

Chloride Fertilization of Wheat in North America

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History of Chloride Fertilization

- Chloride recognised as an essential nutrient in 1954 (Broyer et al)
- Required in very small amounts for crop growth (~100 mg kg⁻¹)
- Deficiency induced in nutrient solutions
 - Cl⁻ widespread in soil and water
 - Responses considered unlikely in field
- Potential role of Cl⁻ in cropping systems recognized in the 1970s in the Phillipines, Europe and northwestern U.S.
- Yield increases from Cl⁻ application verified in the field in Oregon (Christensen et al, 1981)



Winter Wheat Grain Yield as Function of N Source



Take-all root rot of winter wheat was reduced by KCl in Oregon



Cl⁻ has improved crop yields in the Great Plains

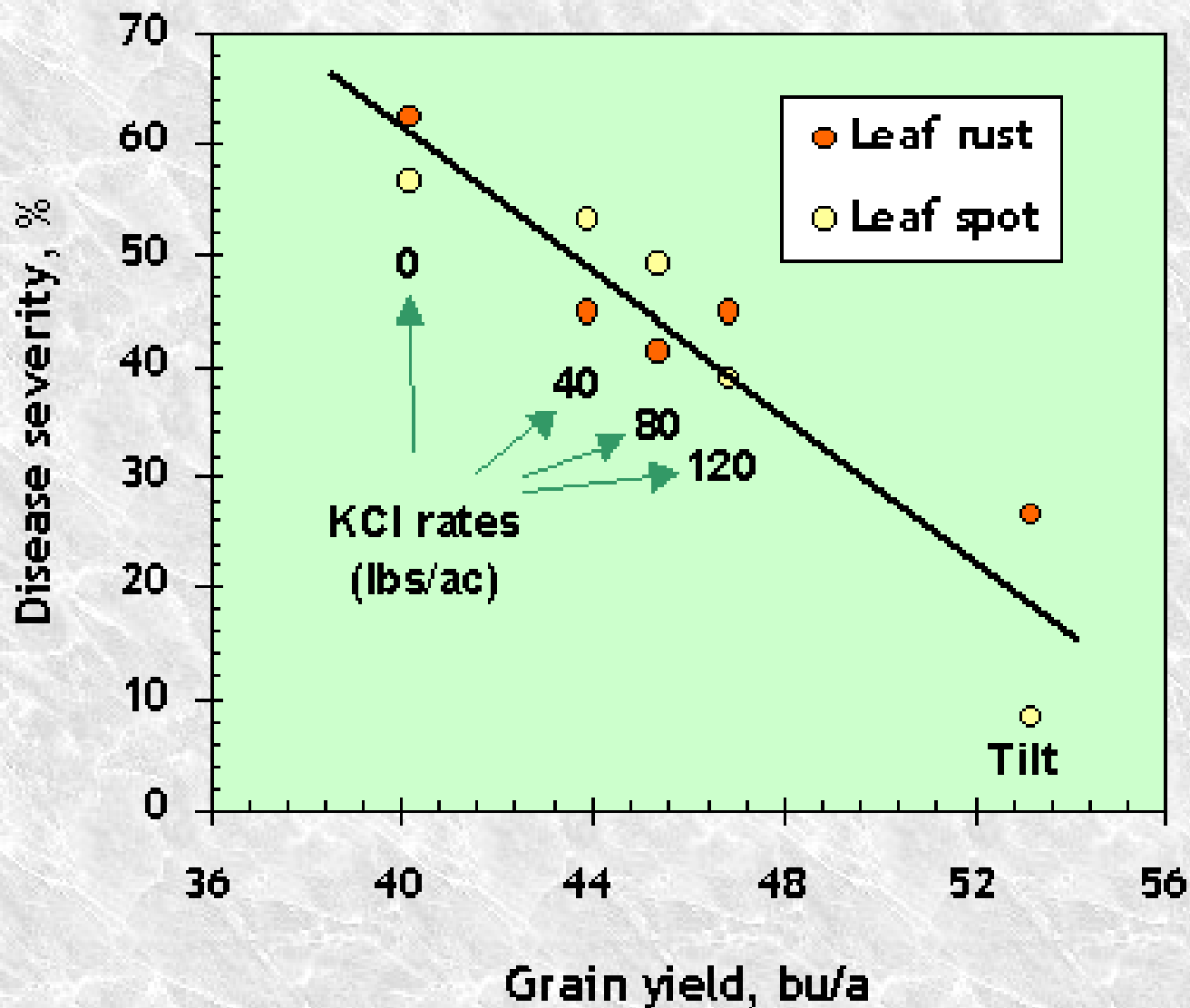
- **Over 210 trials in KS, MN, MT, ND, SD, MB and SK have evaluated Cl⁻ response in wheat and barley**
- **Significant yield response in 48% of trials**
- **Average response of 315 kg/ha**
- **Cl⁻ responses also occurred in other crops**



Yield Increase May Be Due To Disease Suppression

- **Wheat:** take-all root rot, common root rot, fusarium root rot, stripe rust, leaf rust, septoria, tan spot
- **Barley:** common root rot, fusarium root rot, spot blotch
- **Corn:** stalk rot





Foliar disease severity in flag leaves and grain yield for Butte spring wheat, Flandreau, S.D.

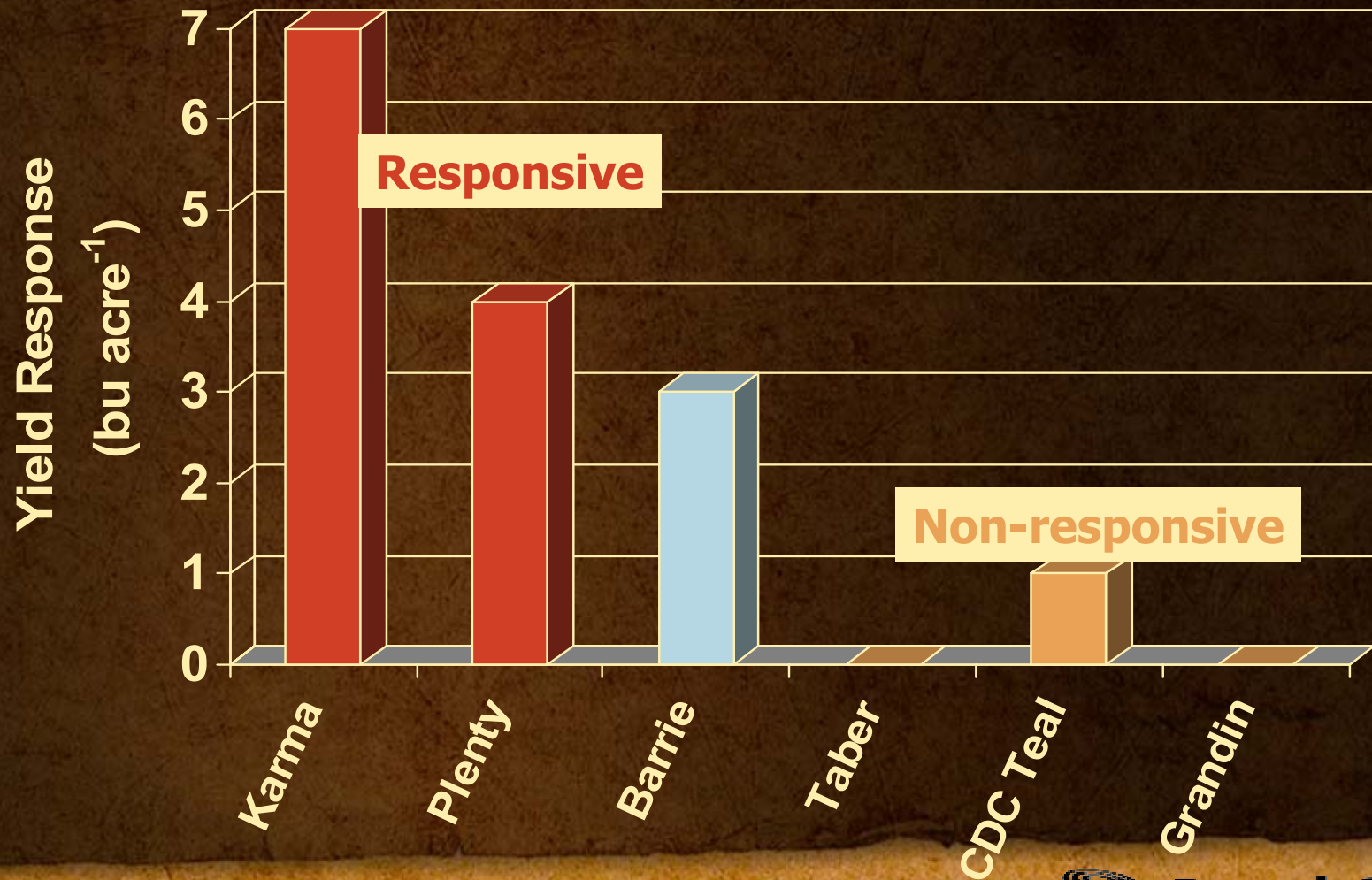
% disease severity = % of flag leaf affected by the indicated disease at milk stage.



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Response of Spring or Durum Wheat Cultivars to Cl⁻ Fertilization



Chloride - An Essential Plant Nutrient

Chloride ...

- **accelerates plant development**
 - 5-7 days for winter wheat
 - 1-5 days for spring wheat
- **reduces lodging**
- **suppresses diseases**
 - root & leaf diseases





**Improved growth,
advanced maturity**

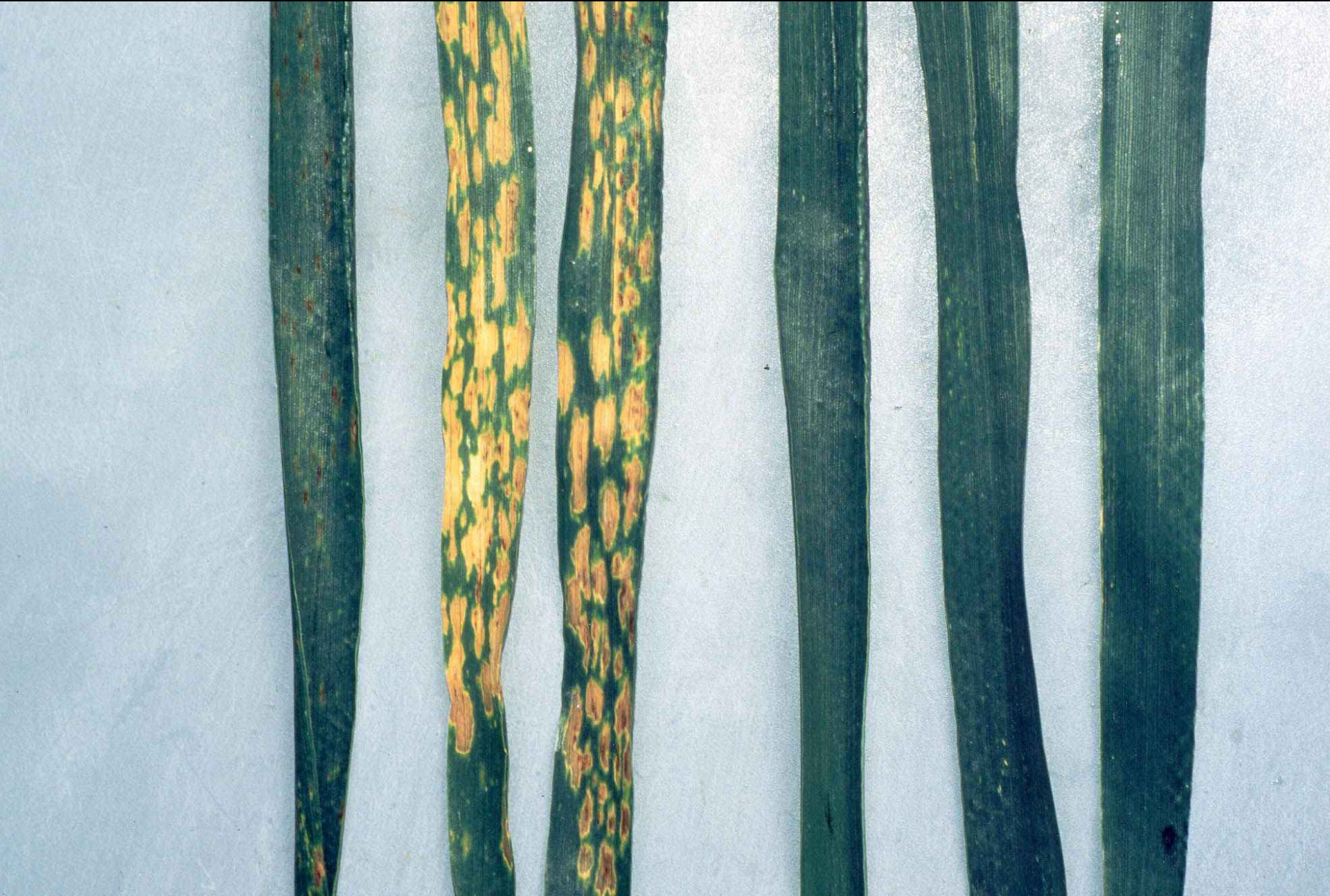
0 kg Cl⁻/ha

17 kg Cl⁻/ha

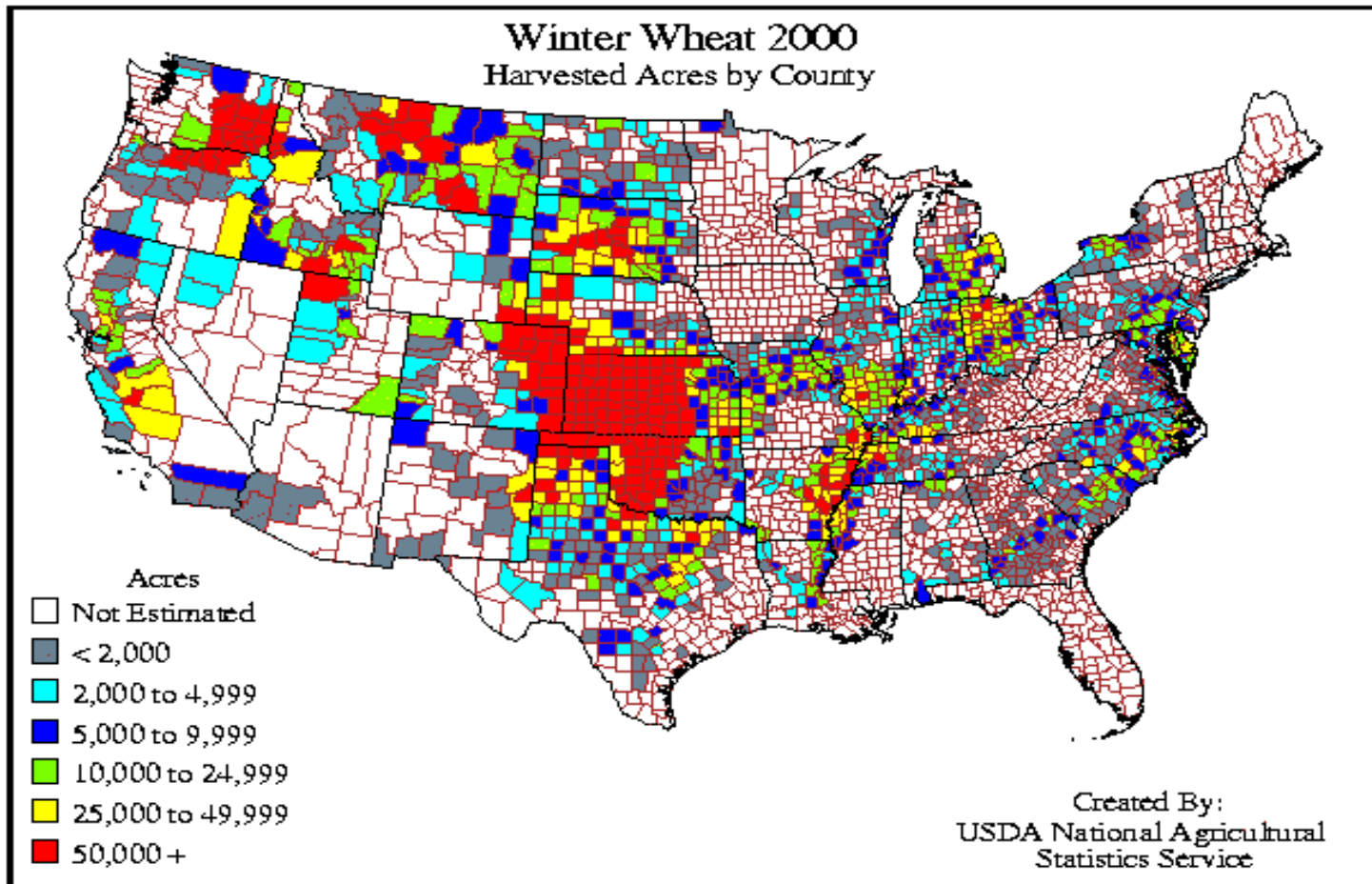


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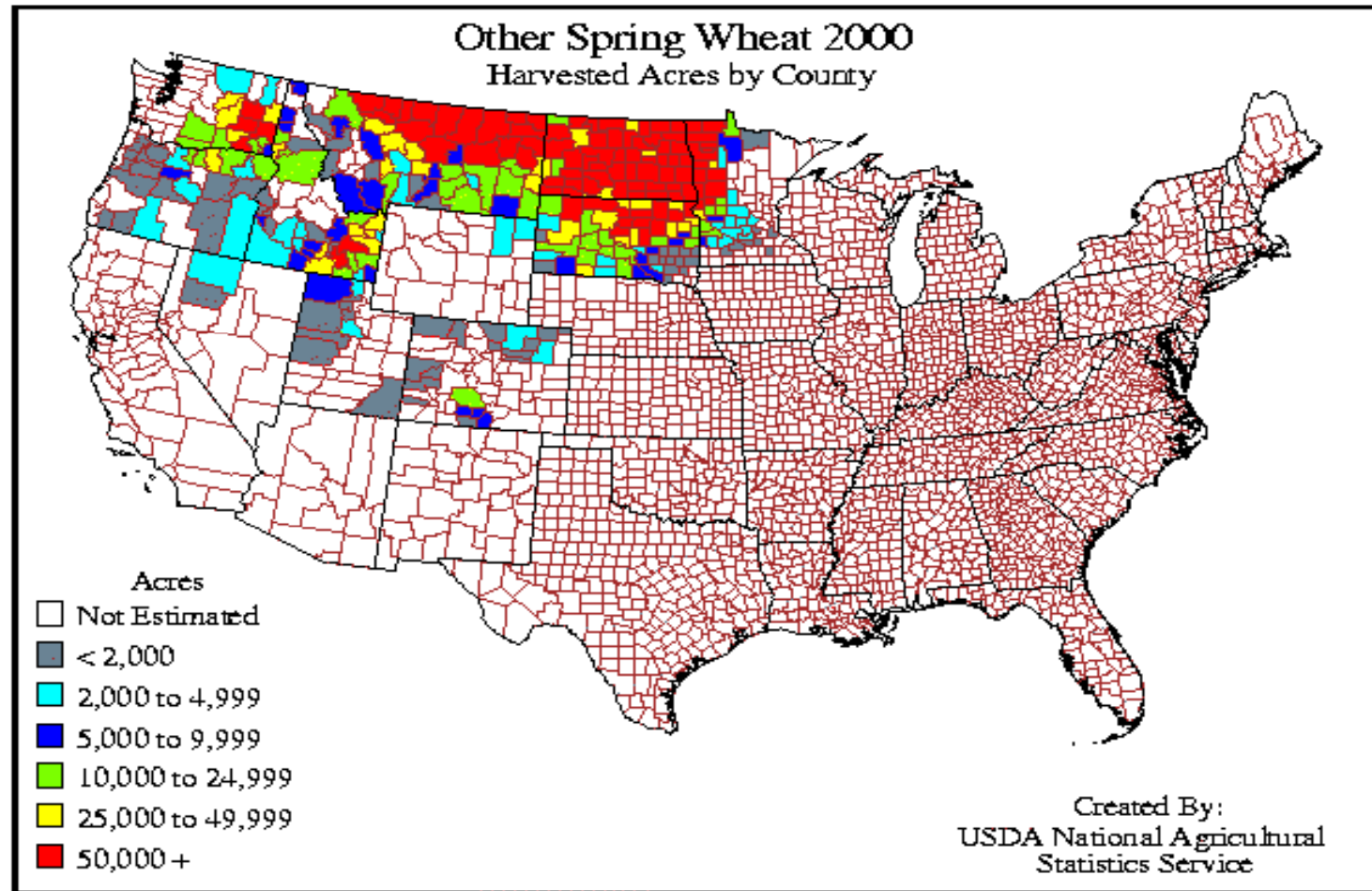
Physiological Leaf Spot



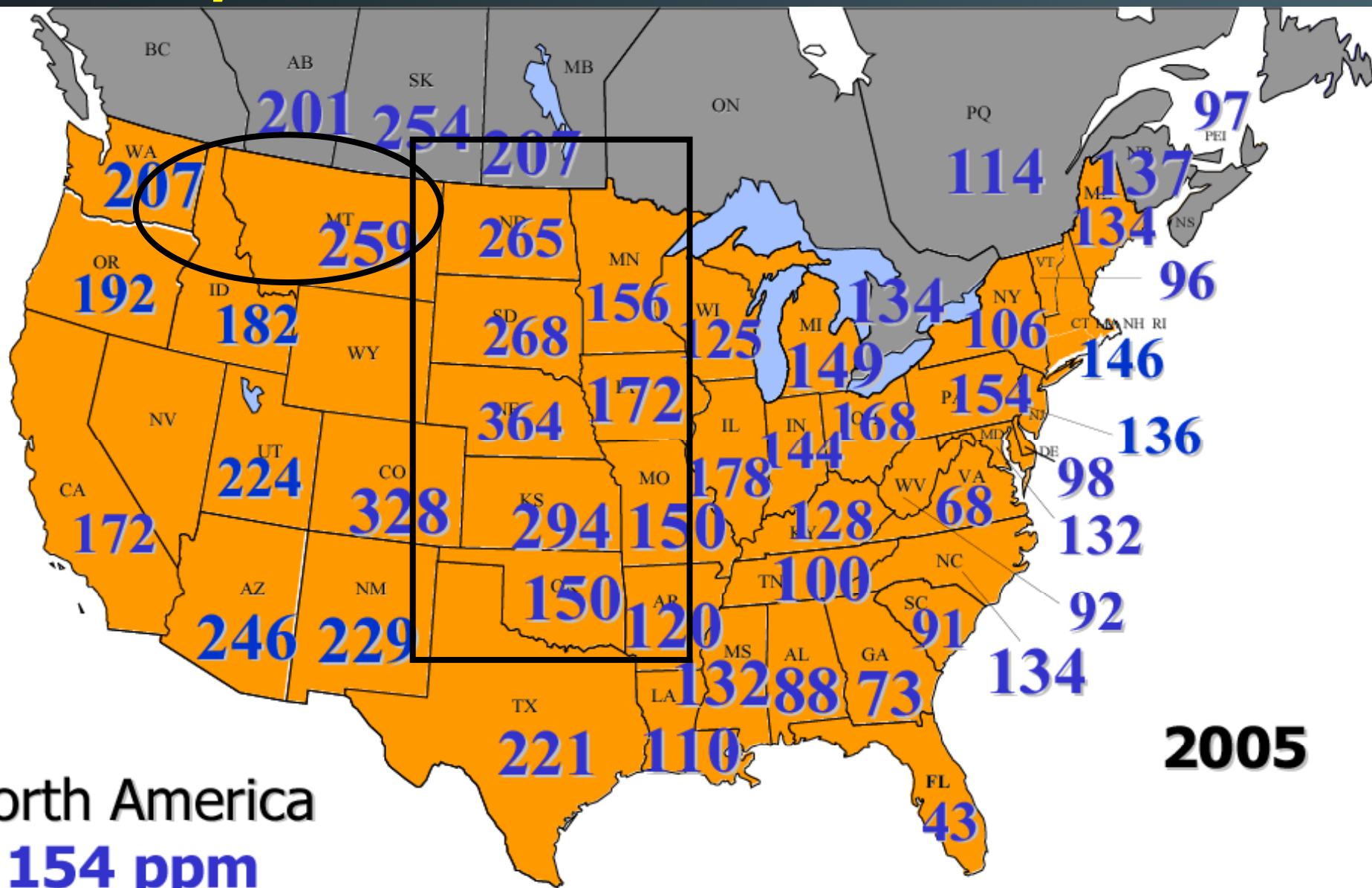
US Winter Wheat Harvested Acres



US Other Spring Wheat Harvested Acres



Median ammonium acetate equivalent soil test K levels, 2005.



North America
154 ppm

2005

Where Are Chloride Soil Test Levels Low?

- Regions where Cl^- deposition from rainfall is low.
- Regions where rainfall is high enough to leach Cl^-
- Regions where KCl fertilizers are little used
- Sandy and low OM soils



Chloride Soil Testing

Chloride is now part of the micronutrient soil test package for most soil testing labs in the U.S. and Canada.



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Chloride Soil Test Guidelines*

(Cl⁻ (kg/ha 0.6 m depth))

Low	<34
Medium	34-67
Sufficient	>67

* International Plant Nutrition Institute (IPNI)

Soil testing can help predict Cl⁻ response

Category	Soil Cl (kg/ha 0.6 m)	Response	
		<u>Frequency</u> %	<u>Average</u> kg/ha
Low	≤ 34	69	269
Medium	35- 67	31	175
High	> 67	<1	20

Based on responsive spring wheat varieties grown at 36 locations in South Dakota.

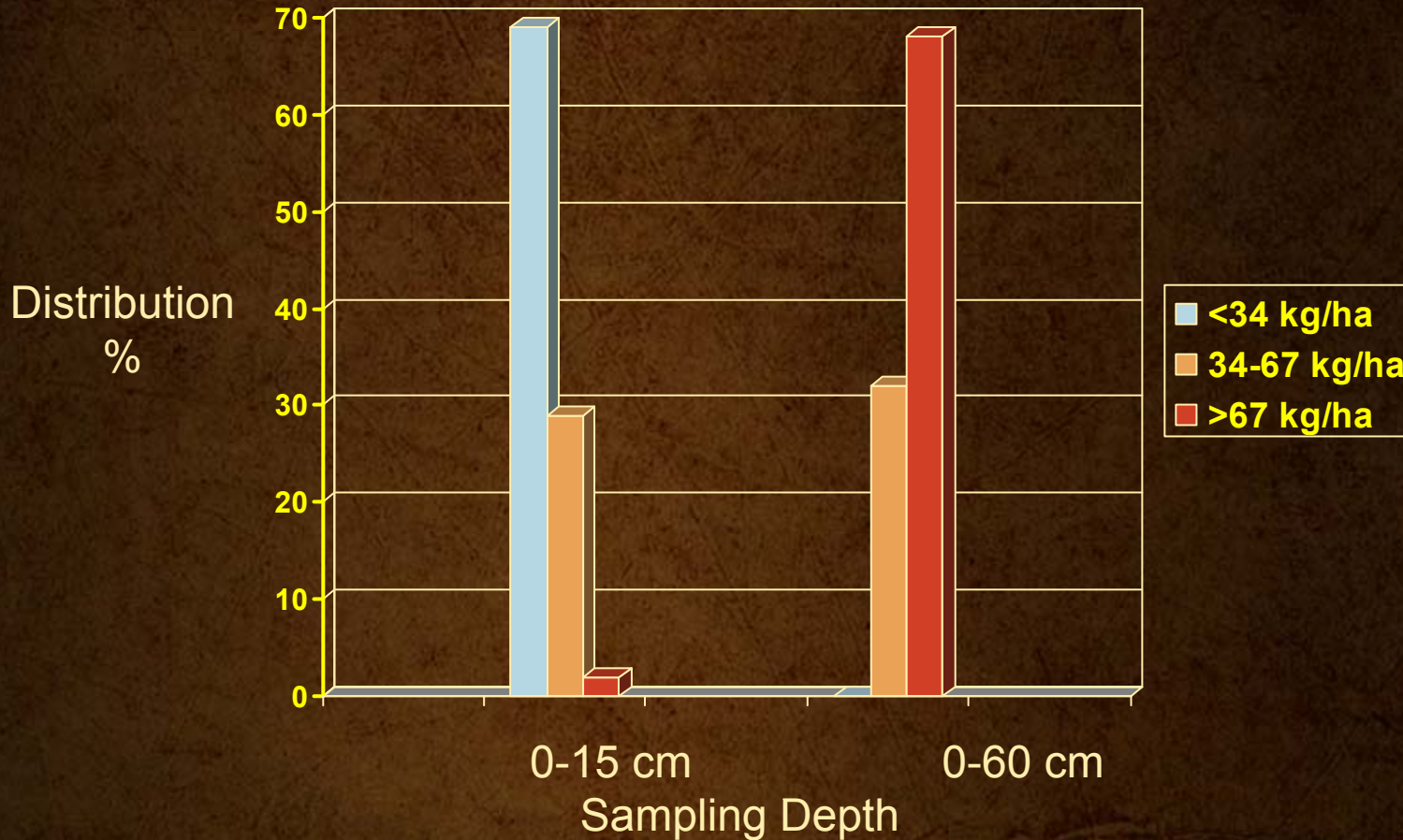


Soil Testing and Chloride?

- The chloride anion (Cl^-) is very mobile with water.
- Higher Cl^- levels observed in different landscape positions,, lower in upper slope (Franzen, ND).
- Topography effects are different depending on the weather (Schoenau, SK)



Relationship of Sampling Depth on Soil Chloride Levels in Oklahoma



Chloride Fertilizer Application

Cl is very soluble ...

- Placement is flexible:
broadcast = banded = topdress
- Seed-placement is very effective but application rates are lower due to concern for salt injury. 45 kg/ha KCl or less when placed with the seed.



Yield and test weight of Pioneer 2158 winter wheat as affected by timing of NH₄Cl application (45 kg/ha), Texas¹

Parameter	Fall Cl	Spring Cl	Control (0 Cl)
Yield (kg/ha)	4004.5a*	4589.1b	3648.4a
Test weight (lbs/bu)	58.0b	60.0c	56.0a
% Plant Cl**	0.28a	0.73b	0.29a

* P=.05

** Determined on whole plant samples at anthesis

1 These results illustrate that in high moisture environments, spring topdress Cl applications are more effective in suppressing leaf rust and increasing yield than fall pre-plant applications.

Gracias



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