Effect of Soil pH on Wheat Diseases

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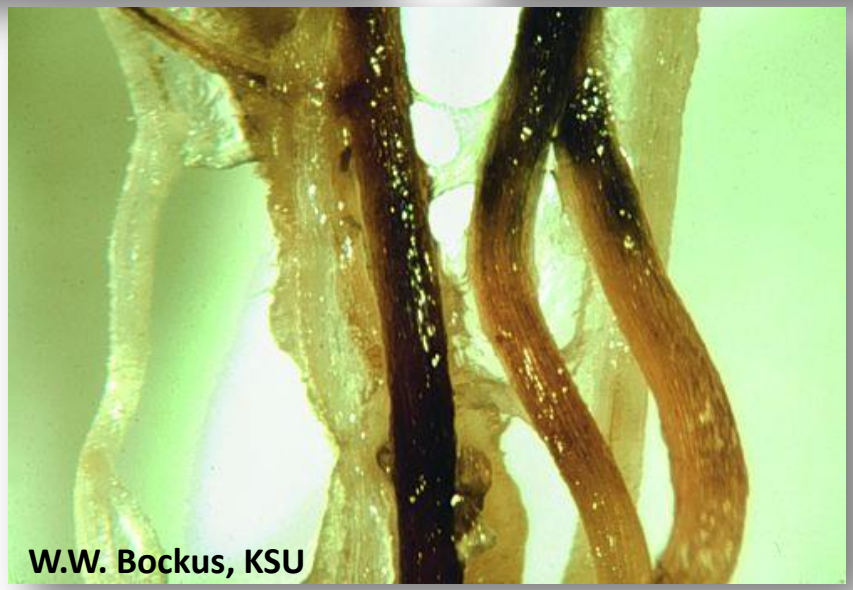
Fungal Diseases of Wheat in the PNW

	Common name	Pathogen
	Stripe rust	*Puccinia striiformis*
✓	Eyespot	*Oculimacula yallundae, O. acuformis*
✓	Cephalosporium stripe	*Cephalosporium gramineum*
	Rhizoctonia root rot	*Rhizoctonia solani, R. oryzae*
✓	Fusarium foot rot	*Fusarium culmorum, F. pseudograminearum*
	Pythium seed/root rot	*Pythium spp.*
	Snow molds	*Typhula ishikariensis, Microdochium nivalis*
✓	Take-all	*Gaeumannomyces graminis*
	Soilborne wheat mosaic	*Wheat soilborne mosaic virus*
	Stem rust	*Puccinia graminis*

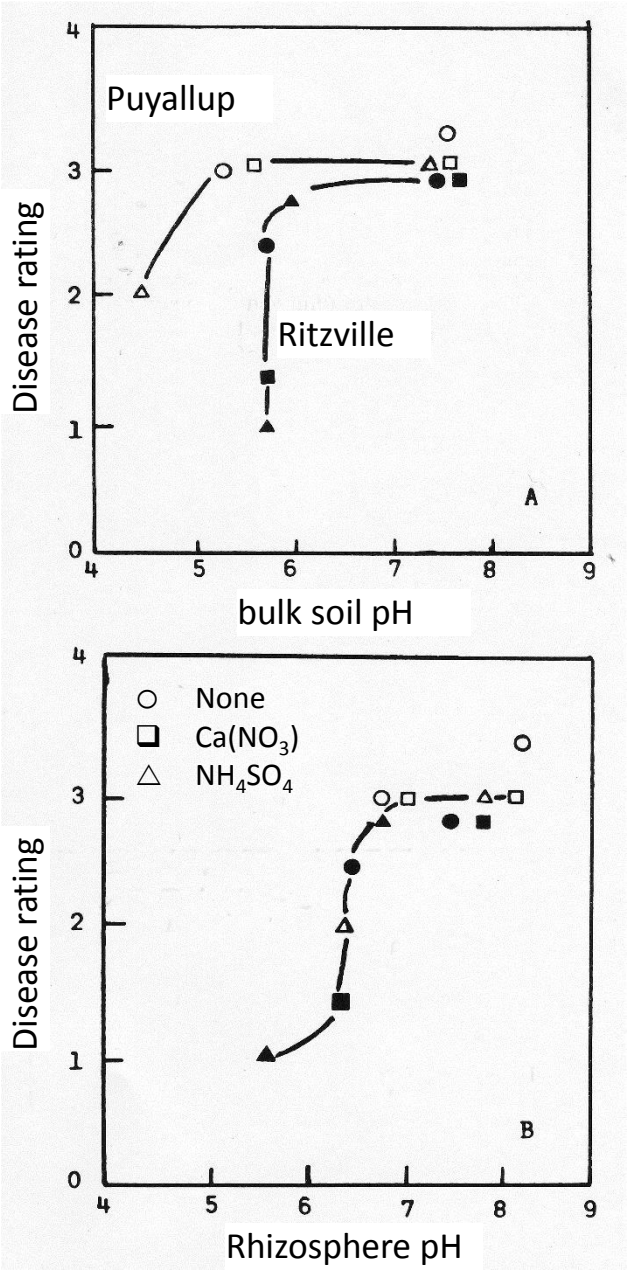
Take-All



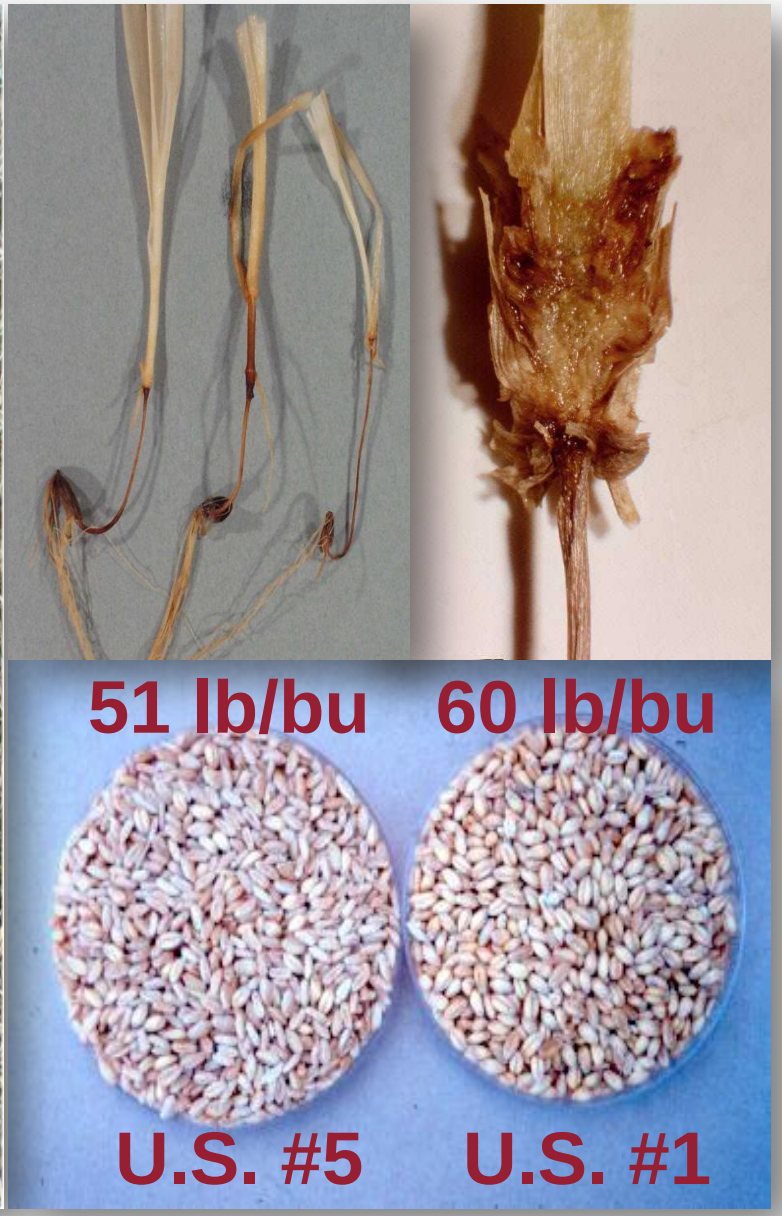
Influence of Soil pH on Take-all

Smiley & Cook, 1973:

- Disease severity is related to soil pH and form of nitrogen
- Disease increases with increasing pH
- Generally, NH_4-N resulted in lower pH and less disease than NO_3-N, especially in the rhizosphere



Fusarium crown rot



Courtesy of R. Smiley

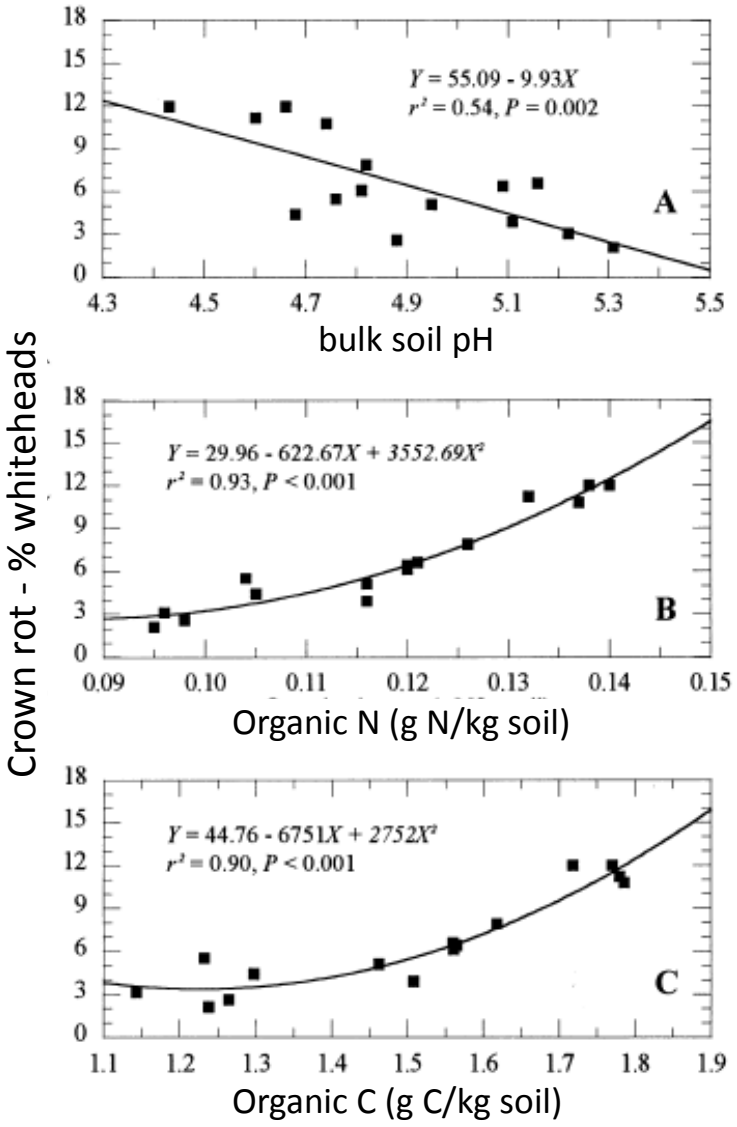
Fusarium Crown Rot

Courtesy of T. Paulitz

Influence of Soil pH on Fusarium Crown Rot

Smiley et al., 1996:

- Long-term plots at Pendleton; pH changes due to N fertilization
- Soil pH inversely proportional to rate of applied N, organic N & C
- Disease inversely proportional to soil pH

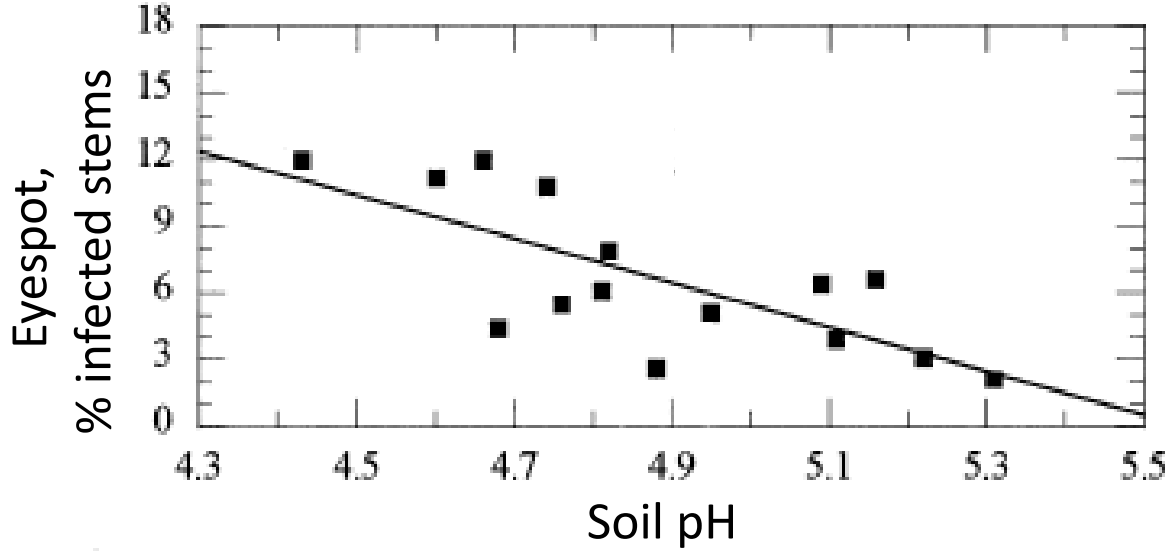


Eyespot or Strawbreaker Foot Rot

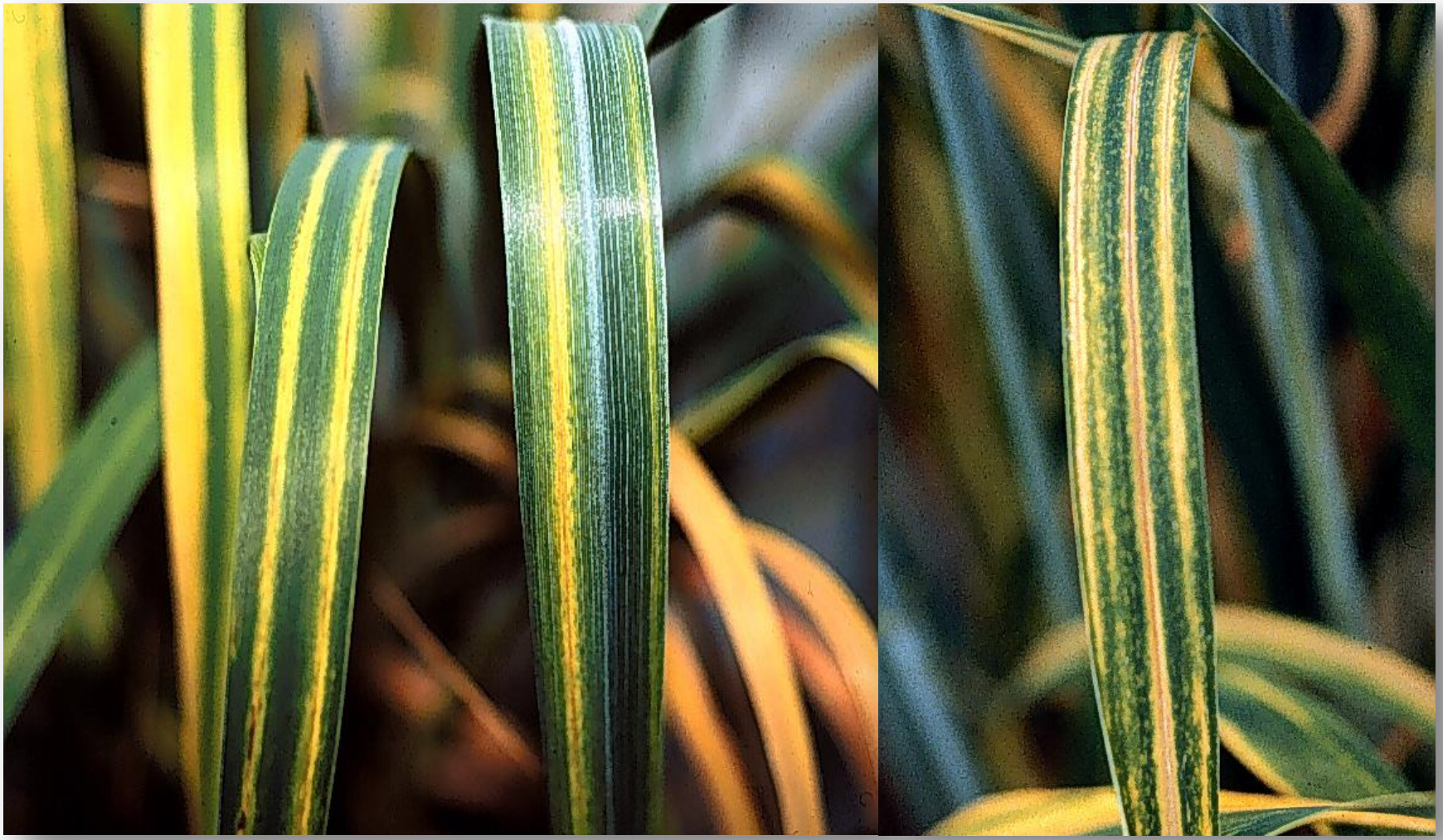
Influence of Soil pH on Eyespot

Smiley et al., 1996: Incidence of eyespot inversely proportional to soil pH from 4.6 -5.2

- **only report in the literature**
- **no data provided ➔ size of response not known**



Cephalosporium stripe



Cephalosporium Stripe

Influence of Soil pH on Cephalosporium Stripe

WA 1964:

- antibiotic production by *C. gramineum*

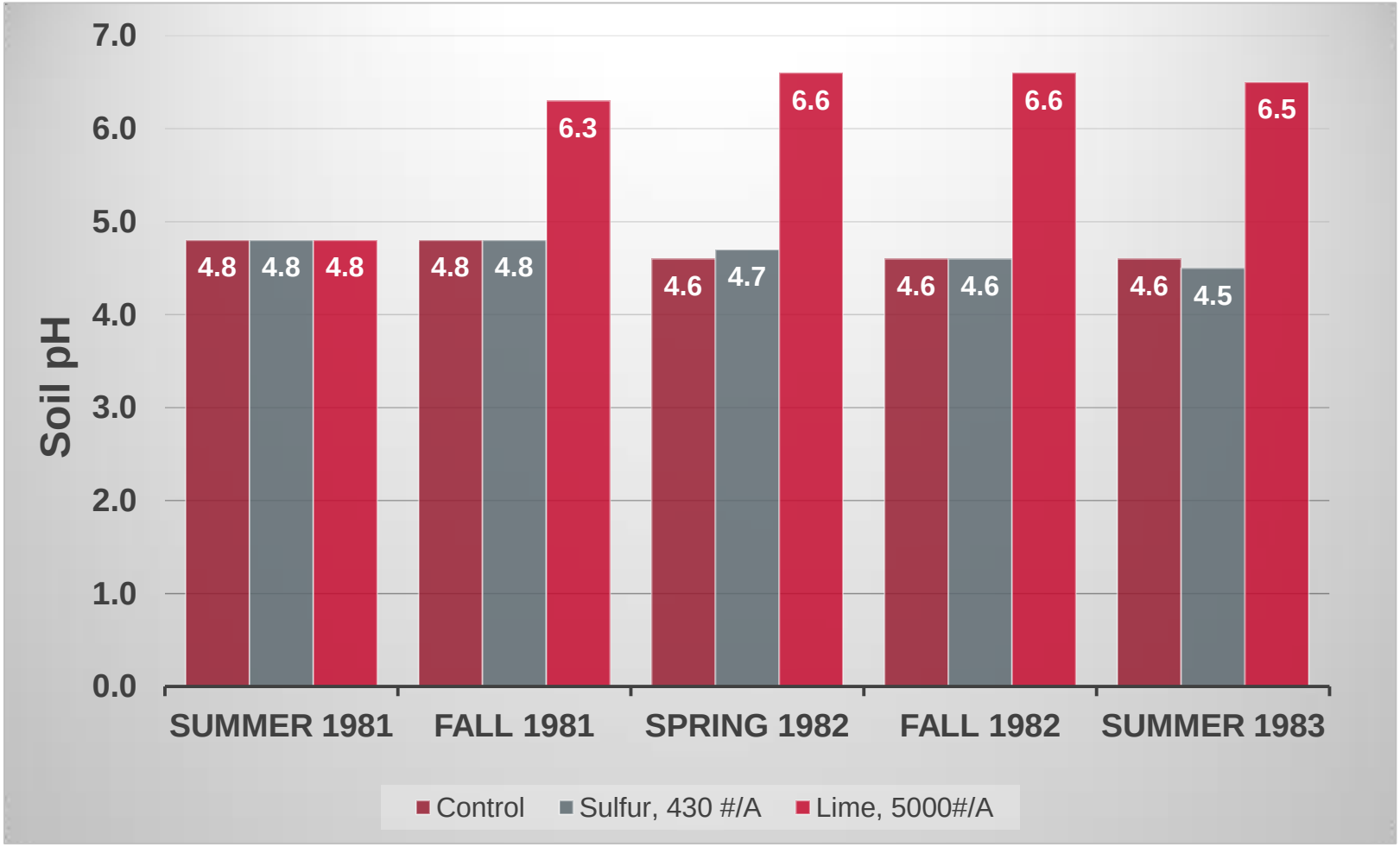
WA 1968:

- survival of *C. gramineum* enhanced at low soil pH

KS 1985:

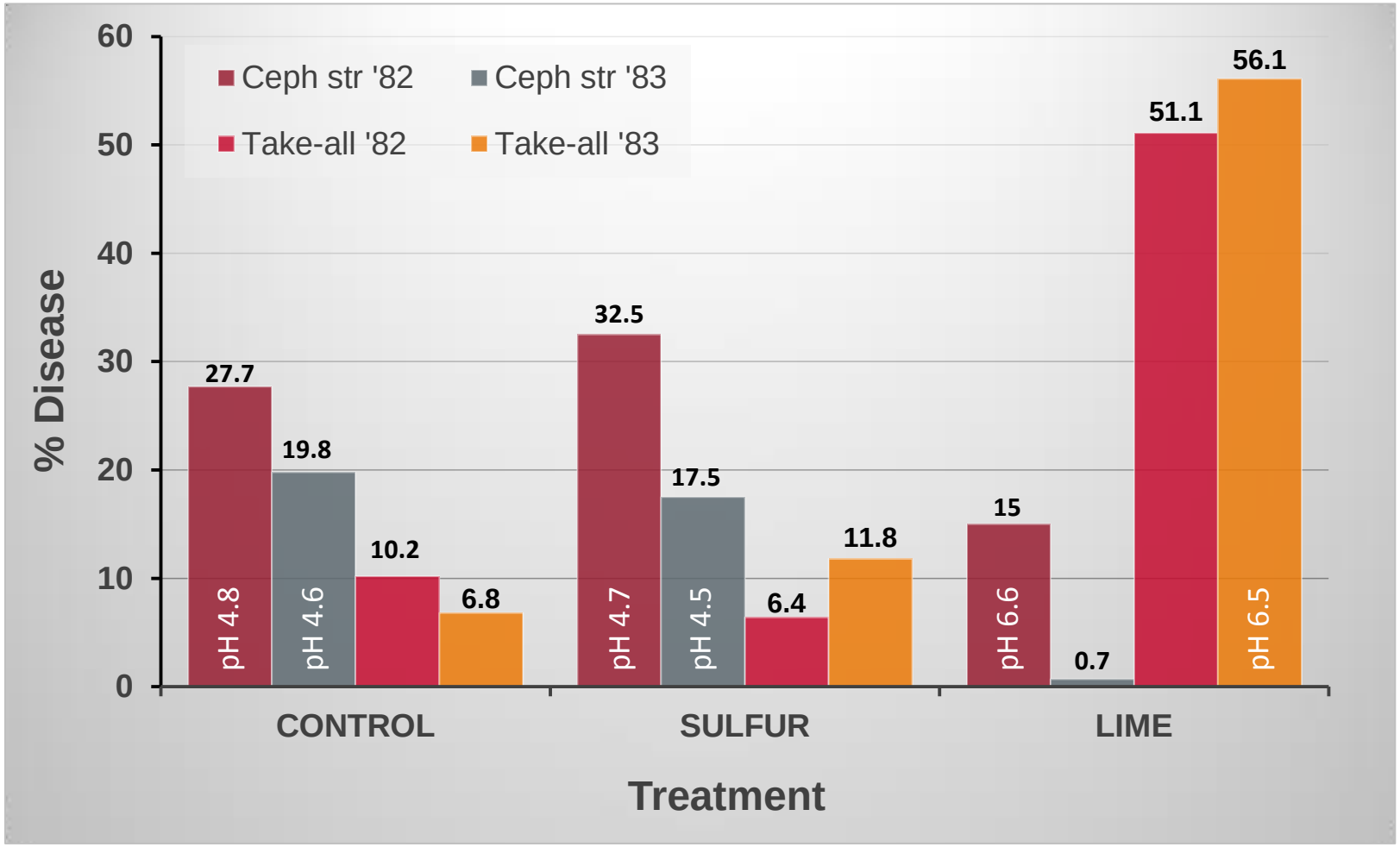
- low soil pH favors disease development

Effect of Soil pH on Cephalosporium Stripe and Take-all



Bockus & Classen, 1985

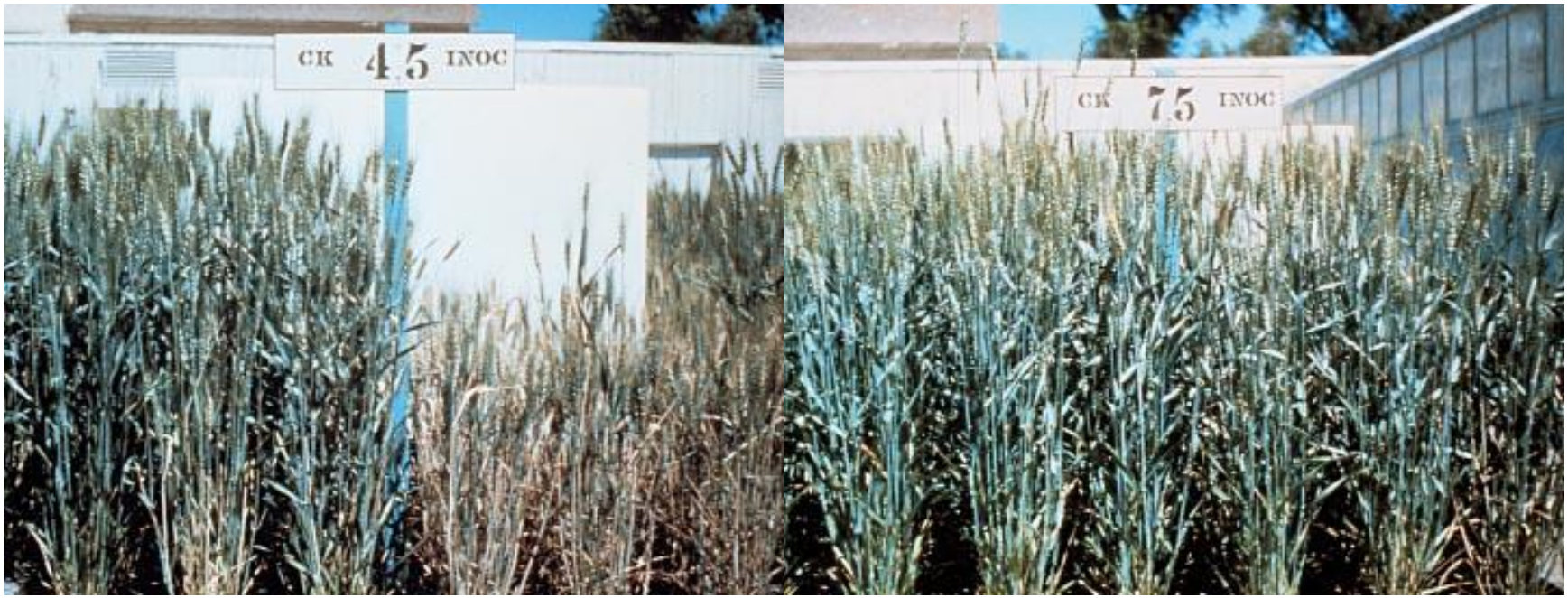
Effect of Soil pH on Cephalosporium Stripe and Take-all



Bockus & Classen, 1985

Influence of Soil pH on Cephalosporium Stripe

➔ **Confirm pH response in Washington**



Control **Inoculated** **Control** **Inoculated**

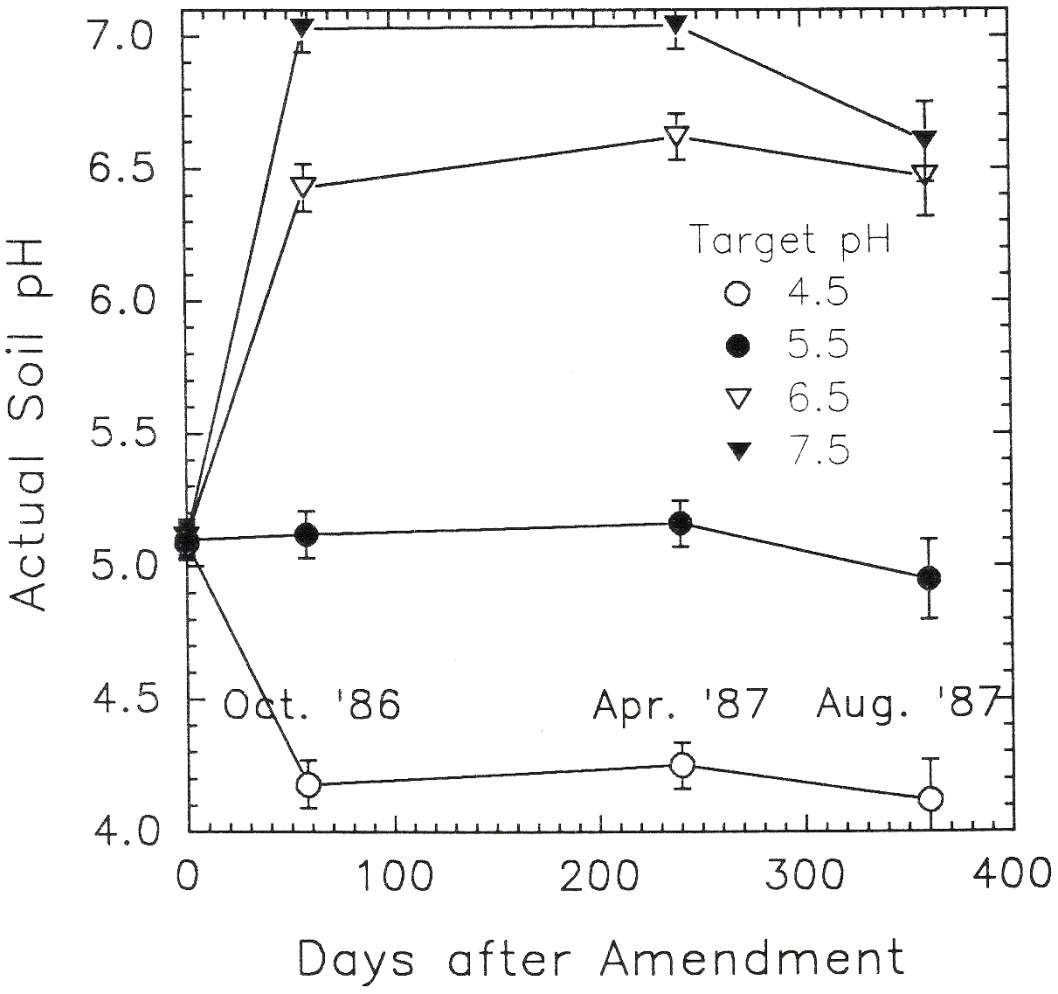
pH 4.5 **pH 7.5**

Love & Bruehl, 1987

Soil pH after Amendment with Lime or H_2SO_4

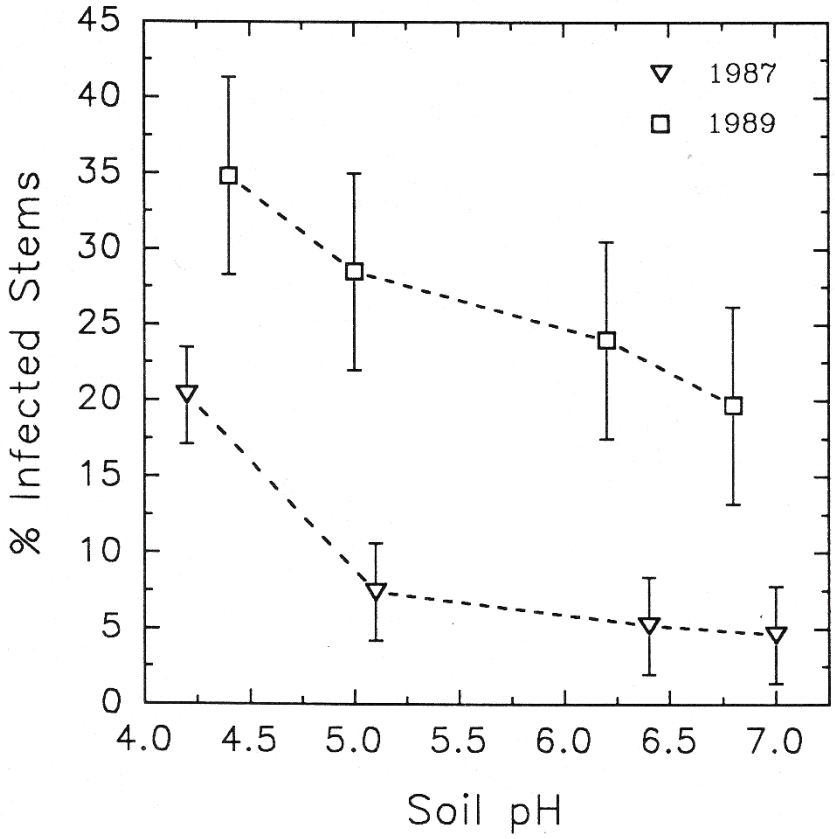
➔ Confirm the effect of soil pH on Cephalosporium stripe under PNW field conditions

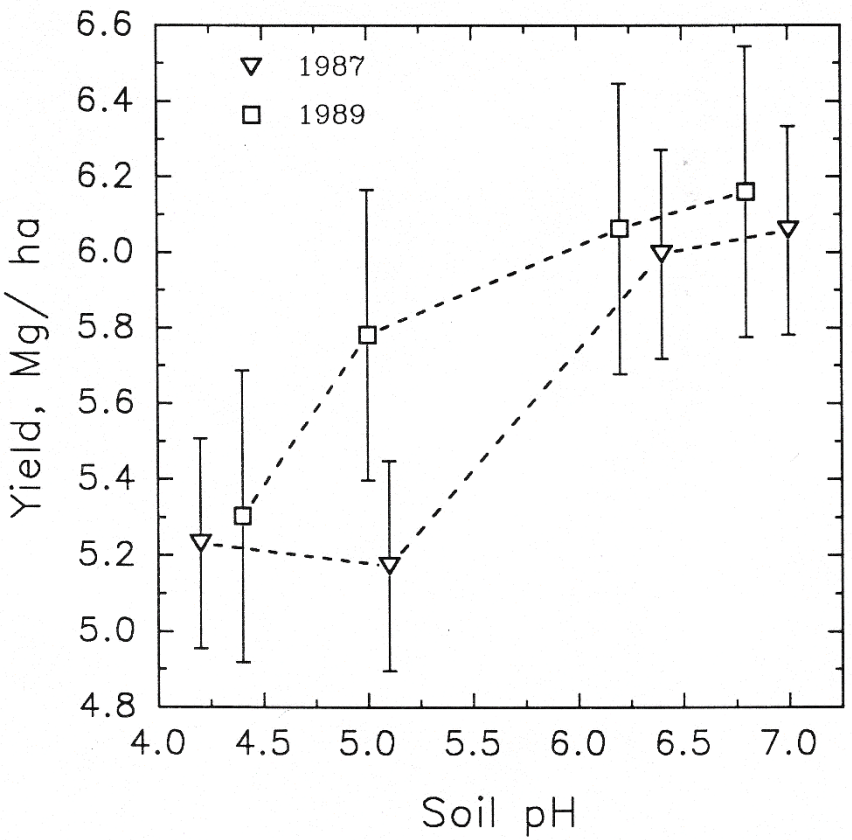
- Adjust soil pH by adding acid or lime



WSU Plant Pathology Farm, Pullman, WA

Incidence of Cephalosporium Stripe in Relation to Soil pH





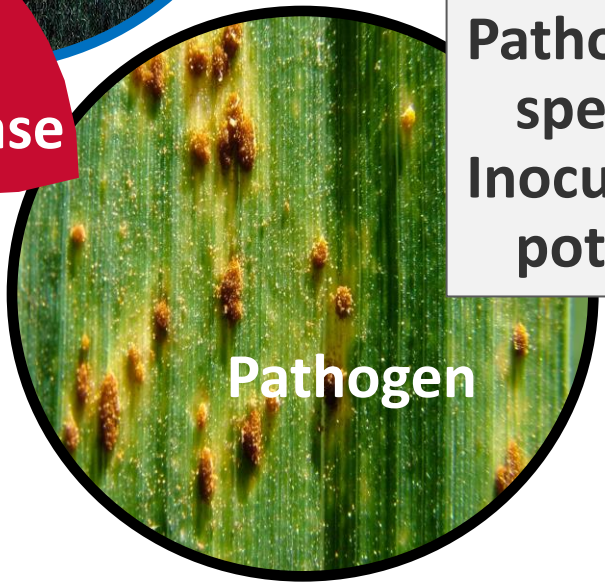
Mean of 3 cultivars (Brevor, Nugaines, Daws) in 1987 and 2 cultivars (Daws, Stephens) in 1989

‘Disease Triangle’

Temperature
Moisture
Soil pH

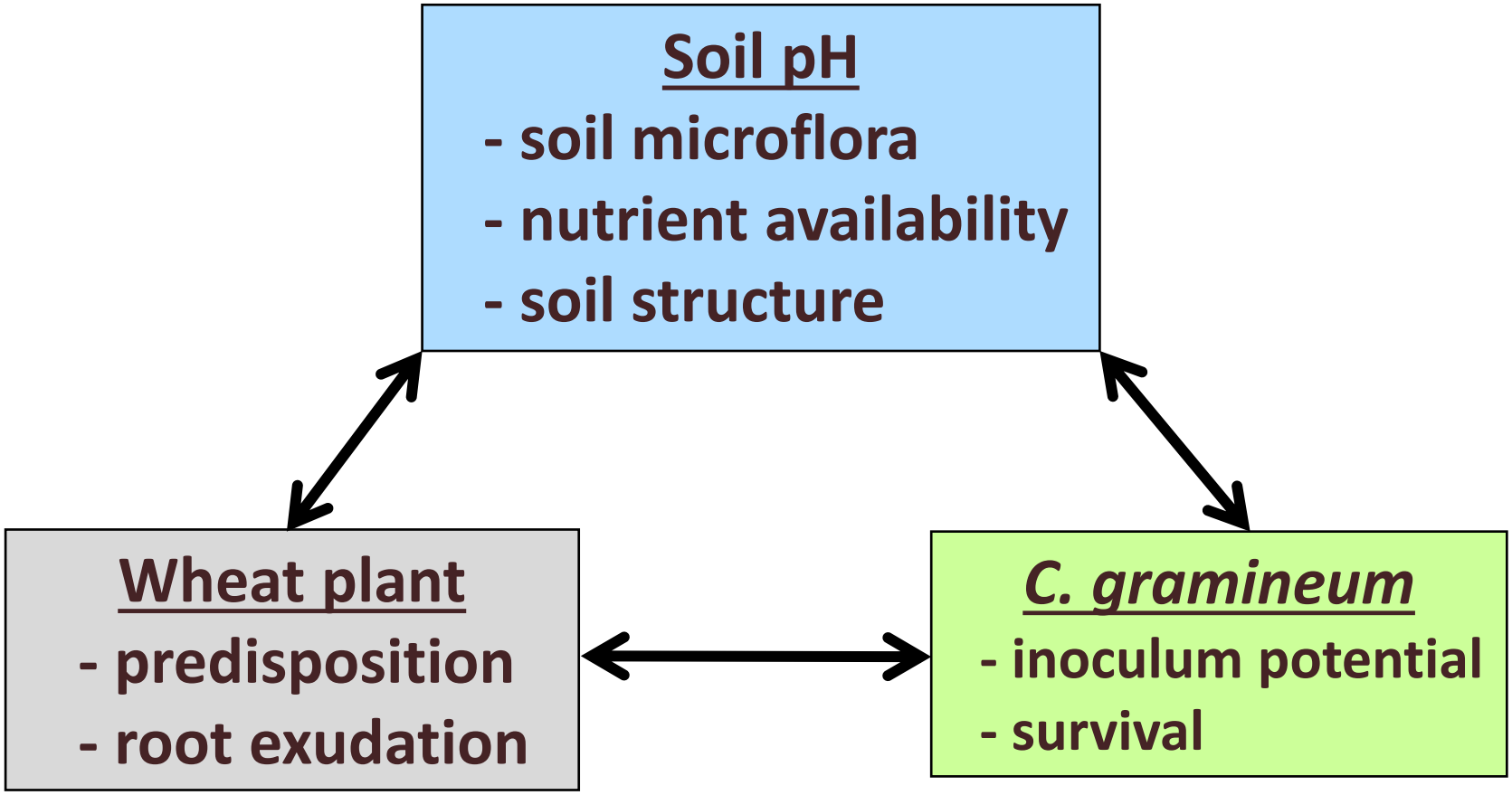
Resistance
Susceptibility

Disease



Virulence
Pathogenic specialization
Inoculum potential

Influence of Soil pH on Cephalosporium Stripe

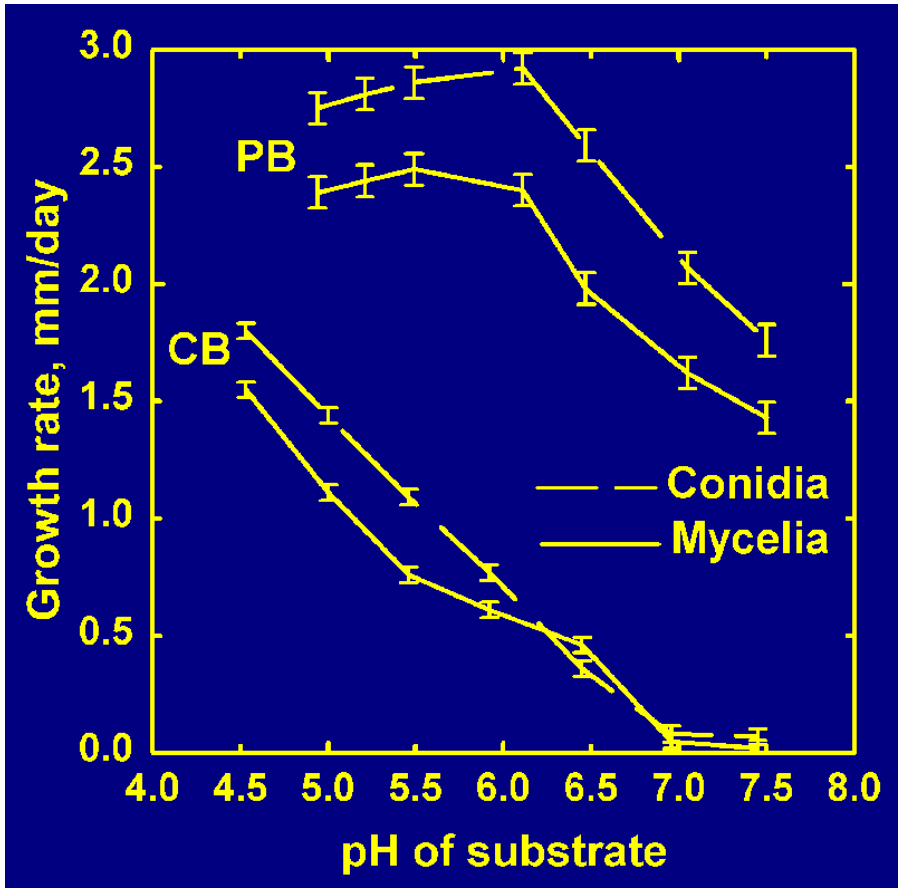


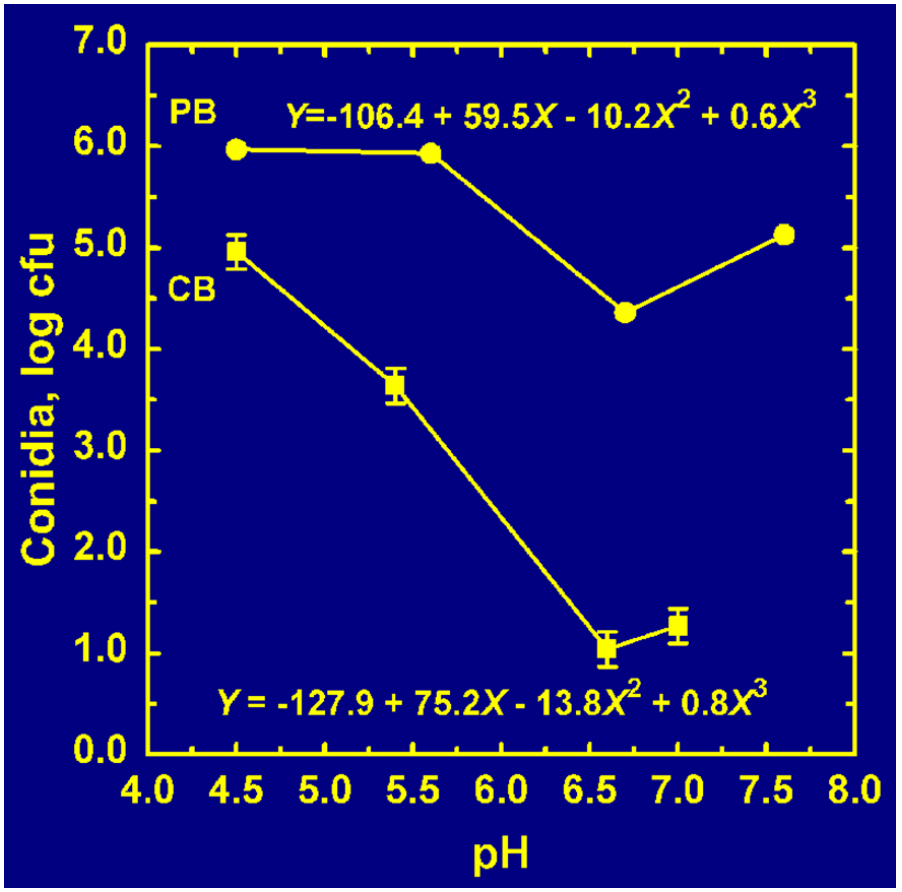
Influence of Soil pH on Cephalosporium Stripe

Objectives:

- **Determine the effect of pH on components of inoculum potential**
  - growth, sporulation, and survival and germination of conidia
- **Determine the relationship between inoculum density and disease incidence**

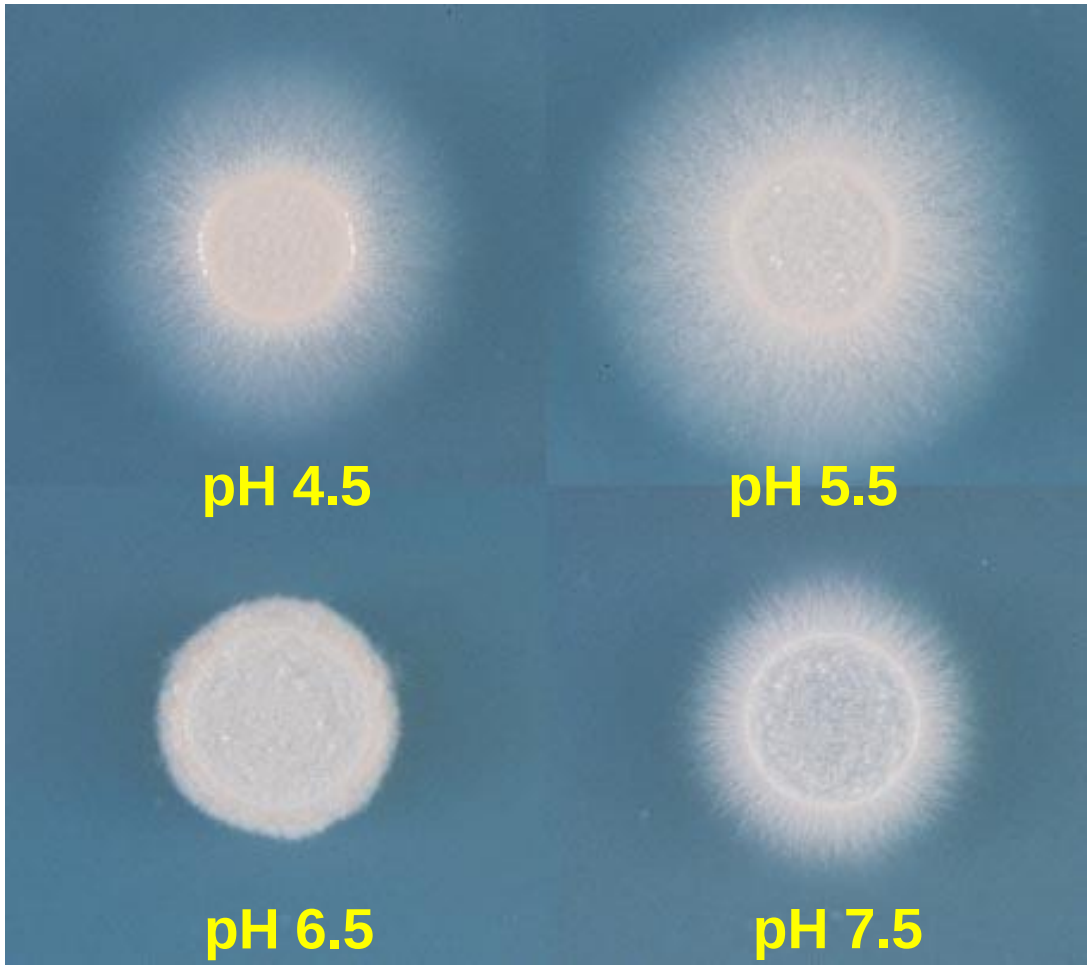
Effect of pH on Growth and Sporulation of *C. gramineum*





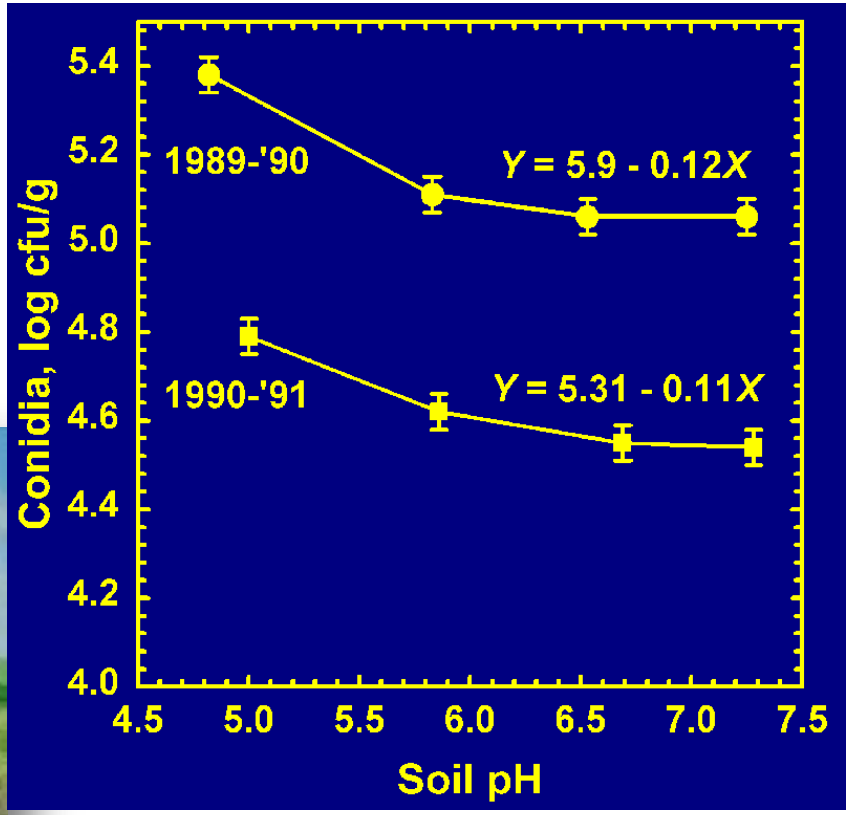
Mean of 3 isolates and 4 replicates MSA, 7 days, 20°C

Effect of pH on Growth and Sporulation of *C. gramineum*



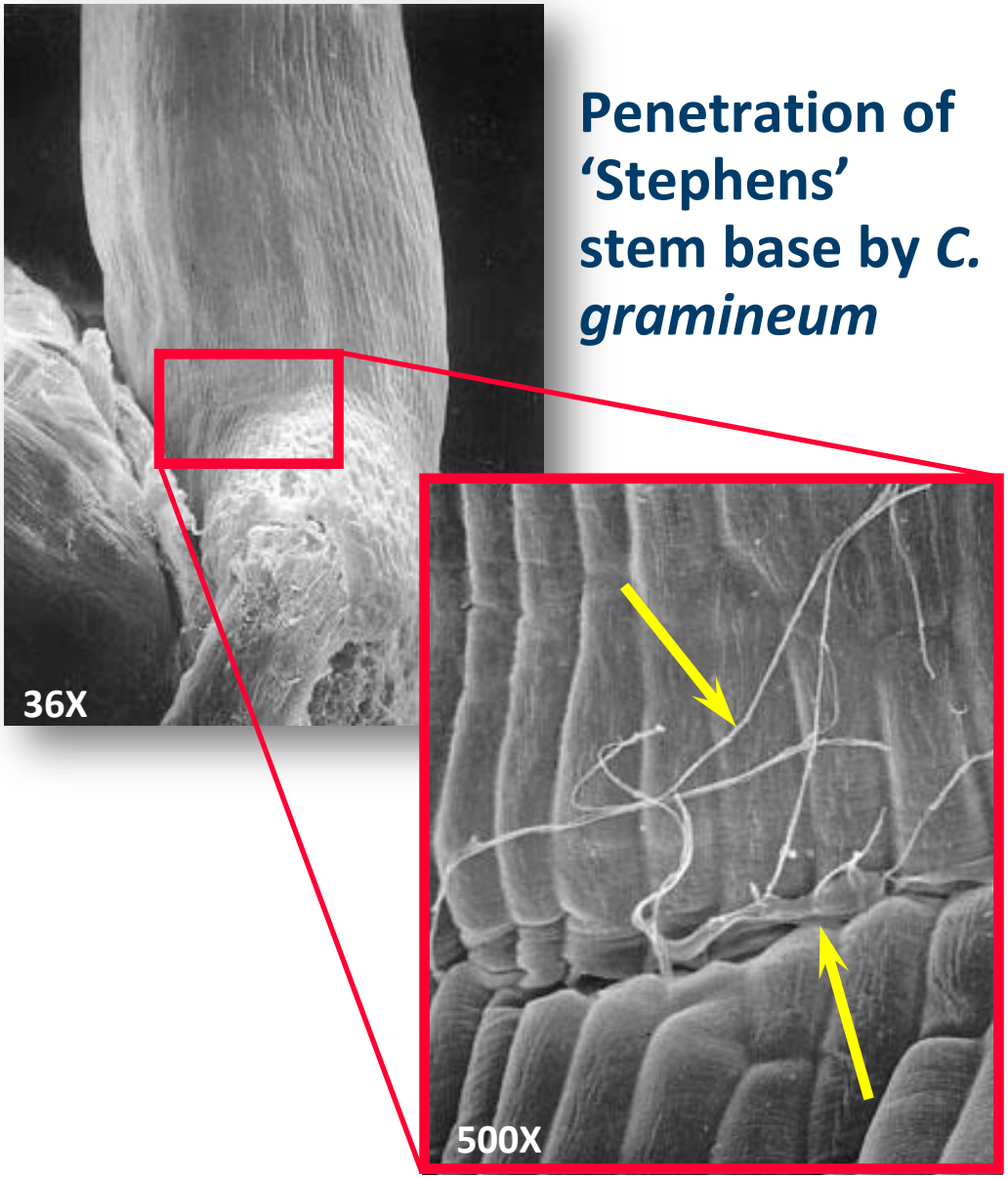
MSA-PB, 7 days at 20°C

Effect of Soil pH on Sporulation of *C. gramineum*

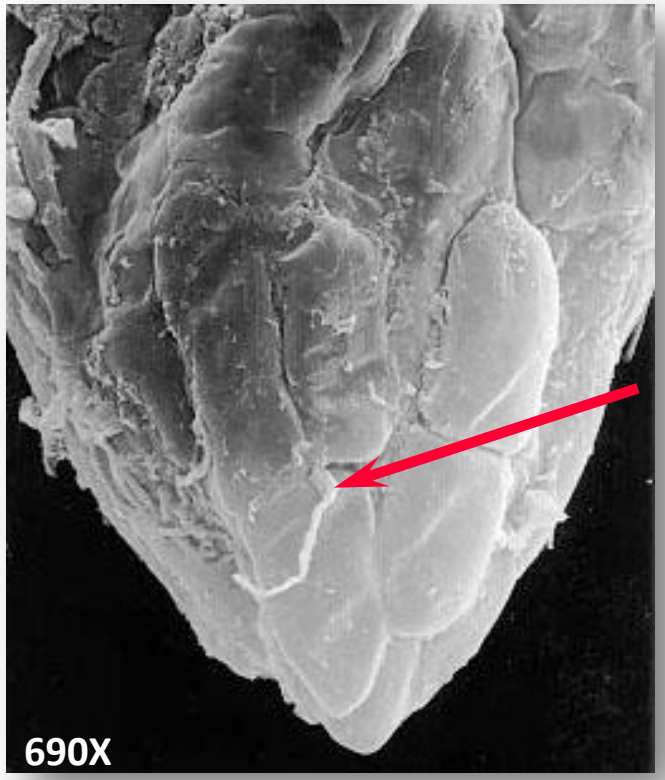


Mean of two rates in 1989-90 (88 & 177 kg/ha) and one in 1990-91 (233 kg/ha)

Effect of soil pH on Infection by *C. gramineum*

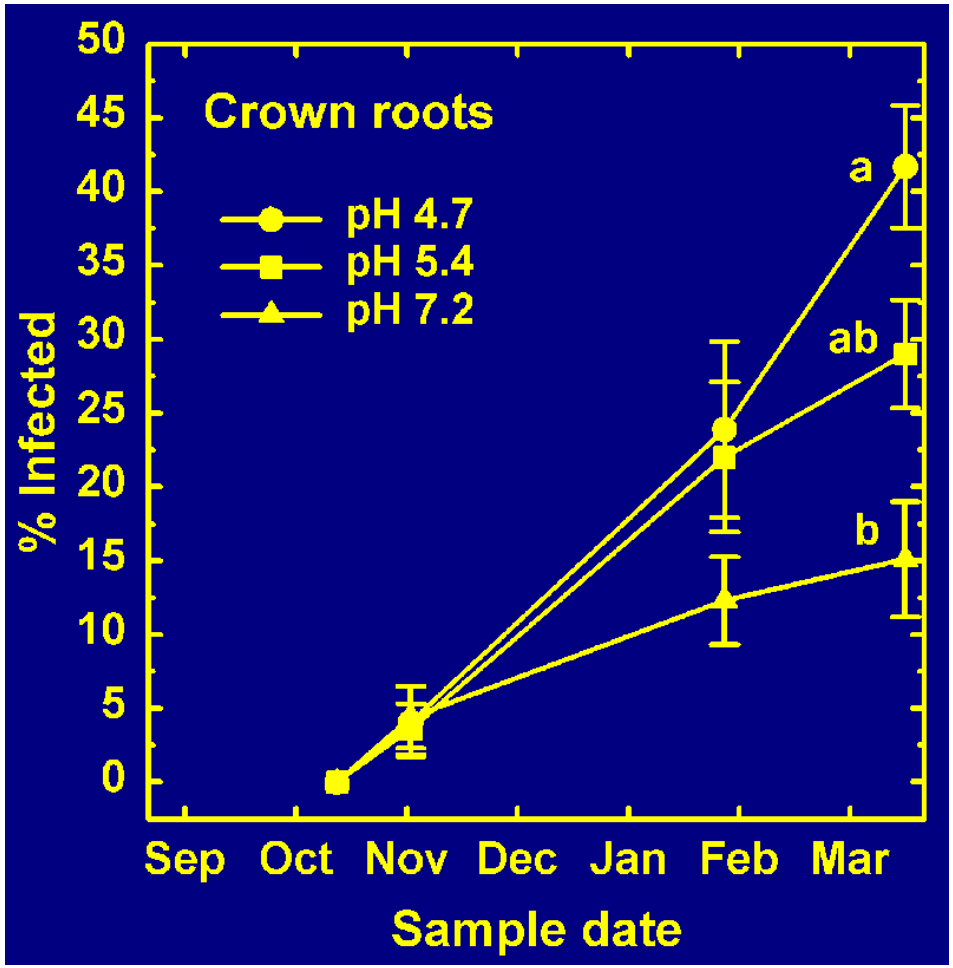


Penetration of 'Stephens' stem base by *C. gramineum*



Root tip - 'Daws'

Isolation of *C. gramineum* from Field-Grown Winter Wheat



Mean of 2 cultivars

Effect of soil pH on Cephalosporium Stripe

Growth and sporulation are greater at pH 4.5 than 7.5

- **More spores (inoculum) are produced at lower pH**
- **Fewer spores are needed to cause the same amount of disease at lower pH**
- **Pathogen survival in straw is greater at lower pH**

Root infection seems to be greater at lower pH

Influence of Soil pH on Cephalosporium Stripe