Cultural Control Practices in the Management of Fusarium Head Blight

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Fusarium Head Blight

incited by
Fusarium graminearum
and other *Fusarium* spp.

re-emerged in 1992 as the most important disease to limit wheat and barley production in the USA

Probable Causes of the Increase in Fusarium Head Blight

weather patterns favoring disease development

susceptible wheat and barley cultivars and expanded corn production

reduced tillage practices adopted for soil conservation

Fusarium Head Blight

Sporadic epidemics reported since wheat production established in the USA

From a historical perspective FHB was most effectively controlled from the end of WWII to the mid-1980's

FHB Pathogens

- *Fusarium graminearum (Gibberella zeae)*, *F. culmorum*, *F. poae*, *F. avenaceum*, *F. equiseti*, *F. acuminatum*, *F. sporotrichioides* and others…

Broad host range

Fusarium species recovered from residues

Wheat and Barley: *F. graminearum (G. zeae)*, *F. avenaceum*, *F. equiseti*, *F. acuminatum*, *F. trincictum*, *F. sambucinum*, *F. semitectum*, *F. poae* (barley), *F. culmorum* (wheat), *F. sporotrichioides*, *F. subglutinans*, *F. oxysporum*, *F. solani*

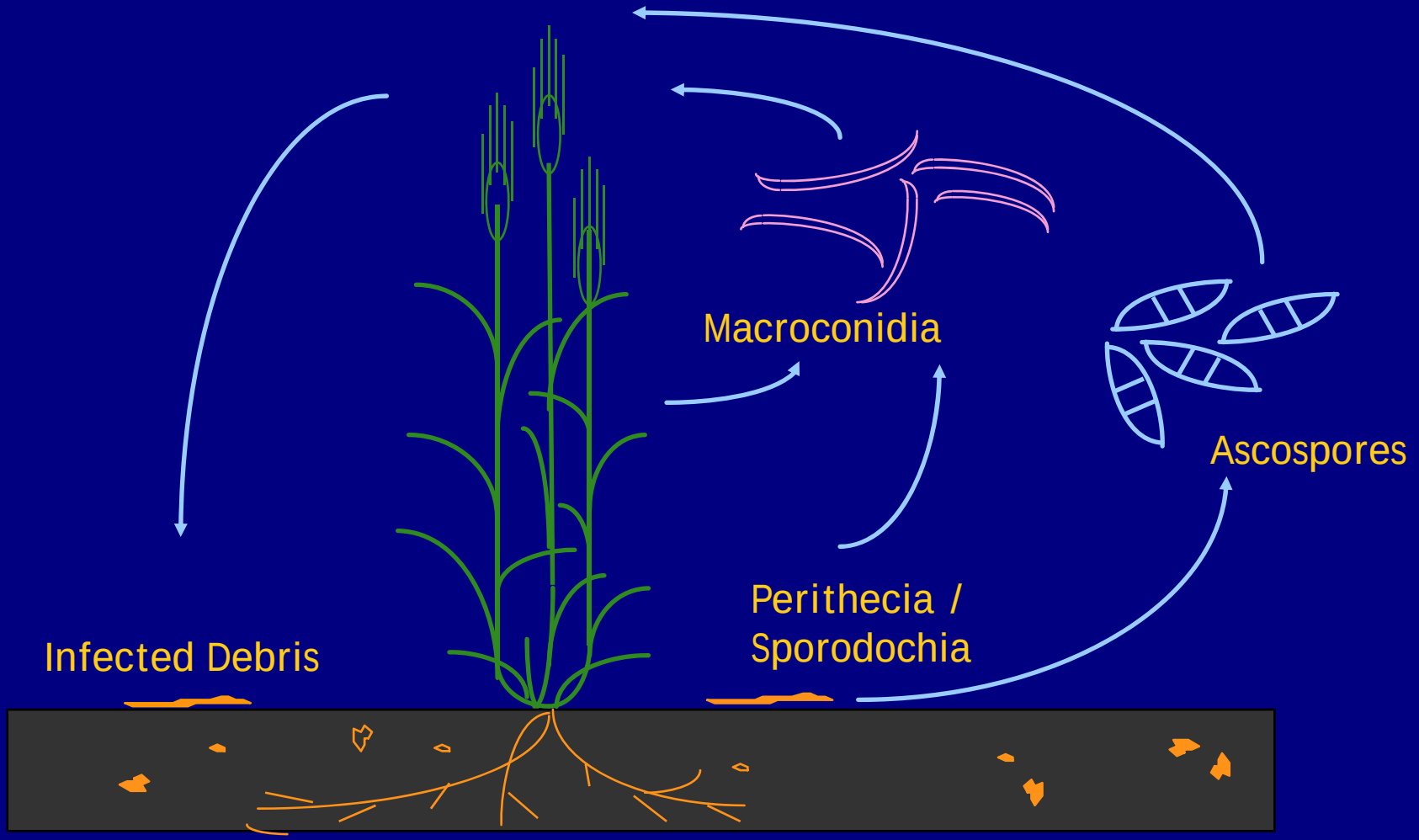
Corn: *F. verticillioides* , *F. subglutinans*, *F. graminearum*, *F. proliferatum*, *F. oxysporum*, *F. equiseti*, *F. solani*

Gramineous weeds: *F. equiseti*, *F. avenaceum*, *F. poae*, *F. oxysporum*, *F. solani*, *F. sambucinum*, *F. graminearum*, *F. subglutinans*

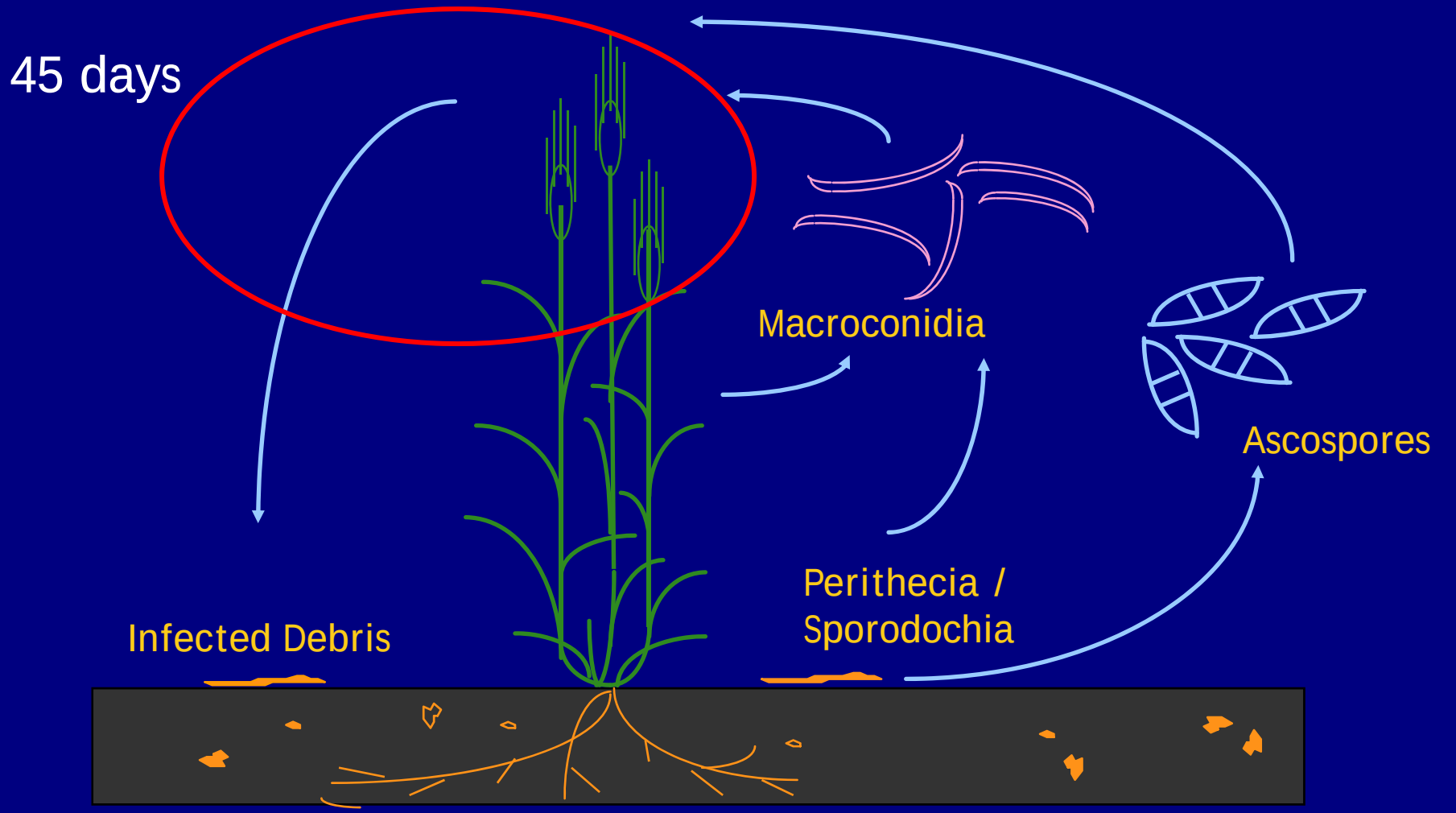
Sunflower: *F. oxysporum*, *F. solani*, *F. equiseti*, *F. acuminatum*, *F. semitectum*, *F. poae*, *F. graminearum*

Broader host range as a saprophyte

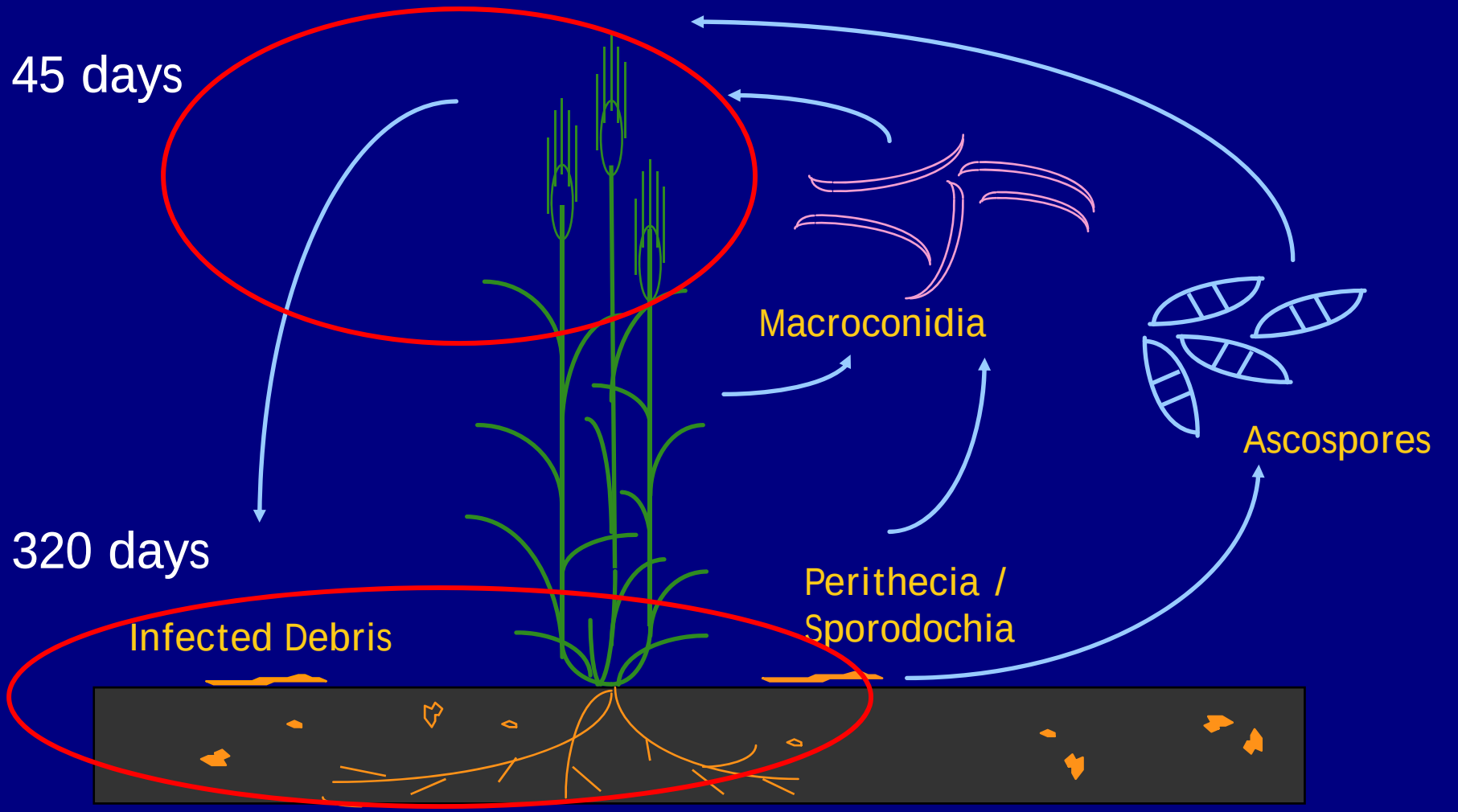
Disease cycle of *Fusarium graminearum*



Disease cycle of *Fusarium graminearum*



Disease cycle of *Fusarium graminearum*



Previous Crop Residues and Tillage

Wheat and barley residues likely as good a host as corn - BUT corn residues persist longer as they are larger and resist breakdown - Bt-corn may exacerbate this!

Inoculum within a field impacts FHB - BUT likely will only impact epidemics when exogenous inoculum is limiting

Reduced tillage (i.e. chisel plowing) increases inoculum, perhaps as much as no-till. There is a need to consider the residue-moisture interactions

We MUST address crop residues if we are going to manage FHB over the long term

Residue Decomposition

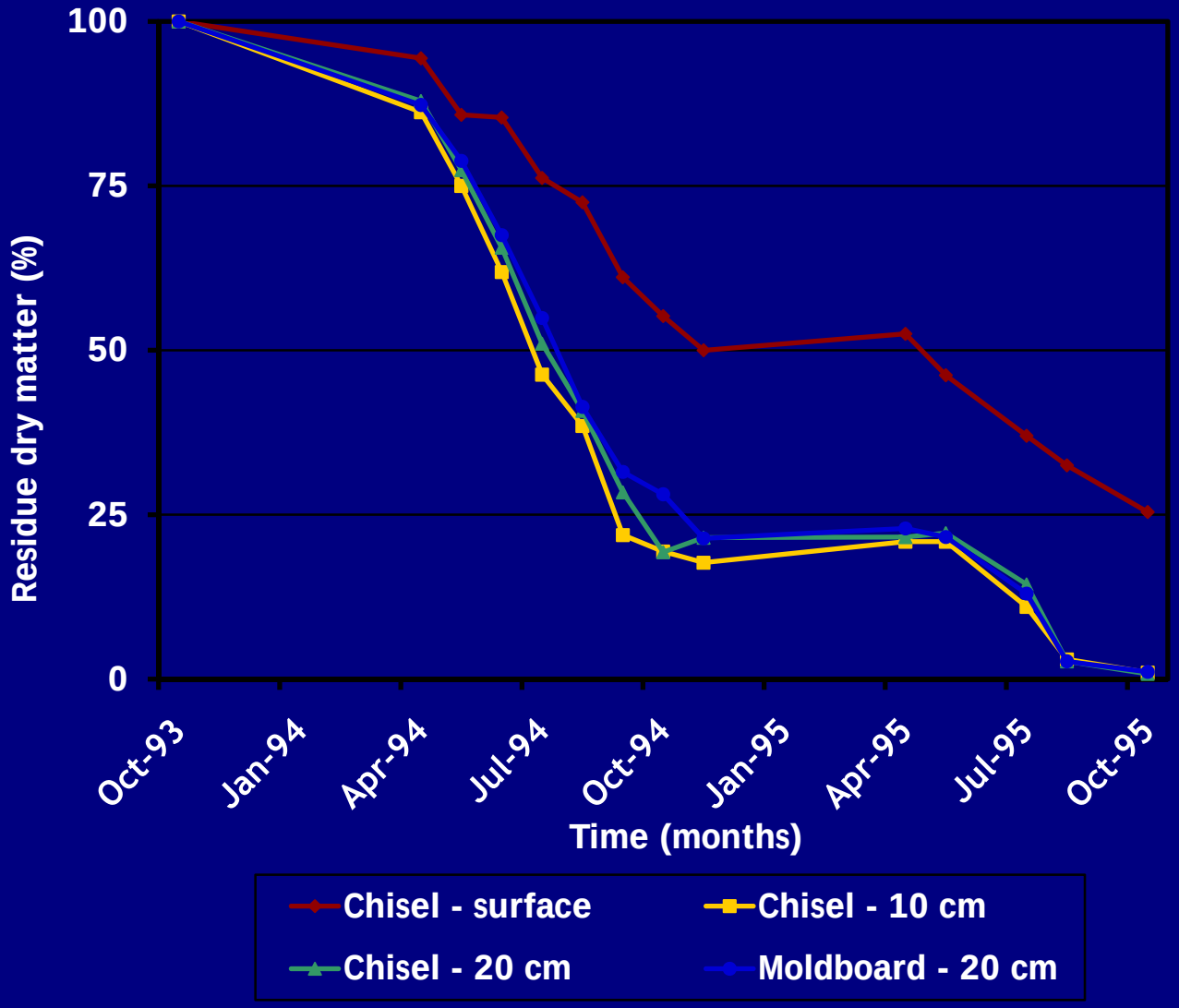
Residue Decomposition and Survival of *Fusarium* in Residues

Field trial - Crookston, MN

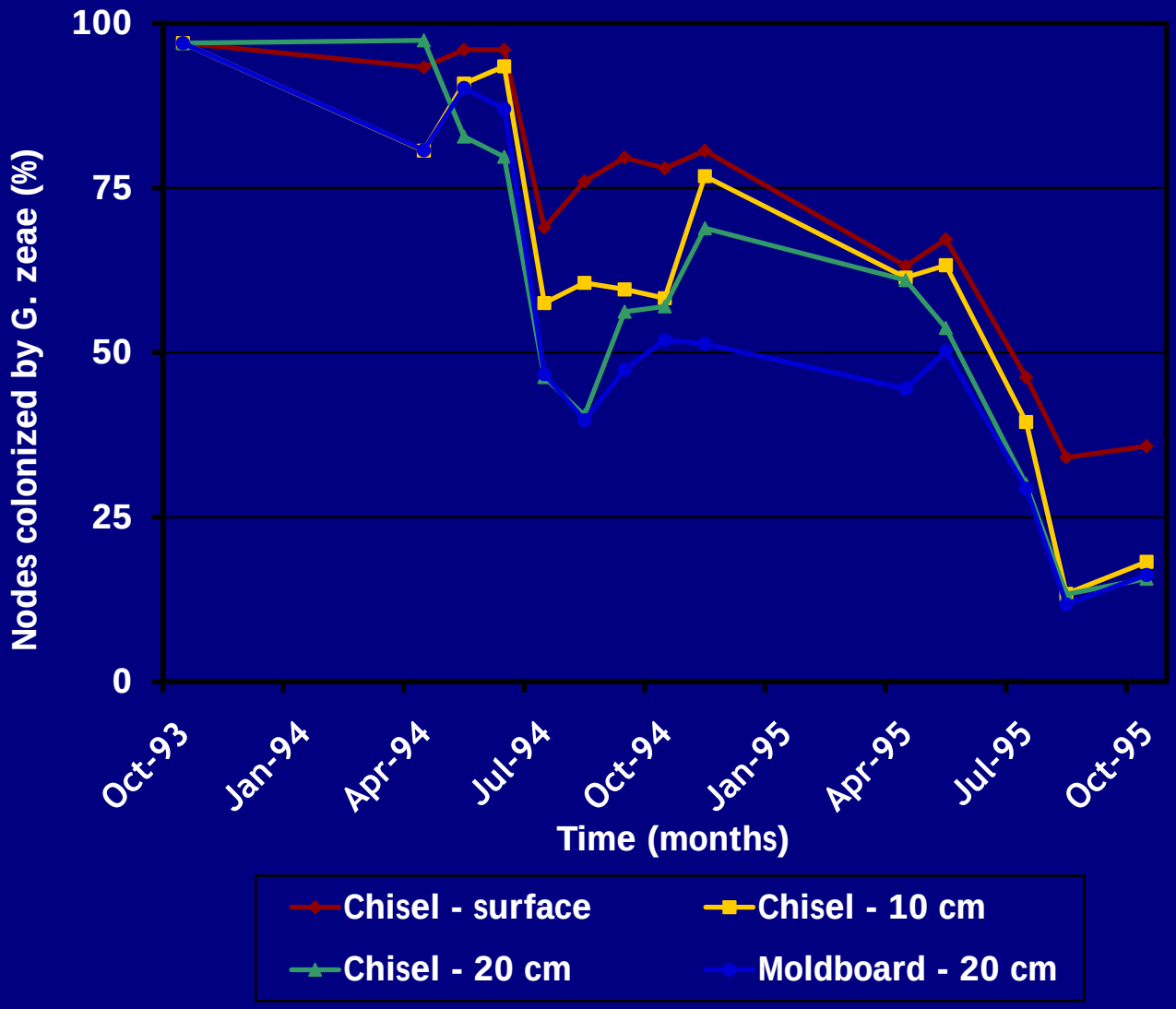
- wheat residue - harvested October 1997
- placement - chisel plow (0, 10, 20 cm depths) & moldboard plow (20 cm)
- collected - April 1998 till July 2000

Pereyra, Dill-Macky and Sims
Plant Disease, 2004

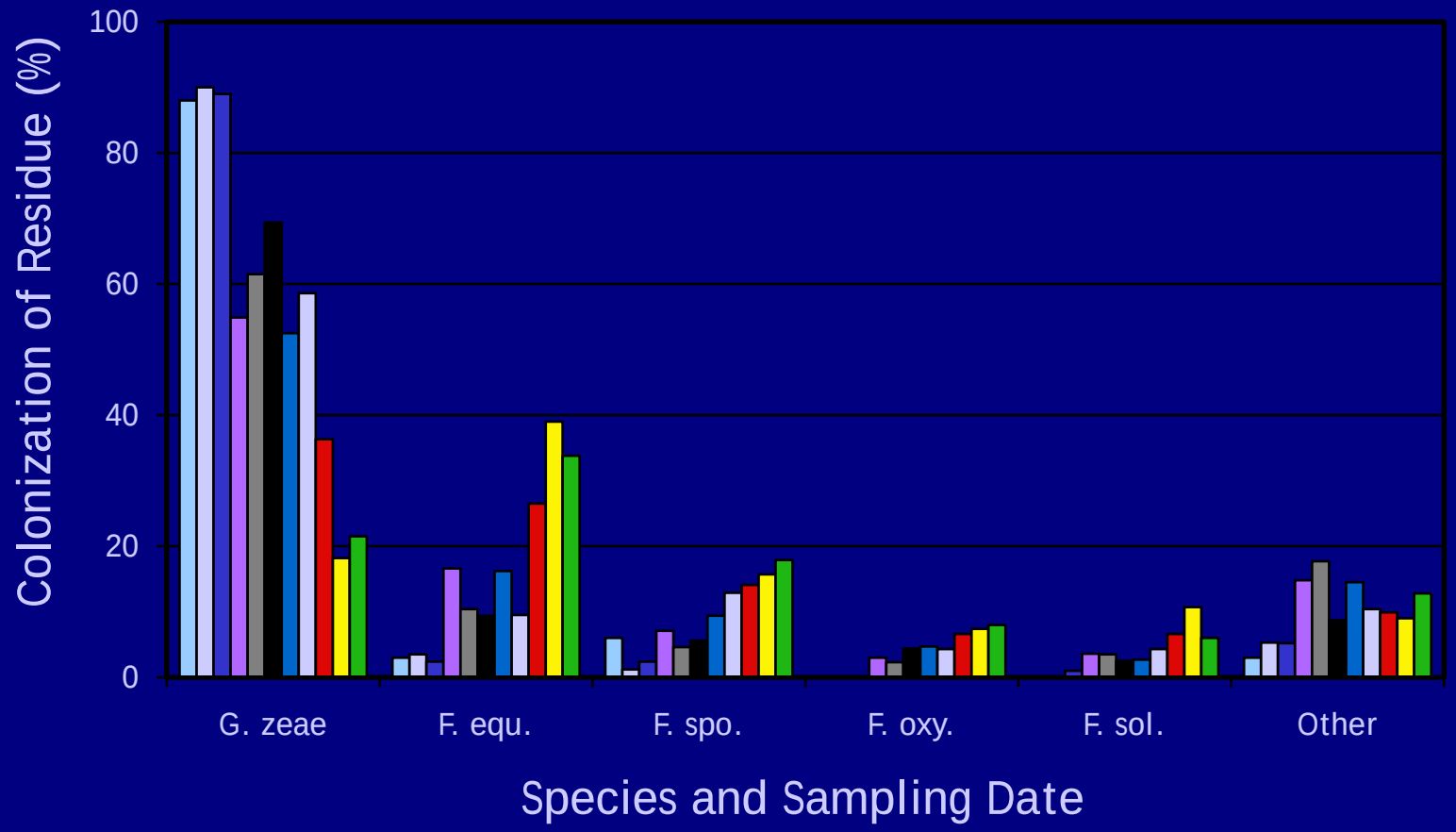
Residue Decomposition



Colonization of Residues



Fusarium - Succession of Species on Residues



Residue Decomposition

Wheat and barley residues support *Fusarium* survival and inoculum as long as they are 'recoverable' - in MN, residues may impact FHB for up to three subsequent cropping seasons

Burying residues eliminates the threat from residues and speeds residue decomposition - BUT residues returned to the soil surface later may still support inoculum production

F. graminearum appears to be one of the earlier colonizers of residues - pathogenic phase may give it a competitive advantage as a saprophyte

Targeting *Fusarium* in Residues

Post-Planting Burning of Residues
'a proof-of-concept study'

Field trials - Ulen and Humboldt, MN

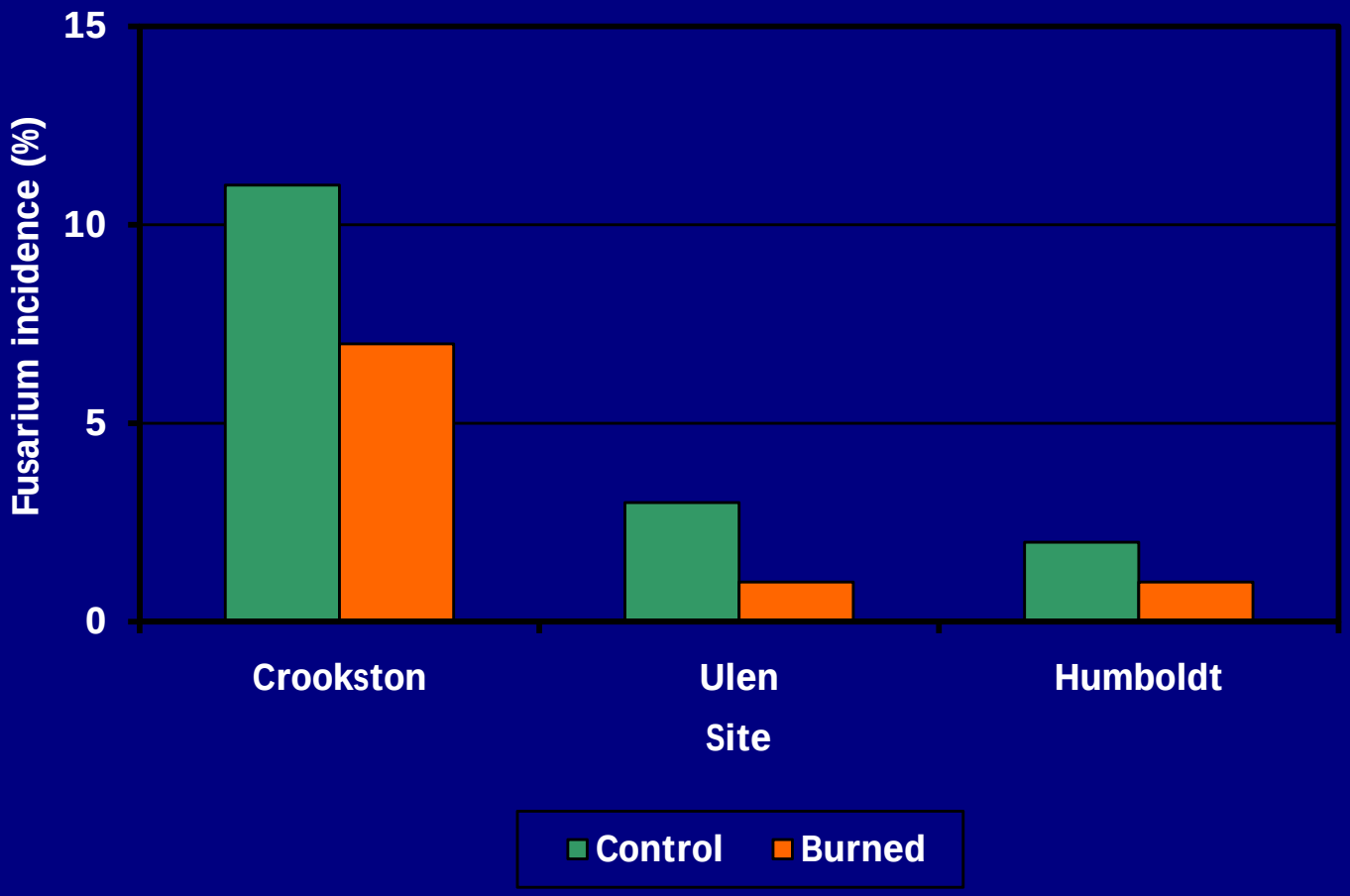
- wheat residue - crop harvested
- residue burned 1-5 days post-planting using a propane-powered alfalfa burner
  - light and severe treatments
- wheat residues, soil samples and plants from subsequent crop were analyzed

Dill-Macky and Salas
Plant Disease, 2004

Effect of Burning Residues

	Nodes (no./m^2)	*F.g.* survival (%)	*F.g.* in soil (cfu/g)
Control	62 a	33 a	693 a
Light	46 b	13 b	598 b
Severe	36 c	9 b	522 b

Impact of Burning on *Fusarium* Colonization of Wheat Plants



Targeting *Fusarium* in Residues

Residues need not be entirely destroyed to reduce the colonization by *F. graminearum*

Burning residues is an impractical solution - HOWEVER this work demonstrates that treating residues to reduce *Fusarium* pathogens may provide a measure of control esp. when sources of exogenous inoculum are limiting

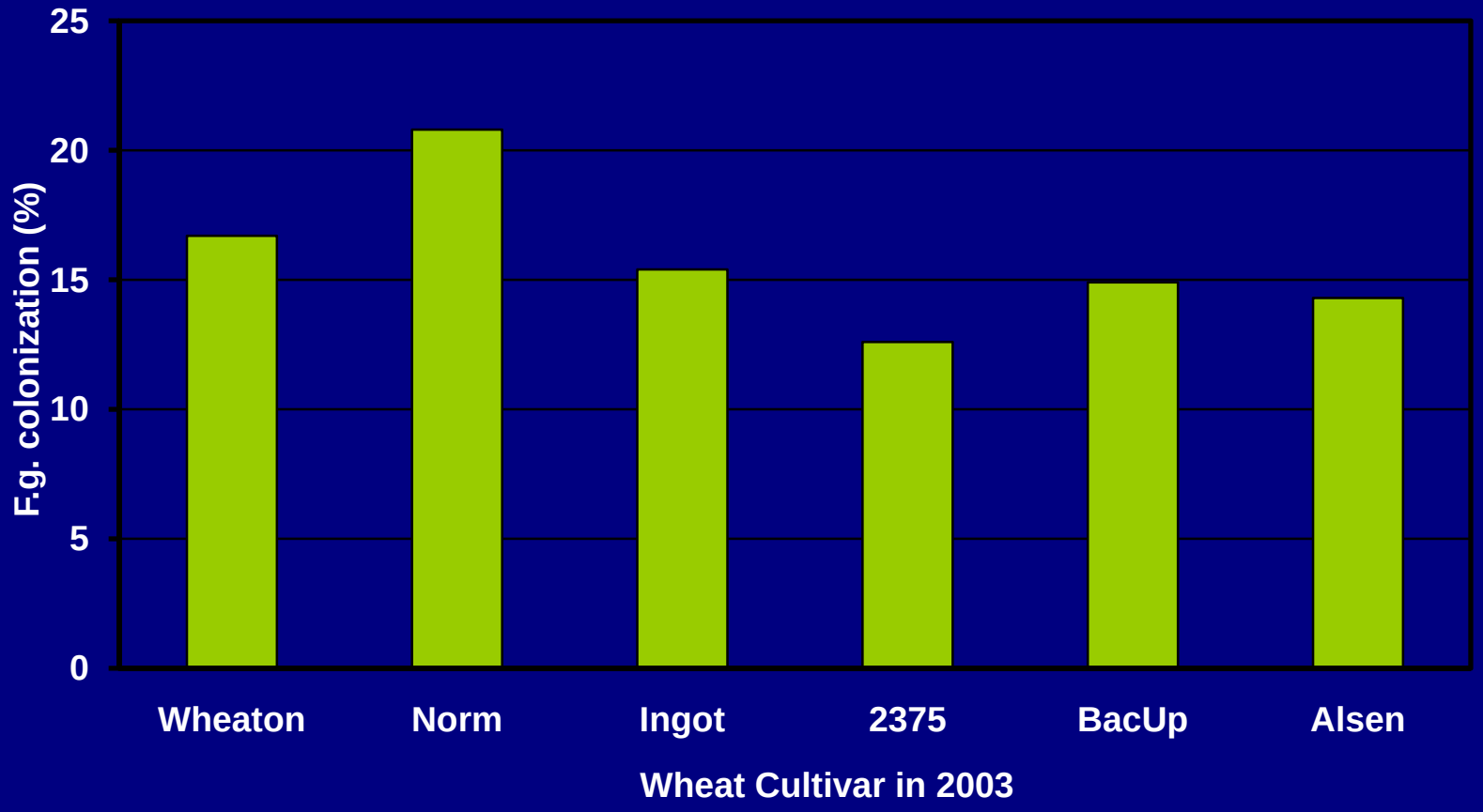
Effect of Host Resistance on Fusarium Head Blight

Field trial - Rosemount, MN

- residues from six wheat cultivars
  - susceptible - Wheaton, Norm
  - mod. susceptible - 2375, Ingot
  - mod. resistant - Backup, Alsen
- plots chisel plowed after harvest
- planted to wheat cv. 'Wheaton' in spring
- *F. graminearum* isolated from i) residues, ii) air in canopy at early dough, iii) plants at hard dough

Dill-Macky and Salas
Plant Disease, 2004

Effect of 2003 Wheat Cultivar Selection on the Colonization of the 2004 Wheat Crop



Salas and Dill-Macky
Phytopathology, 2005

Effect of Host Resistance on *Fusarium* Survival

Resistance to FHB in wheat influences the colonization of residues as measured by their ability to support *Fusarium* survival and inoculum production

FHB resistance may provide a benefit in future cropping seasons by reducing inoculum potential

An Argument for Cultural Control Practices in the Management of FHB

Very susceptible cultivars have been eliminated from production in FHB prone regions

Resistance has been improved - BUT it is unrealistic to anticipate that wheat or barley cultivars immune to FHB will be developed or that the best resistance(s) available will be sufficient to eliminate the risk of FHB

Improved levels of resistance will however

i) reduce the risk of FHB in the growing season AND ii) reduce the risk of future epidemics by reducing the level of *Fusarium* in crop residues

An Argument for Cultural Control Practices in the Management of FHB

Chemical control is needed in the management of FHB

Improved application technologies and the development of forecasting systems have improved our ability to use fungicides as a control measure

High inoculum pressure and weather conditions favorable for disease can still overwhelm these best management practices

Crop residues are problematic as they harbor the initial inoculum from which FHB epidemics develop

increased corn acreage - esp. Bt-corn

other host & non-host residues exacerbate this problem in reduced tillage systems

Cultural Control Practices in the Management of FHB - future research -

Eliminating *Fusarium* inoculum from residues - chemical control directed to the residues, interfering with *Fusarium* sporulation

Promoting residue decomposition - shredding (Bt-corn), fertilizer applications

Promoting *Fusarium*-antagonists - green manures, soil amendments, biological control

Any solution must be able to be effectively integrated into the production system

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