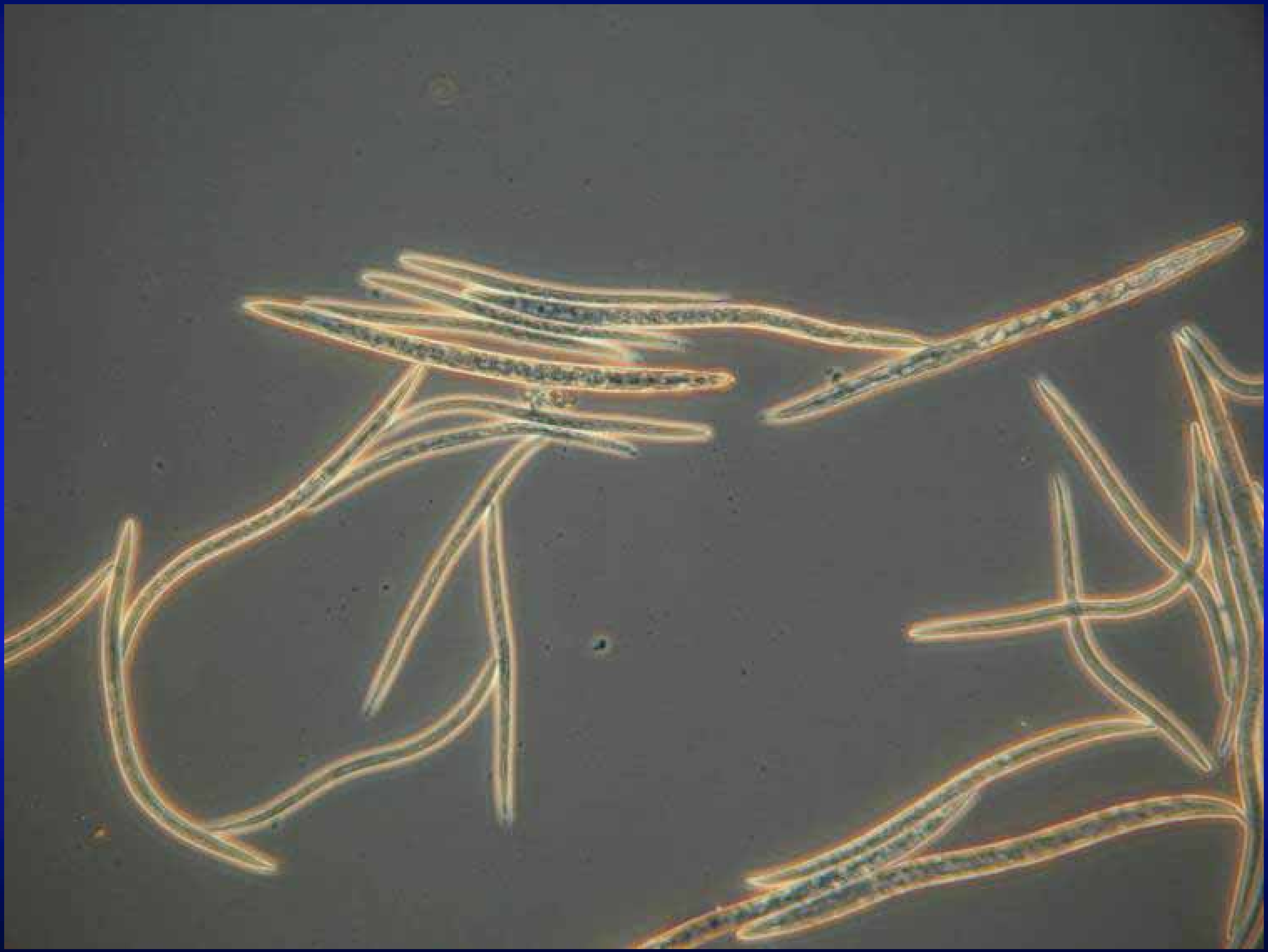


Alfalfa stem nematodes survive best in plant debris in poorly cleaned seed.

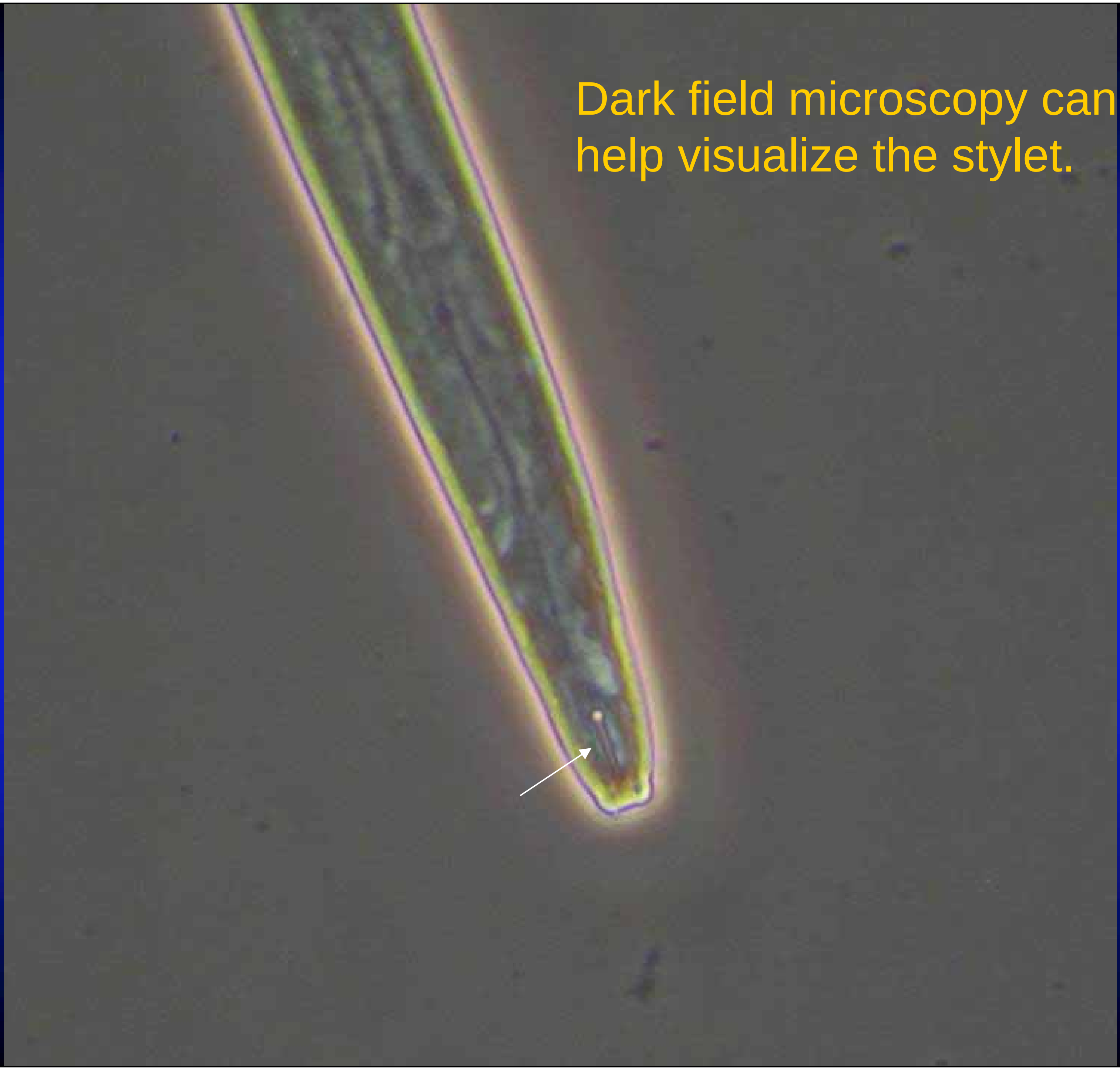
A closer view of nematode infected debris (leaf) in an infected seed sample.

# How many nematodes are in symptomatic leaves???

Answer: More than you imagined and lots of them!



Light transmission photomicroscopy of an alfalfa stem nematode.  Note the very small stylet.


Dark field microscopy can
help visualize the stylet.

# Nematodes enter primordial bud tissue and migrate into developing buds

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.


Physiologic imbalance of growth hormones

Infected stems usually become enlarged and discolored, nodes swell, internodes fail to elongate

Pectinase, propectinase, amylase

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Anything that moves nematode-infested soil or infested alfalfa tissue moves the nematodes…eggs can survive in hay fed to cows….the resulting cows manure can spread the pathogen when spread onto clean fields!

ASN-can infect seed (in a state of anydrobiosis), roots, and crown tissues, even roots on occasion.

ASN-infested plants are often predisposed to infection by other diseases.

## Control

Host resistance-Plant Certified Seed Of Resistant Varieties on clean ground!!

Removal of first cutting eliminates many ASN

Cut when the top 5-8 cm of soil is dry

A 2-3 year rotation with a non-host species such as corn, small grains or beans (DO NOT PLANT SAINFOIN!)

Chemical nematicides (follow labeled instructions)-usually too costly, generally ineffective.  Use of BIOFUMIGANTS?

Fumigating infected seed before planting on clean ground helps to begin with fewer or non-infected seed? Not effective?

Planting clean seed on ASN infested ground leads to infection

Control cont’d

**PLANTING ASN-INFESTED SEED ON CLEAN GROUND LEADS TO INFECTION AS IF NO ROTATION WAS PRACTICED!**

**Clean equipment after cutting an ASN infected field…these rascals can dry right onto the surface of any haying equipment and can be rehydrated when cutting hay on clean ground.**

# New Disease and Old Disease (first the old)

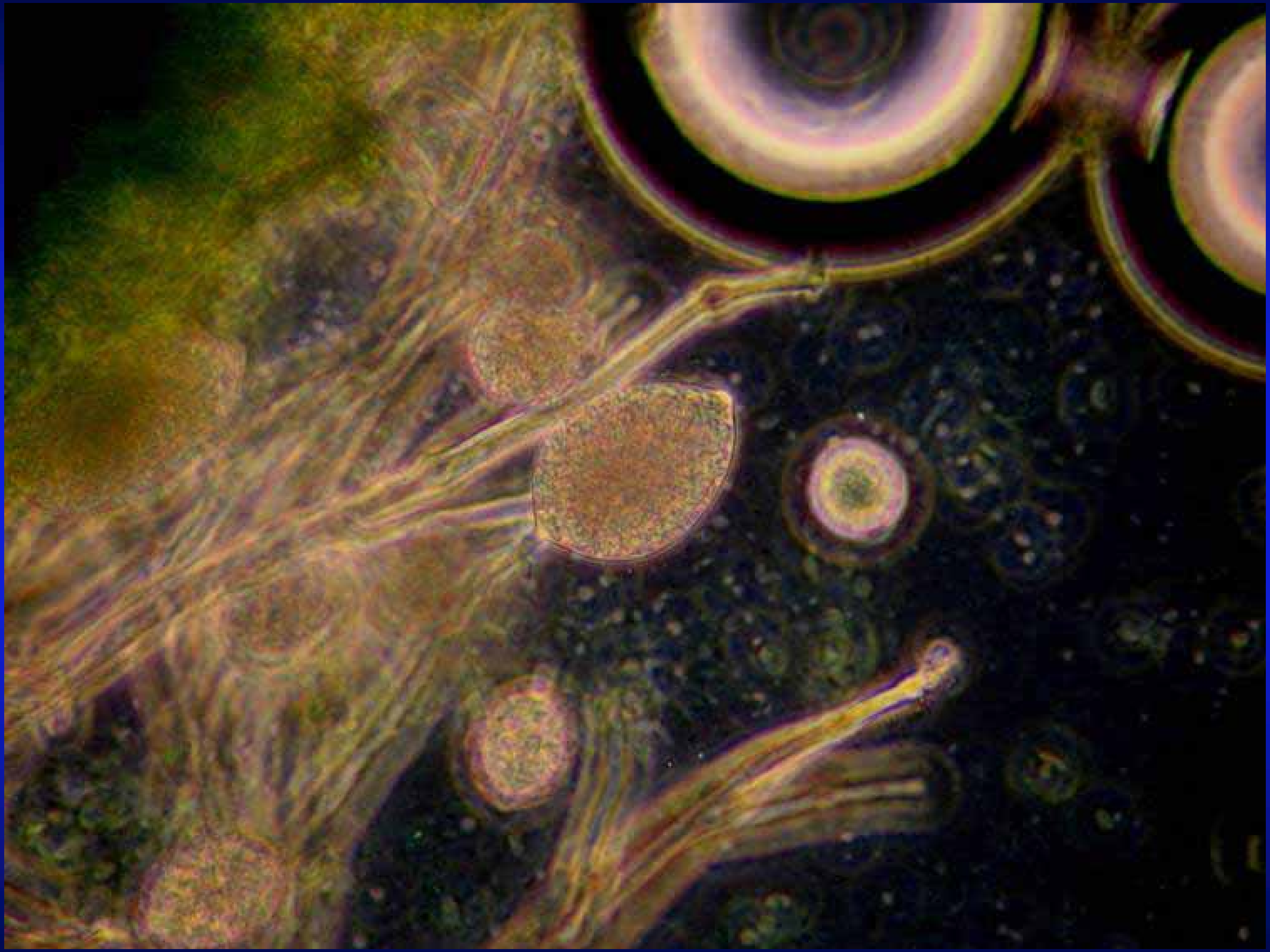
*Phytophthora infestans* on tomato-an old disease that is occurring in some greenhouses around Utah (it's wet this year!).

Sporangia on underside of leaf-enlarged view.

Sporangiophores and sporangia beneath the dissecting scope (on the underside of the tomato leaf).

Spores can move by wind, water, or by mechanical means. They can germinate to directly penetrate the host. Also, we should remember that a sporangium can encyst, then differentiate, and can then germinate releasing motile zoospores (5 to 8 of them)! The zoospores swim to their new host in water!

# A closer view of undifferentiated sporangia of *P. infestans.*



# Just a reminder:

Some natural plant appendages such as this glandular trichome, are not spore bearing structures but are natural appendages of the plant.

Control

Sanitation…..remove infected plants and destroy them (no composting or leaving in cull pile).

Good spacing among plants….provides good air movement in the greenhouse.  No overhead watering!  Minimize or eliminate leaf wetness.  Do not sit plants in common watering source or trays or flats.

Remove nightshade family host plants (egg plants etc.).

Chemical control may be limited for the greenhouse?  If the label does not explicitly rule-out greenhouse application, then it should be OK to use it.

# Cucurbit Yellow Vine Disease (CYVD)

*Serratia marcescens*

# The early research

**Bacteriology**

## Identification, Phylogenetic Analysis, and Biological Characterization of *Serratia marcescens* Strains Causing Cucurbit Yellow Vine Disease

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Accepted for publication 23 April 2003.

Rascoe, J., Berg, M., Melcher, U., Mitchell, F. L., Bruton,
D., and Fletcher, J. 2003. Identification, phylogenetic ana
logical characterization of *Serratia marcescens* strains ca
yellow vine disease. Phytopathology 93:1233-1239.

A serious vine decline of cucurbits known as cucurb
disease (CYVD) is caused by rod-shaped bacteria that
phloem elements. Sequence analysis of a CYVD-specif
chain reaction (PCR)-amplified 16S rDNA product showe
to be a γ-proteobacterium related to the genus *Serratia*. T
characterize the bacteria, one strain each from watermelo
and several noncucurbit-derived reference strains were
sequence analysis and biological function assays. Taxonor
genetic placement was investigated by analysis of the
rDNA regions, which were amplified by PCR and directly s
comparison, eight other bacterial strains identified by othe

**Bacteriology**

## Genotyping of *Serratia marcescens* Strains Associated with Cucurbit Yellow Vine Disease by Repetitive Elements-Based Polymerase Chain Reaction and DNA-DNA Hybridization

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AB

Zhang, Q., Weyant, R., Steigerwalt, A. G., White, L. A., Melcher, U.
Bruton, B. D., Pair, S. D., Mitchell, F. L., and Fletcher, J. 2003. Geno
typing of *Serratia marcescens* strains associated with cucurbit yellov
vine disease by repetitive elements-based polymerase chain reaction an
DNA-DNA hybridization. Phytopathology 93:1240-1246.

The bacterium that causes cucurbit yellow vine disease (CYVD) ha
been placed in the species *Serratia marcescens* based on 16S rDNA an
*groE* sequence analysis. However, phenotypic comparison of the organ
ism with *S. marcescens* strains isolated from a variety of ecologica
niches showed significant heterogeneity. In this study, we compared th
genomic DNA of *S. marcescens* strains from different niches as well a
type strains of other *Serratia* spp. through repetitive elements-base
polymerase chain reaction (rep-PCR) and DNA-DNA hybridization. Wit
the former, CYVD strains showed identical banding patterns despite th

## *Serratia marcescens*, a Phloem-Colonizing, Squash Bug-Transmitted Bacterium: Causal Agent of Cucurbit Yellow Vine Disease

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ABSTRACT

Bruton, B. D., Mitchell, F., Fletcher, J., Pair, S. D., Wayadande, A., Melcher, U., Brady, J., Bextine, B., and Popham, T. W. 2003. *Serratia marcescens*, a phloem-colonizing, squash bug-transmitted bacterium: Causal agent of cucurbit yellow vine disease. Plant Dis. 87:937-944.

Cucurbit yellow vine disease (CYVD), which can inflict heavy losses to watermelon, pumpkin, cantaloupe, and squash in U.S. production areas from the midwest to northeastern states, causes phloem discoloration, foliar yellowing, wilting, and plant decline. Bacteria were cultured from the phloem of crown sections of symptomatic plants of *Citrullus lanatas* and *Cucurbita pepo*. Those bacteria testing positive in CYVD-specific polymerase chain reaction (PCR) were all gram negative and appeared morphologically identical, producing creamy white, smooth, entire, convex colonies on Luria-Bertani or nutrient agar. Characterized cucurbit-derived strains of *Serratia marcescens* were introduced into greenhouse-grown squash plants by puncture inoculation and into field-grown squash plants by enclosure with *S. marcescens*-fed squash bugs, *Anasa tristis*. Up to 60% of the bacteria-inoculated plants in the greenhouse and up to 17% of field plants caged with inoculative squash bugs developed phloem discoloration and tested positive for *S. marcescens* by CYVD-specific PCR. None of the controls developed phloem discoloration or tested positive by PCR. Of the diseased field plants, 12% (2 of 35) also yellowed, wilted, and collapsed, exhibiting full symptom development of CYVD. However, neither plant collapse nor decline was observed in the greenhouse-grown, puncture-inoculated plants. The morphology, growth habit, and PCR reaction of bacteria cultured from crown tissue of a subset of plants in each experimental group were indistinguishable from those of the inoculum bacteria. Evidence presented from our studies confirms that the squash bug can transmit *S. marcescens*, the CYVD causal bacterium. The *S. marcescens–A. tristis* relationship described here is the first instance in which the squash bug has been identified as a vector of a plant pathogen. Our experiments represent a completion of the steps of Koch's postulates, demonstrating that *S. marcescens* is the causal agent of CYVD and that the squash bug, *A. tristis*, is a vector of the pathogen.

Additional keywords: *Coreidae, Heteroptera,* vine decline

Early studies provided evidence that the disease was likely insect transmitted (8). For example, CYVD-symptomatic watermelon plants often were aggregated in small patches (12) and weekly insecticide applications significantly reduced the incidence of CYVD (8). In watermelon and cantaloupe fields of 5 ha or more, the incidence of CYVD was generally greater in perimeter rows than in the middle of the field. Bextine et al. (2) demonstrated that CYVD could be prevented in squash field plots by using mesh row-cover fabric to exclude insects. Several insect species initially were tested as potential vectors, although these preliminary studies failed to positively confirm or exclude any particular insect (25). Empirical evidence continued to implicate the squash bug *Anasa tristis* (DeGeer) as a vector of CYVD. Historically, although it never has been reported as a pathogen vector, the squash bug has been a serious pest of cucurbits, particularly squash and pumpkin. Its pest status and biology are reviewed elsewhere (21). In contrast to previous reports, squash bugs also can be an extremely serious pest of watermelon in Oklahoma and Central Texas (13,23,24,28), an area subject to severe outbreaks of CYVD (7). Pair et al.

Zhang, Q., Weyant, R., Steigerwalt, A. G., White, L. A., Melcher, U., Bruton, B. D., Pair, S. D., Mitchell, F. L., and Fletcher, J. 2003. Genotyping of *Serratia marcescens* strains associated with cucurbit yellow vine disease by repetitive elements-based polymerase chain reaction and DNA-DNA hybridization. Phytopathology 93:1240-1246.

Cucurbit yellow vine disease (CYVD) was first observed in squash (*Cucurbita maxima*) and pumpkin (*C. pepo*) in 1988 in Oklahoma and Texas (7), but is now known to affect other cucurbits, including watermelon and cantaloupe. The disease has been confirmed in Arkansas (J. C. Correll, *personal communication*), Tennessee (4), Massachusetts (26), Kansas (N. A. Tisserat, J. Fletcher, and B. D. Bruton, *unpublished data*), Colorado (B. D. Bruton, *unpublished data*), and Nebraska (R. M. Harveson and B. D. Bruton, *unpublished data*). Affected plants exhibit characteristic symptoms of yellowing, stunting, gradual decline, and phloem discoloration. Losses can range from less than 5 to 100% in affected fields.

Disease symptoms consistently are associated with the presence in the phloem of a rod-shaped, gram-negative bacterium, detected using transmission electron microscopy (7). The bacterium was cultured, and Koch's postulates were completed by mechanical inoculations and by transmission via an insect vector, the squash bug, *Anasa tristis*, confirming that this bacterium is the causal agent of CYVD (6).

Two CYVD pathogenic strains, W01-A and Z01-A, were originally isolated from diseased watermelon and zucchini, respectively. Sequence analysis of 16S rDNA and *groE* gene fragments of these two strains indicated that they shared more than

Infected squash will begin to yellow and suddenly collapse.

A preliminary diagnosis of a stem cut very close to the soil surface shows yellow discoloration in the vascular tissues….the symptoms diminish further up the stem away from the soil surface.

Yellow discoloration of CYVD infected pumpkin cut near soil surface.

# What do we know about CYVD?

The bacterial pathogen is a rod shaped gram-negative bacterium ….for the most part it is not pathogenic to humans but strains in the same species can be pathogenic to some people (eg. HIV compromised persons). The bacterial species is known to be pathogenic to some insects.

Pathogenic on squash, melons, cucumbers….cucurbits!

Vectored by the squash bug……so control your insects. Squash bugs like to lay their eggs on squash plants…..being used to bait the bug away from other cucurbits to spray them there for control.

Is it here in Utah? We don't know…..I think so…probably…we need molecular diagnostic confirmation and to conduct Koch's postulates.

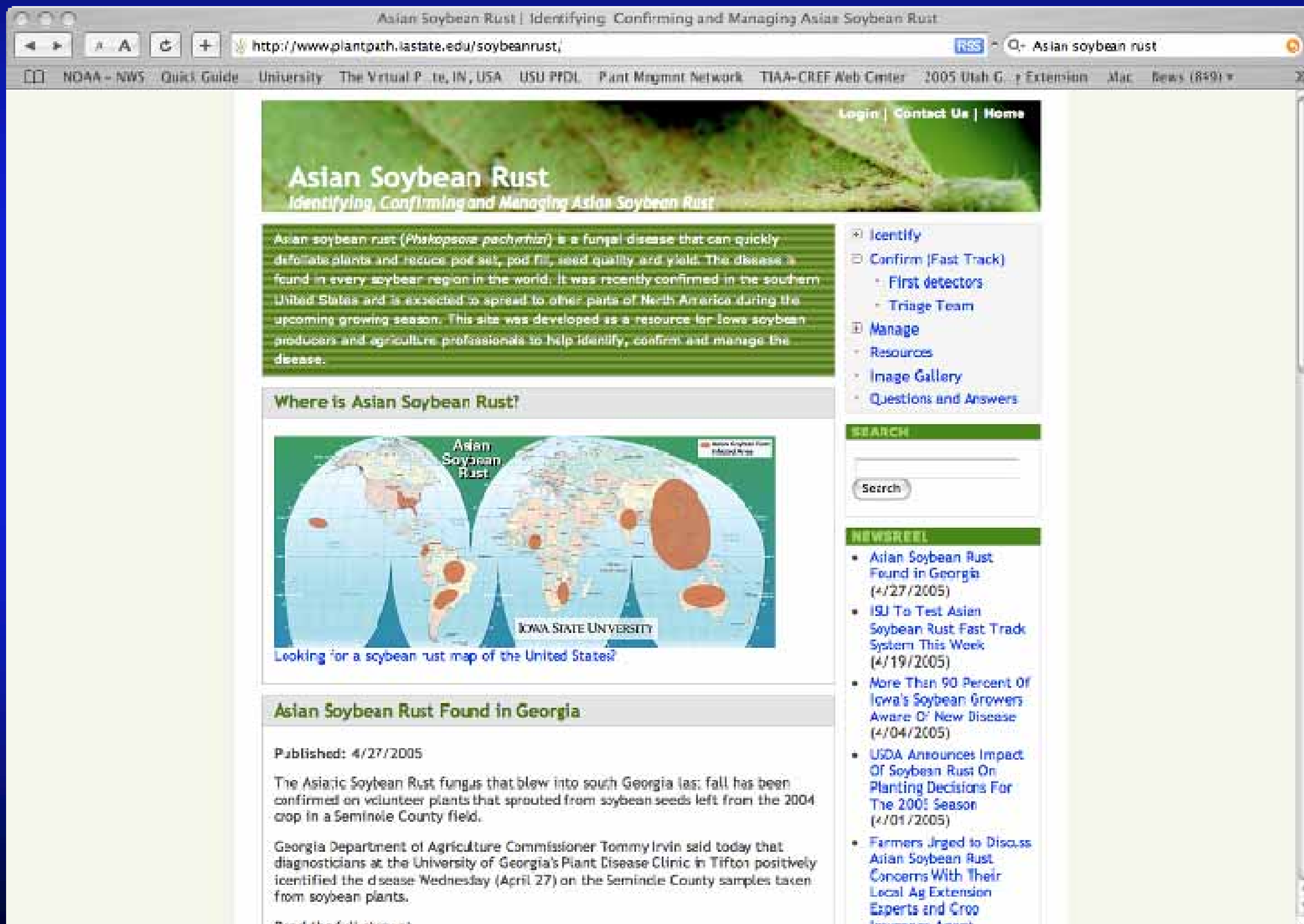
# Diseases of National Concern (for Utah?)

## Sudden Oak Death (SOD)

http://www.suddenoakdeath.org

# Asian Soybean Rust

http://www.plantpath.iastate.edu/soybeanrust/



# Common characteristics of both diseases:

Both are considered new diseases

Both pathogens have a very wide host range….and they are getting wider for SOD (Jasmine is the new host of the month)!

Both are important to the agriculture of the U.S.

Both are capable of moving from infected areas to uninfected areas

Both are known to have economic impacts but both diseases are potentially more ecological damaging than anyone is currently admitting (more realization for SOD at this time).

# Can these diseases occur in Utah?

Never say never, if the conditions are right (adequate moisture, suitable host, inoculum of the pathogen) it can/will happen.  I hope neither pathogen gets to Utah!

Thank You!

Drive safely!