SURVEY/MANAGEMENT OPTIONS IN NORTH DAKOTA, USA

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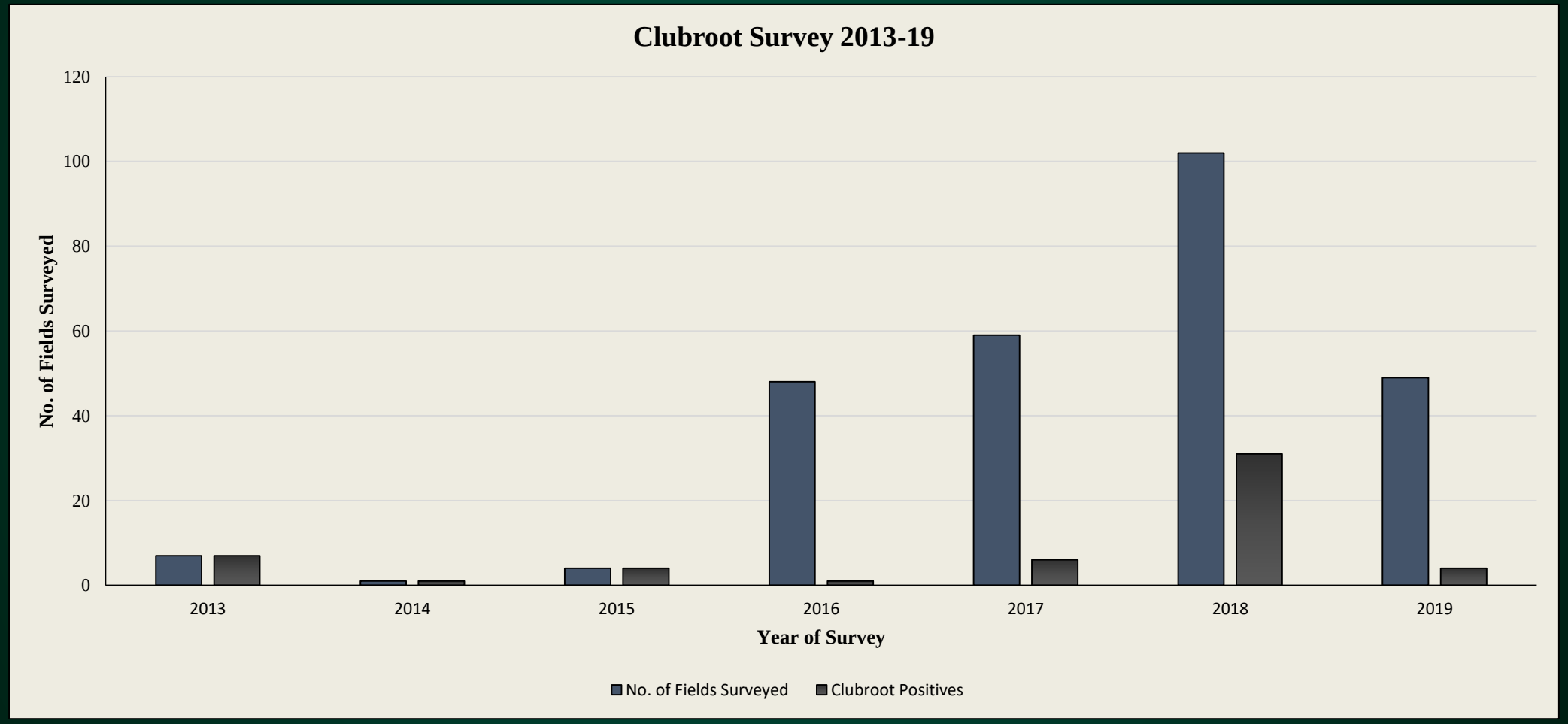
Outline

- Clubroot Survey
- Soil Amendments
- Resistant Cultivars
- Pathotypes of *Plasmodiophora brassicae*
- Summary

Canola Acreage in North Dakota

Year	Area Planted (1000 acers) in ND
2016	1460
2017	1590
2018 & 2019	1650, 1700

Survey Results from 2013-2019 in Cavalier County



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Soil Samples of Cavalier County

Year	# of samples	Average pH	Range	Average Buffer pH	Range
2018	101	6.4	4.8-7.4	6.79	5.1-7.35
2019	49	6.5	4.7-7.8	7.19	6.06-7.8

- 8% of fields were infected with clubroot in 2019 survey (Visual Observations)
- 33% of fields in 2018

pH range of Clubroot infected fields
2018: 4.5-6.4
2019: 4.7-6.7

Clubroot positives identified through Molecular assays

Positive fields of clubroot detected through molecular assays				
Sample ID	**Depth (Inches)**	**pH**	**Buffer pH**	**Spore population/gm of soil**
Cavalier County				
CCtc-38	0-3	5.3	6.73	13280
CCtc-11	0-3	7.6	7.64	184
Rolette County				
RLTC-3	0-3	7.6	7.42	27
Towner County				
TWC-3	0-3	7.3	7.32	17.15
TWC-7	0-3	7.0	7.22	16.56
Pembina County				
PBC-1	0-3	6.5	6.95	25.32
PBC-3	0-3	6.3	6.87	13.98
PBC-5	0-3	7.0	7.10	29.42
PBC-6	0-3	7.5	7.50	29

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Visible symptoms>80,000spores/gm

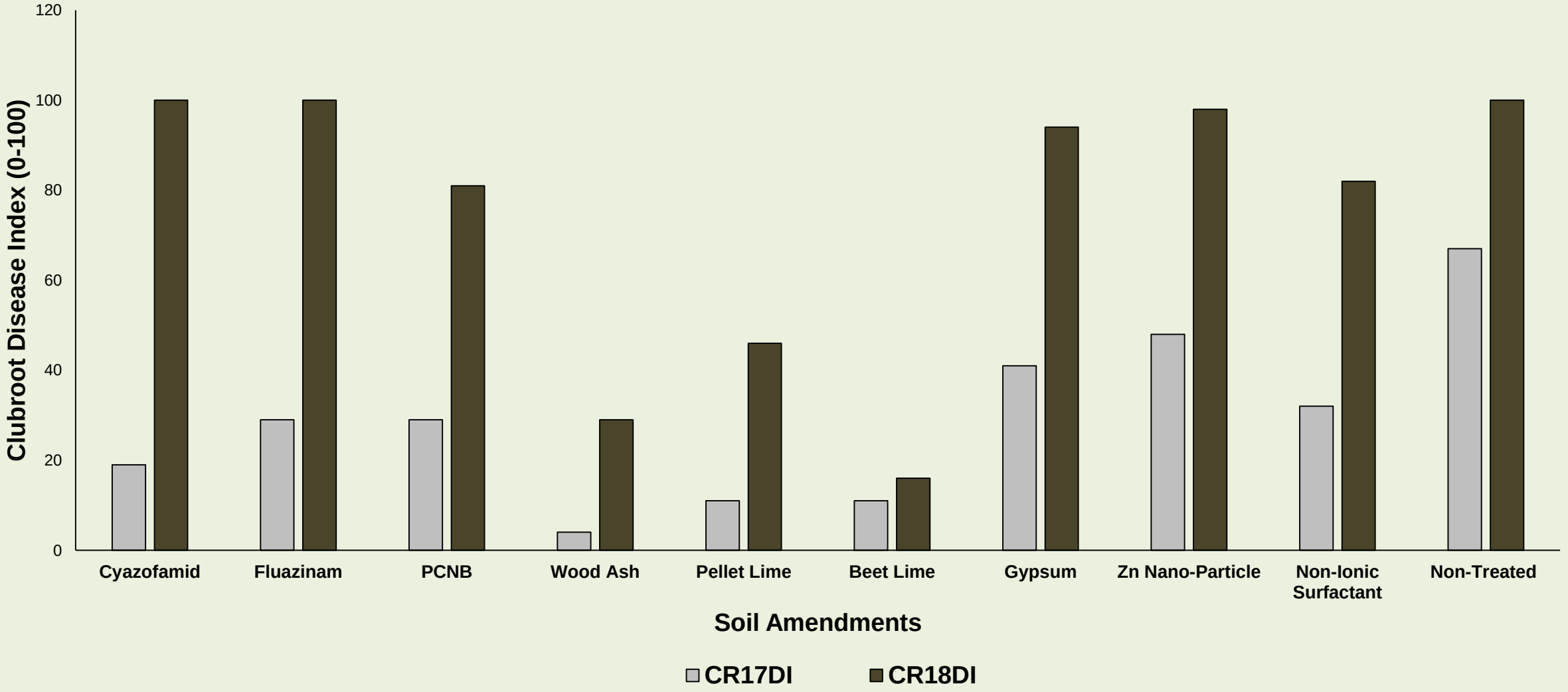
Chittem, Del Rio and Chapara 2019

Evaluation of Soil Amendments

- Two Objectives:

1. Different Rates of Beet lime, Pellet lime and Wood ash were tested
2. A surfactant was tested alone and in combination with the best treatments over the years

Prior Research: Clubroot Disease Index (DI) observed in two years of field study



2017: Mean: 29
LSD: 17
P-Value: 0.0001

Base Clubroot resting spore population
2017: 5.5 millions/gm of soil
2018: 13.5 millions/gm of soil

2018: Mean: 33
LSD: 21
P-Value: 0.0004

Objective 1: Evaluation of different rates of three soil amendments to manage Clubroot on Canola

Treatments	Rates (t/a)
WOODASH	0
WOODASH	2.5
WOODASH	5
WOODASH	7.5
PELLETLIME	0
PELLETLIME	2.5
PELLETLIME	5.0
PELLETLIME	7.5
BEETLIME	0
BEETLIME	5
BEETLIME	10
BEETLIME	15

Variety: DKL-30-42

Factorial RCB Design
Replicated 4 times

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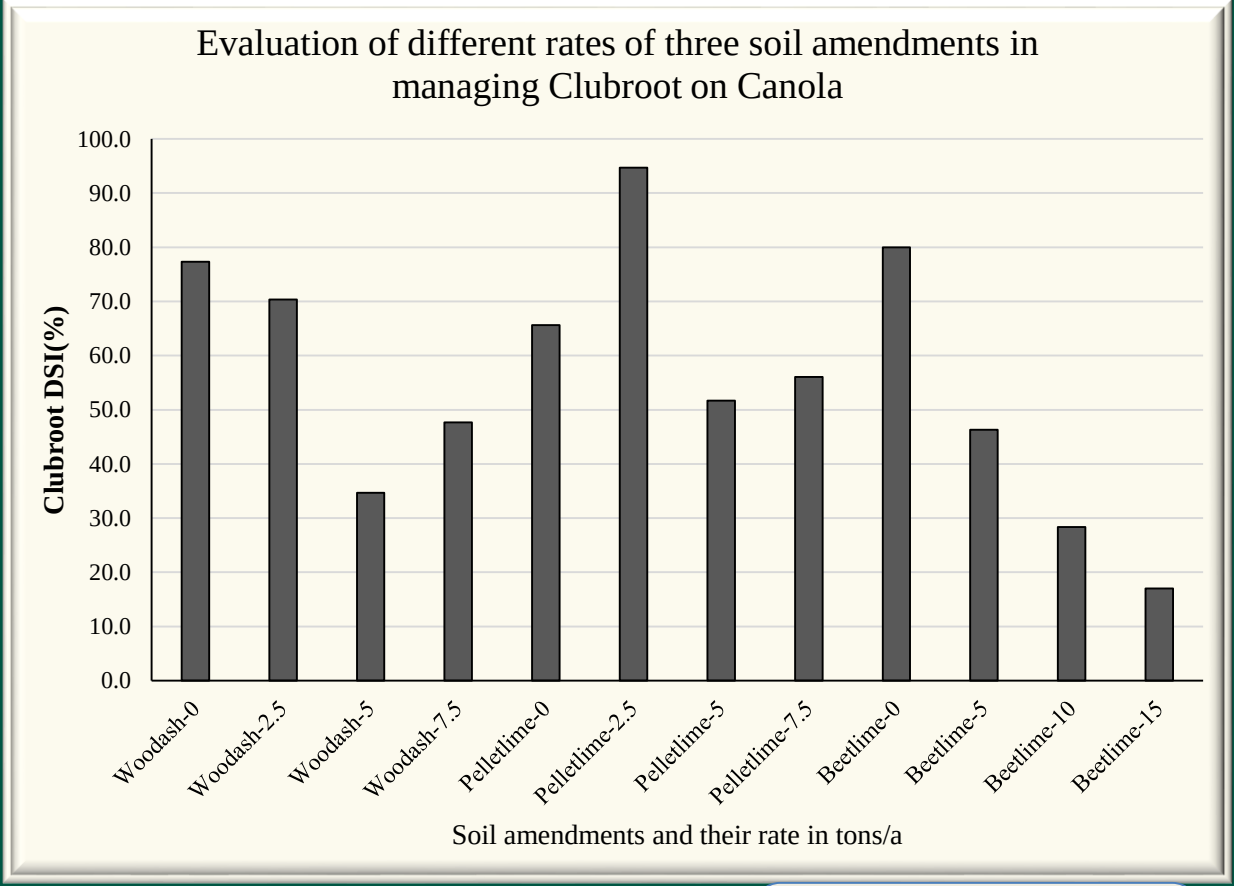
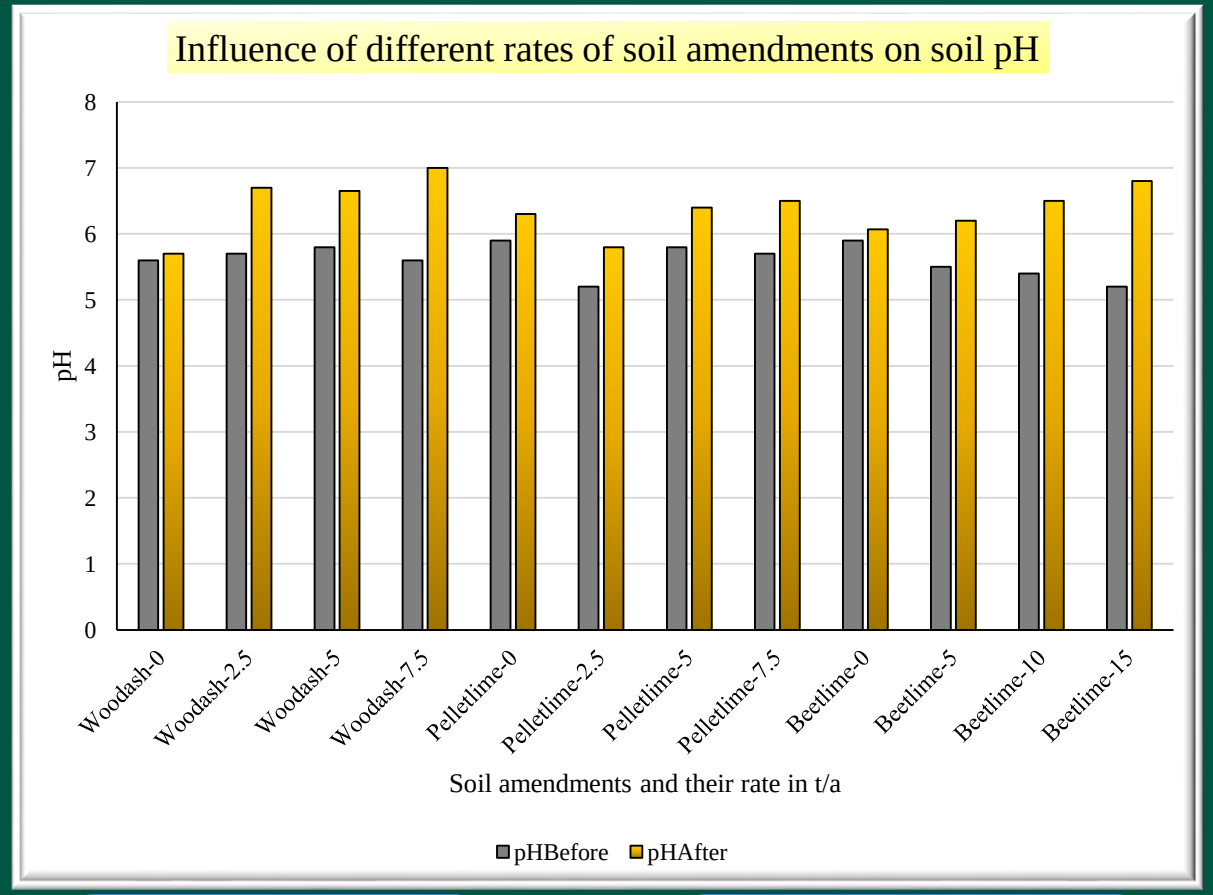
Objective 1 Results: Evaluation of different rates of three soil amendments to manage Clubroot on Canola





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Mean: 55.9
LSD: 29.2
P-Value (0.05): 0.0238*

pH Before application
Mean: 5.6
LSD: 0.44
P-Value (0.05): 0.41NS

pH After application
Mean: 6.4
LSD: 0.7
P-Value (0.05): 0.0049*

Objective 2: Evaluation of Surfactant to Manage Clubroot Under Field Condition

entry	Treatment	Rate
1	ORO-RZ	2pt/a
2	TRICHODERMA	10.5oz/a
3	AQUAGRO+ORO	10g/meter of row
4	RANMAN+ORO	7.5l/ha
5	ALLEGRO+ORO	1.75l/ha
6	BEETLIME+ORO	7.5t/ha
7	NANOCAL	4pt/a
8	LIME+ORO	7.5t/ha
9	BEETLIME	7.5t/ha
10	LIME	7.5t/ha
11	CHECK	CHK

Design: RCB
Replicated 4 times

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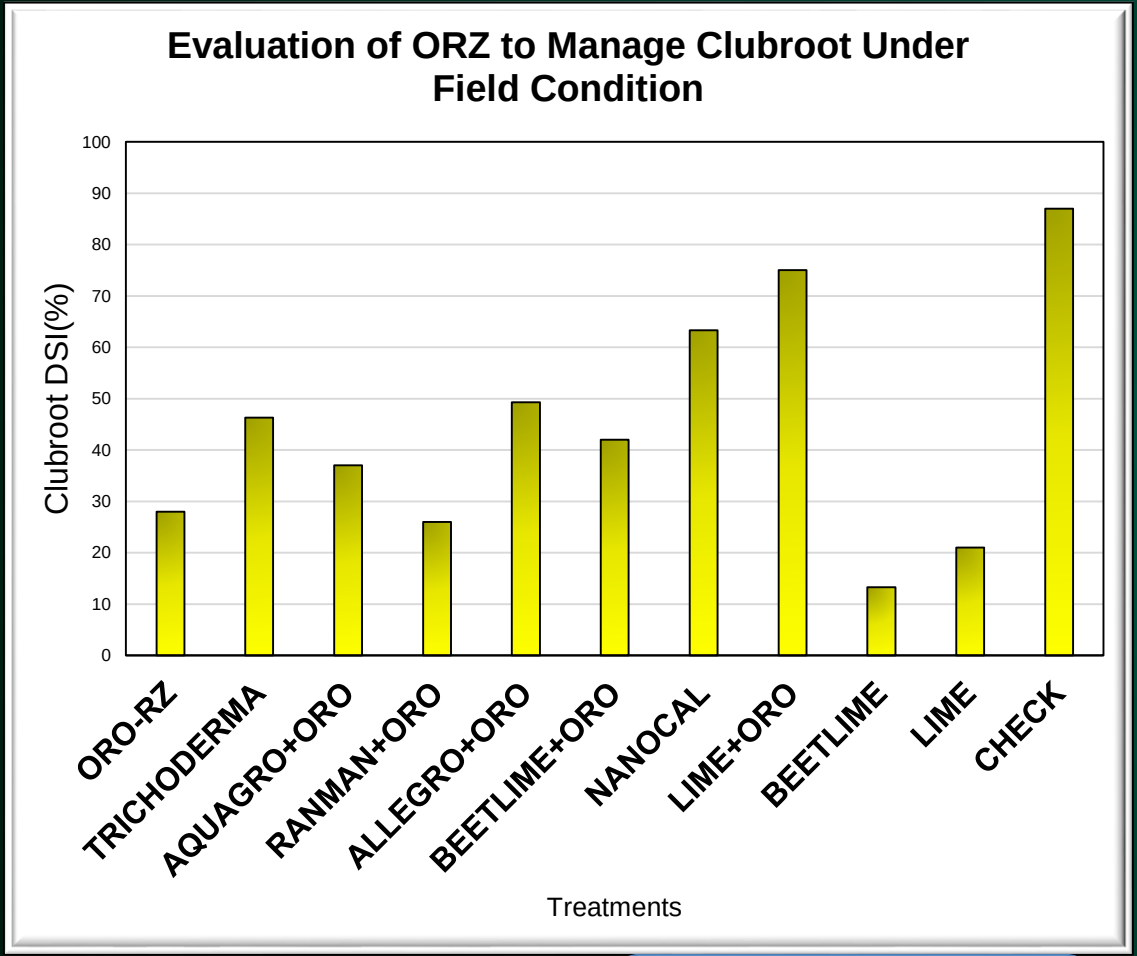
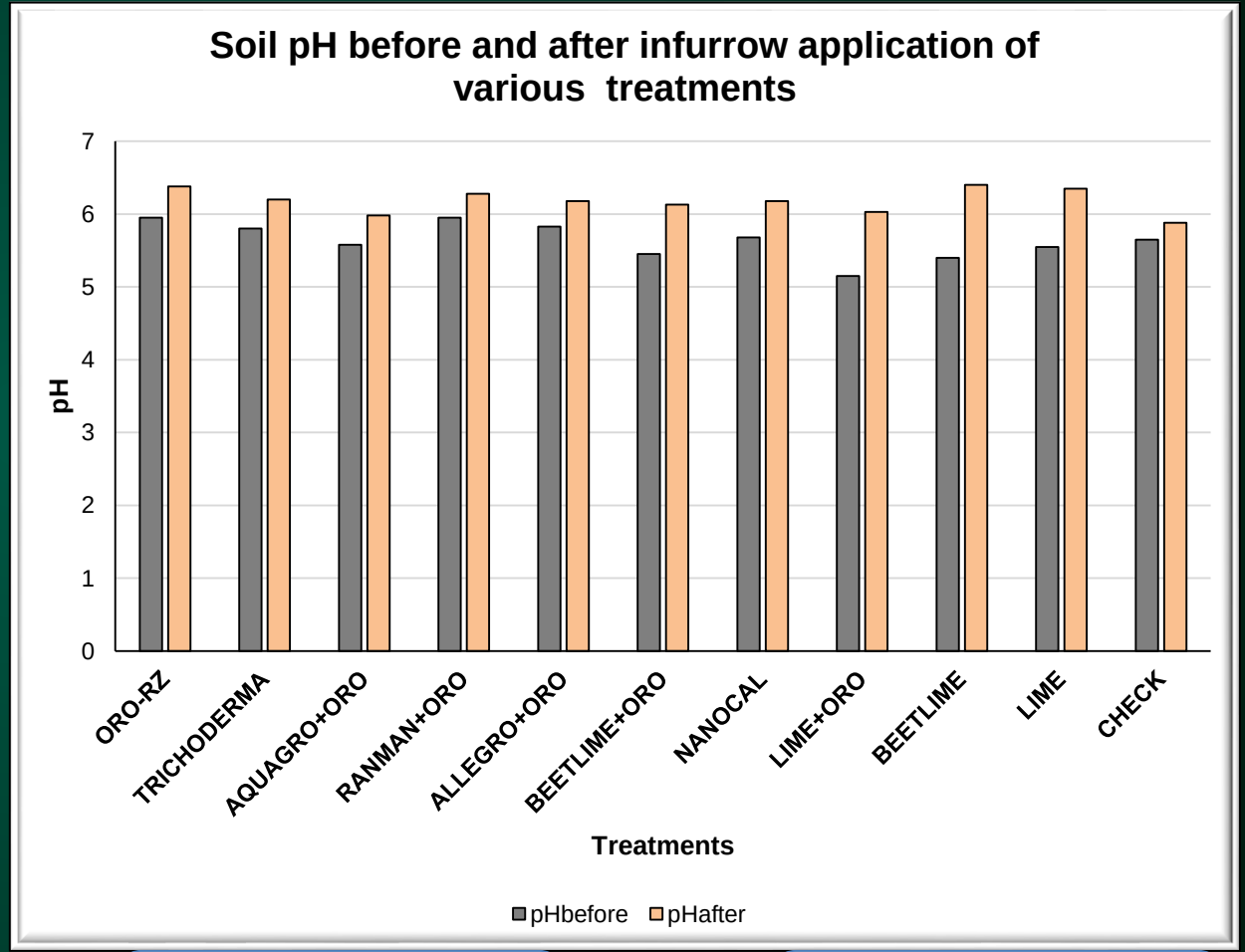
Courtesy: Korey Sundby

Results Objective 2: Evaluation of Surfactant to Manage Clubroot Under Field Condition





Clubroot DSI in Treatments
Mean: 44
LSD: 44
P-Value (0.05): 0.0417*

pH Before application
Mean: 5.6
LSD: 0.56
P-Value (0.05): 0.163NS

pH After application
Mean: 6.2
LSD: 0.61
P-Value (0.05): 0.8895NS

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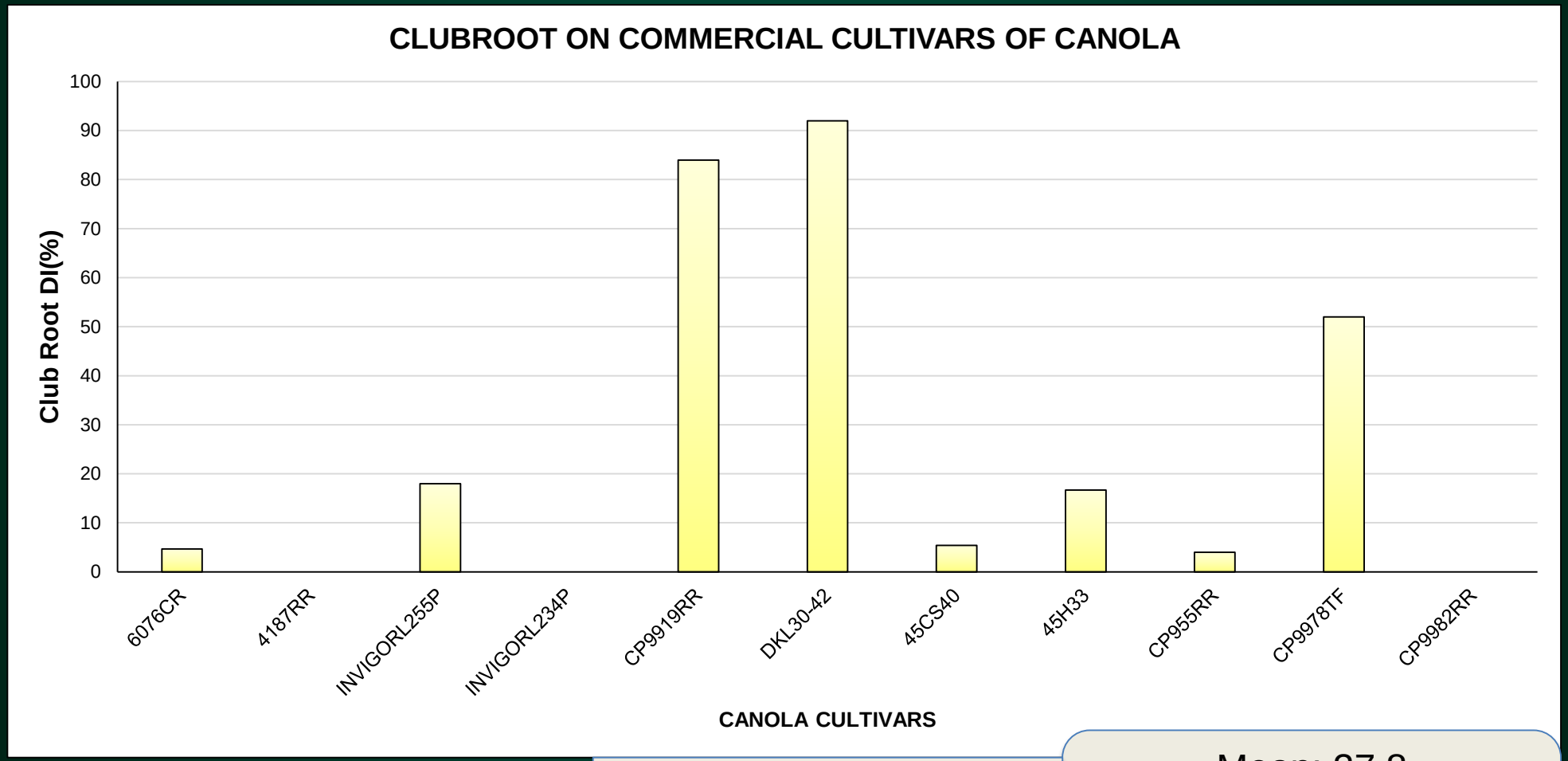
Evaluation of Cultivar Resistance to Clubroot-2019



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Check: DKL-30-42

Mean: 27.8
LSD: 29.2
P-Value: 0.00001

Plasmodiophora brassicae pathotype determination in North Dakota

- Galls collected from 33 clubroot infected canola fields in 2018
- Representative samples were screened By Dr. Strelkov research group in Alberta, Canada

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Clubroot on Canola- Pathotype designations of *Plasmodiphora brassicae* from North Dakota

Common Clubroot Pathotypes: 2,3,5,6 and 8 (Williams et al. 1966) - 4 differentials can separate 16 pathotypes (P3A is Variant of P3)

Some et al. 1996: P1, P2, P3,P4 and P5 (3 differentials, 5 pathotypes)

Canadian Clubroot Differentials {CCD} set; Uses 13 brassica hosts.

Sample	North Dakota clubroot Pathotype Designation		
	Some et al. (1996)	Williams (1966)	Canadian Clubroot Differential Set
FFCR	P3	8	Novel
MMCR	P3	2	Novel
PBCR-2	P2	8	N
RBCR-4	P3	8	Novel
RBCR-5	P3	8	AE
YCR-16	P3	8	Novel

Dr. Strelkov, Alberta

European Clubroot Differential (ECD) – 15 Differentials can differentiate 35 pathotypes (16/15/15)

Threshold >50%

Summary

- Clubroot spreading to new fields in North Dakota
- Visible symptoms were reported from acidic pH soils
- Beet lime, and Pellet lime can be used in **clubroot patch** management
- Surfactants need more years of study
- Resistant varieties are available to manage clubroot with recommended length of rotations
- Pathotypes of *P. brassicae* determined so far in North Dakota are manageable with the currently available CR resistant canola varieties

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Thank You

Acknowledgements

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To all my colleagues and to MANY OTHERS