



Native Seedlings to Resist Canada Thistle Invasion

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Functional Groups Research



Resistance to Invasive Canada thistle

PROBLEM: Poor stand establishment leaves sites open to invasive weeds

Establishment is the critical weak link in restoring or re-establishing prairie

OBJECTIVE: Develop management practices to encourage the development of resilient prairie ecosystems able to resist Canada thistle and other invasive weeds

Treatments

Time of planting: (Main plots)

1. Fall frost seeding ~ October 20, 2004 and 2005
2. Spring seeding ~ May 5, 2006 and 2007
3. Summer seeding ~ June 20, 2005 and 2006

Seed mix and thistle management (subplots)

1. Plateau (Imazapic) pre-emergence, mow if needed – U3
2. Mow (clip) – U3
3. Transline (clopyralid) post emergence – September –U3
4. Untreated control – U3
5. Cool season plants only
6. Warm season plants only

Methods and Materials

- Former corn and soybean field
- Seeded into smooth brome
- fall treated with glyphosate + 2,4-D
- Prairie seed drilled and packed
- Plateau: applied post plant/premergence

Transline: Fall applied

Data collected:

- Canada thistle stand count in May and August

- Species presence /absence
- Visual biomass %

• Study on-going

Native only, cool only mix @ 15 lb/A PLS

		% of mix
Wild-rye, Canadian	<i>Elymus canadensis</i>	30
Wheat-grass, slender	<i>Elymus trachycaulus</i>	30
Wheat-grass, western	<i>Elytrigia smithii</i>	20
Needle grass, green	<i>Stipa viridula</i>	19
Milkvetch, Canada	<i>Astragalus canadensis</i>	0.4
Penstemon, showy	<i>Penstemon grandiflorum</i>	0.4
Alexanders, golden	<i>Zizia aurea</i>	0.2

Mixture U3 (Native SW MN Mesic Tall-grass Prairie) Seeded at 15 lbs PLS /A

Common Name	Botanical Name	% of Mix	Common Name	Botanical Name	% of Mix
Oats or winter wheat*	<i>Avena sativa</i> or <i>Triticum aestivum</i>	32	Milkvetch, Canada	<i>Astragalus canadensis</i>	0.4
Wild-rye, Canadian	<i>Elymus canadensis</i>	6	Penstemon, showy	<i>Penstemon grandiflorum</i>	0.2
Wheat-grass, slender	<i>Elymus trachycaulus</i>	6	Alexanders, golden	<i>Zizia aurea</i>	0.4
Wheat-grass, western	<i>Elytrigia smithii</i>	4	Milkweed, butterfly	<i>Asclepias tuberosa</i>	0.4
Rye-grass, annual	<i>Lolium italicum</i>	8	Aster, smooth-blue	<i>Aster laevis</i>	0.2
Needle grass, green	<i>Stipa viridula</i>	4	Partridge pea	<i>Chamaecrista fasciculata</i>	0.4
Bluestem, big	<i>Andropogon gerardi</i>	6	Prairie clover, white	<i>Dalea candidum</i>	0.2
Grama, sideoats	<i>Bouteloua curtipendula</i>	6	Prairie clover, purple	<i>Dalea purpureum</i>	0.4
Switch grass	<i>Panicum virgatum</i>	1	Tick-trefoil, showy	<i>Desmodium canadense</i>	0.4
Bluestem, little	<i>Schizachyrium scoparium</i>	10	Coneflower, narrow-leaved	<i>Echinacea angustifolia</i>	0.4
Indian grass	<i>Sorghastrum nutans</i>	10	Sunflower, early	<i>Heliopsis helianthoides</i>	0.4
Dropseed, tall	<i>Sporobolus asper</i>	1	Blazingstar, rough	<i>Liatris aspera</i>	0.2
			Blazingstar, tall	<i>Liatris pycnostachya</i>	0.2
			Bergamot, wild	<i>Monarda fistulosa</i>	0.2
			Coneflower, columnar	<i>Ratibida columnifera</i>	0.2
			Coneflower, grey-headed	<i>Ratibida pinnata</i>	0.4
			Black-eyed Susan	<i>Rudbeckia hirta</i>	0.4
			Goldenrod, stiff	<i>Solidago rigida</i>	0.2
			Vervain, blue	<i>Verbena hastata</i>	0.2
			Vervain, hoary	<i>Verbena stricta</i>	0.2

Native only, warm only mix @ 15 lb/A PLS

		% of mix
Bluestem, big	<i>Andropogon gerardi</i>	24
Switch grass	<i>Panicum virgatum</i>	5
Bluestem, little	<i>Schizachyrium scoparium</i>	35
Indian grass	<i>Sorghastrum nutans</i>	35
Coneflower, grey-headed	<i>Ratibida pinnata</i>	0.4
Goldenrod, stiff	<i>Solidago rigida</i>	0.4
Vervain, hoary	<i>Verbena stricta</i>	0.2

4 replicates of each treatment

Randomized split plot experimental design

Summer Seeded 2005 Transline POST U3 Mix 207	Clip as needed U3 Mix 208	Cool Only Control Clip as needed 209	Warm Only Control Clip as needed 210	Plateau PRE U3 Mix 211	Control U3 Mix 212
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Plot size 20 ft by 20 ft
(6.1 m by 6.1 M)

Over seeded
10 Canada thistle
Per square ft (108/m²)
in center 5 ft² (0.46 m²)
Lightly rake in before seeding

4 replicates of each treatment

Randomized split plot experimental design

3 Planting periods

- Fall dormant
- Spring
- Summer

6 functional group treatments

U3 Mix Summer Seeded 2005 Transline POST 207	U3 Mix Clip as needed 208	Cool Only Control Clip as needed 209	Warm Only Control Clip as needed 210	U3 Mix Plateau PRE 211	U3 Mix Control 212
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Plot size 20 ft by 20 ft
(6.1 m by 6.1 M)

Seeded 10 Canada thistle/ft² (108/m²)
in center 5 ft² (0.46 m²), lightly raked in



Functional Groups Research



Effect of Time of Planting (first count after Transline application)

Season and year	Thistle shoots/m ²
Fall 2004	52.6 a
Summer 2005	12.2 b
Spring 2007	11.5 bc
Summer 2006	5.8 cd
Fall 2005	5.6 d
Spring 2006	2.1 e

Effect of Management strategies (first count after fall clopyralid application)

Treatment	Thistle shoots/m ²
Warm season only	20.8 a
Mix Control	12.9 ab
Mix Plateau	11.0 b
Mix Clip	9.1 b
Cool season only	8.4 b
Mix Transline	2.5 c

Interaction between management strategies and time of establishment (first count after fall clopyralid application)

	Thistle shoots/m ²					
Treatment	F04	Su05	F05	Sp06	Su06	Sp07
Warm	99.8 a	29.9 a	10.4 a	6.5 a	7.4 ab	47.6 a
Mix Control	61.7 a	10.8 a	6.1 a	5.9 ab	6.9 ab	25.4 a
Mix Plateau	60.6 a	10.8 a	4.5 a	5.4 ab	3.7 ab	24.0 a
Mix Clip	60.2 a	15.8 a	9.2 a	1.0 bc	14.9 a	23.6 a
Cool	42.2 ab	12.0 a	3.7 a	0.3 c	8.9 ab	3.8 b
Mix Transline	21.9 b	4.6 a	2.6 a	0.0 c	1.0 b	0.0 c

Est. Fall 2004 Canada thistle (shoots/m²)

Trt.	8/05	5/06	8/06	5/07	8/07	5/08
Mix Clip	111.9 a	64.6 abc	61.4 ab	53.8 a	28.5 a	40.4 a
Cool	88.8 a	50.6 bc	52.2 ab	46.3 a	32.8 a	36.6 a
Mix Plateau	145.9 a	63.5 abc	47.9 ab	41.4 a	33.9 a	35.0 a
Mix Trans.	143.2 a	24.8 c	28.0 b	30.7 a	22.6 a	20.4 a
Warm	119.4 a	100.6 a	72.7 a	64.1 a	34.4 a	31.2 a
Mix Control	155.0 a	82.8 ab	54.9 ab	50.6 a	38.2 a	35.0 a

% COVER Results



Warm season only est. summer 2005



U3 Mix Clopyralid est. summer 2005



2008

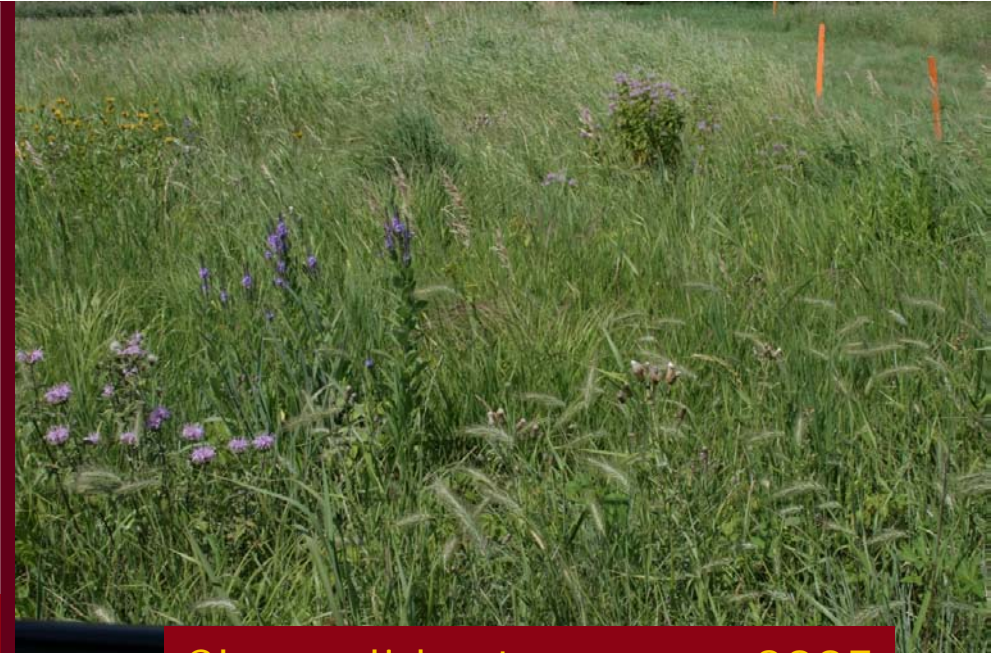
Cool season only est. summer 2005



U3 Mix Control est. summer 2005



Warm season only est. summer 2005



Clopyralid est. summer 2005

2010



Cool season only est. summer 2005



Untreated Control est. summer 2005



U3 Mix Imazapic Summer 2005

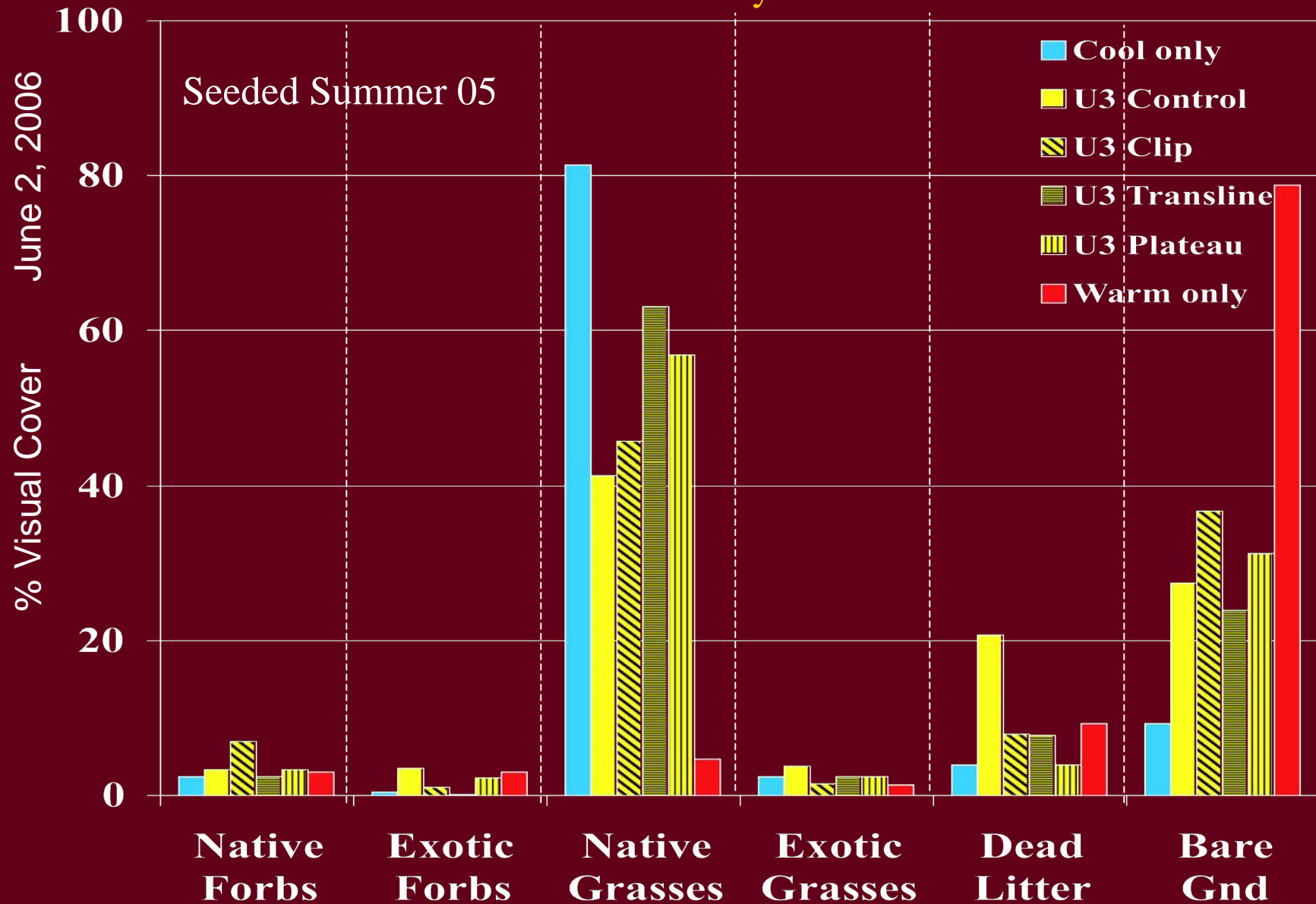


U3 Mix Clip Summer 2005

2010

Rep 3

Functional Group x Canada Thistle Est. Lamberton, MN. 2004 - 2006 Cycle.



U3 Transline trts. Just applied n = 4.

Succession Observations

Control est. Spring 2006



Control est. Spring 2007



2008

Control est. Summer 2005



Control est. Summer 2006





Control est. Fall 2004



Control est. Fall 2005

2008

Control est. Spring 2006

Control est. Spring 2007

2010

Control est. Summer 2005

Control est. Summer 2006





Control est. Fall 2004

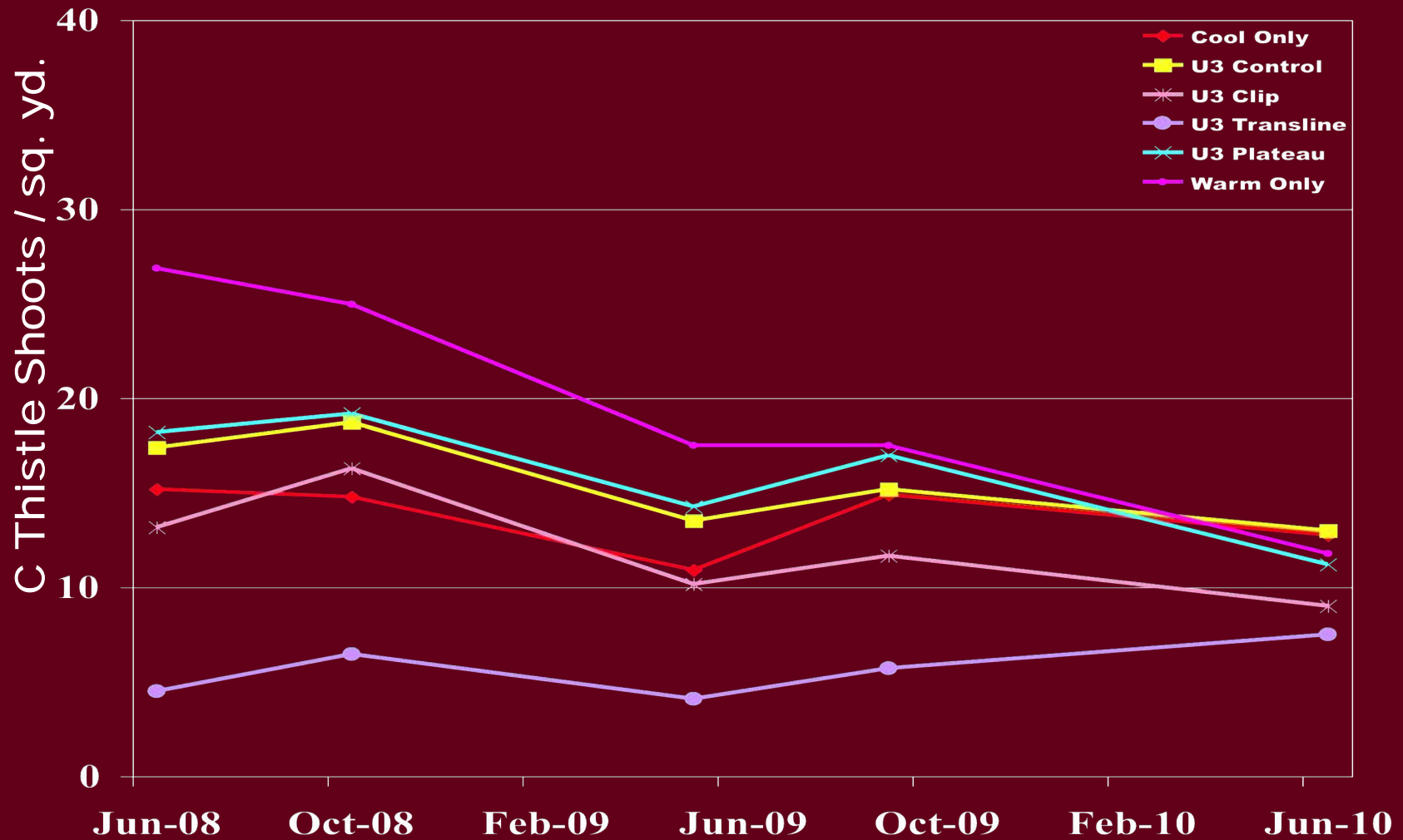


Control est. Fall 2005

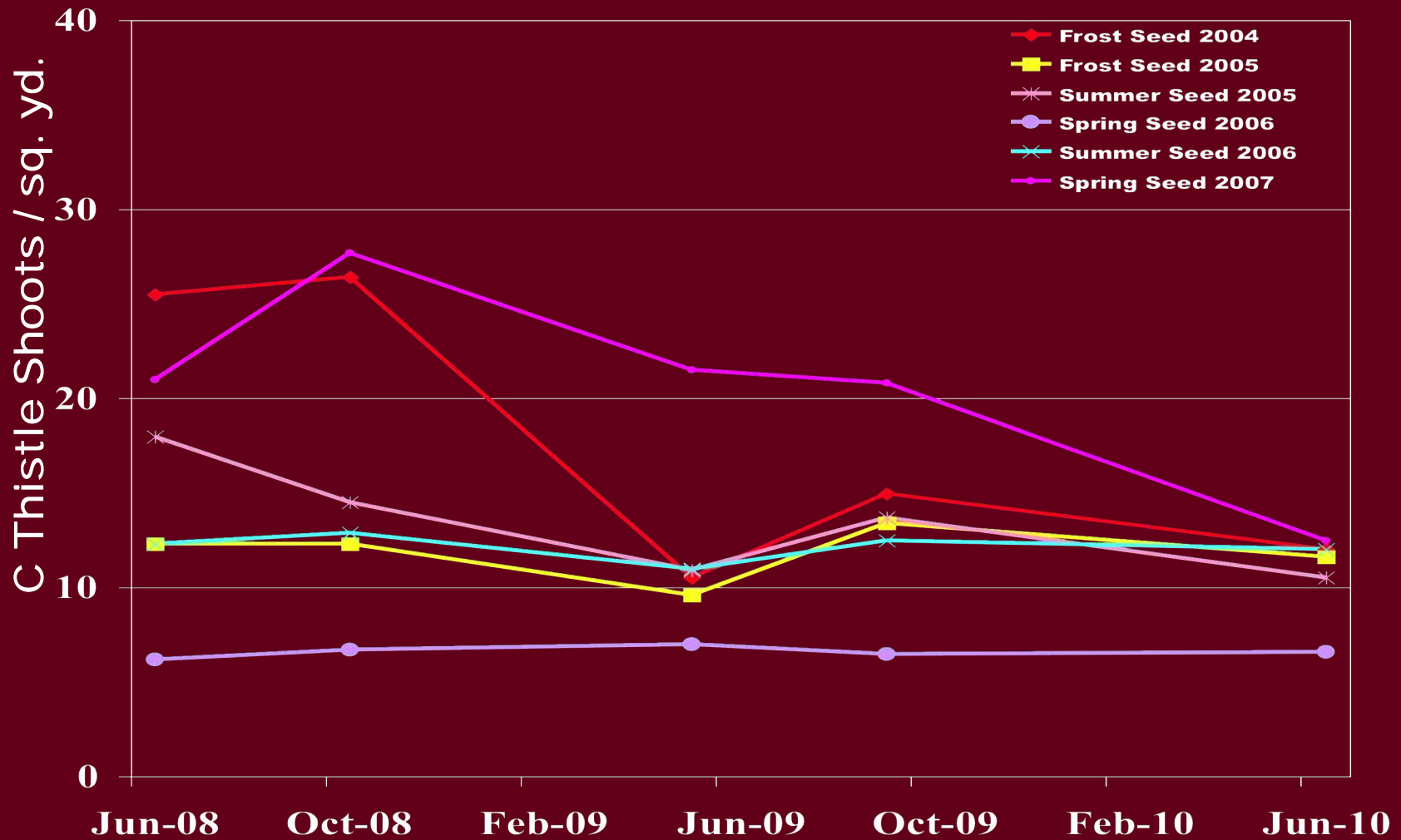
2010

Check 04 and 05 - earlier slide too -are

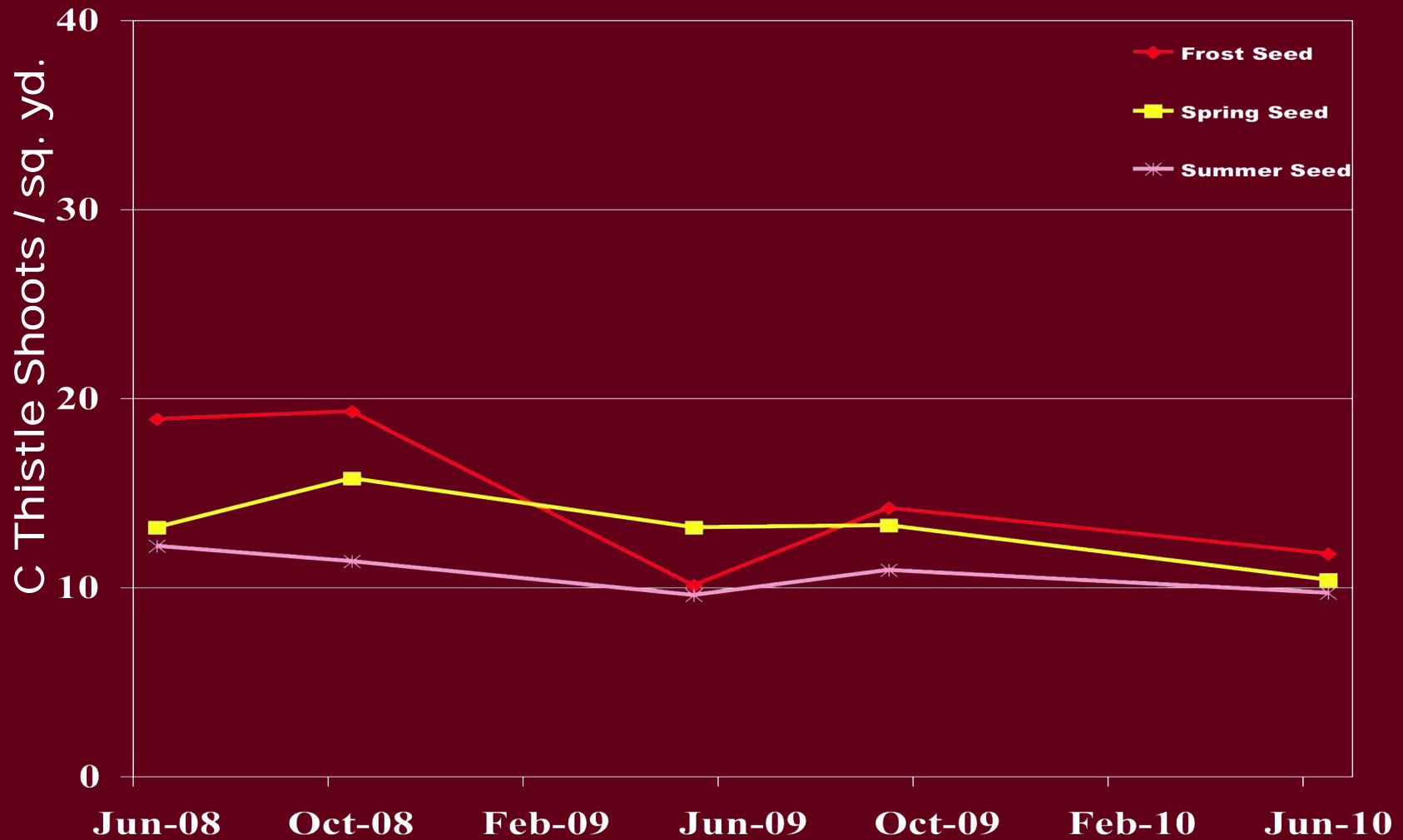
Functional Group x Canada Thistle Est. Lamberton, MN. Canth Shoot Cnts. Over Time



Functional Group x Canada Thistle Est. Lamberton, MN. Canth Shoot Cnts. Over Time



Functional Group x Canada Thistle Est. Lamberton, MN. Canth Shoot Cnts. Over Time



n = 48.

Resistance to Invasion Summary

- Season of planting effects variable
 - Environment key - year to year variation in establishment of Canada thistle and natives
- Sub-treatment effects
 - Clopyralid most effective 2^o management treatment
 - Plateau not an effective treatment
 - Scout early to determine if herbicide intervention warranted
 - Clipping helps depending on environment

Functional Groups Matter

- Important to include cool and warm season grasses and forbs in seed mixes
- Warm season only – worst treatment
- Cool season only – effective especially in Spring plantings

Summary

- Planting season did not effect resistance
- Year to year variation in establishment of Canada thistle great
- Clopyralid most effective management treatment
- Warm season only – worst treatment
- Cool season only – effective especially in Spring plantings

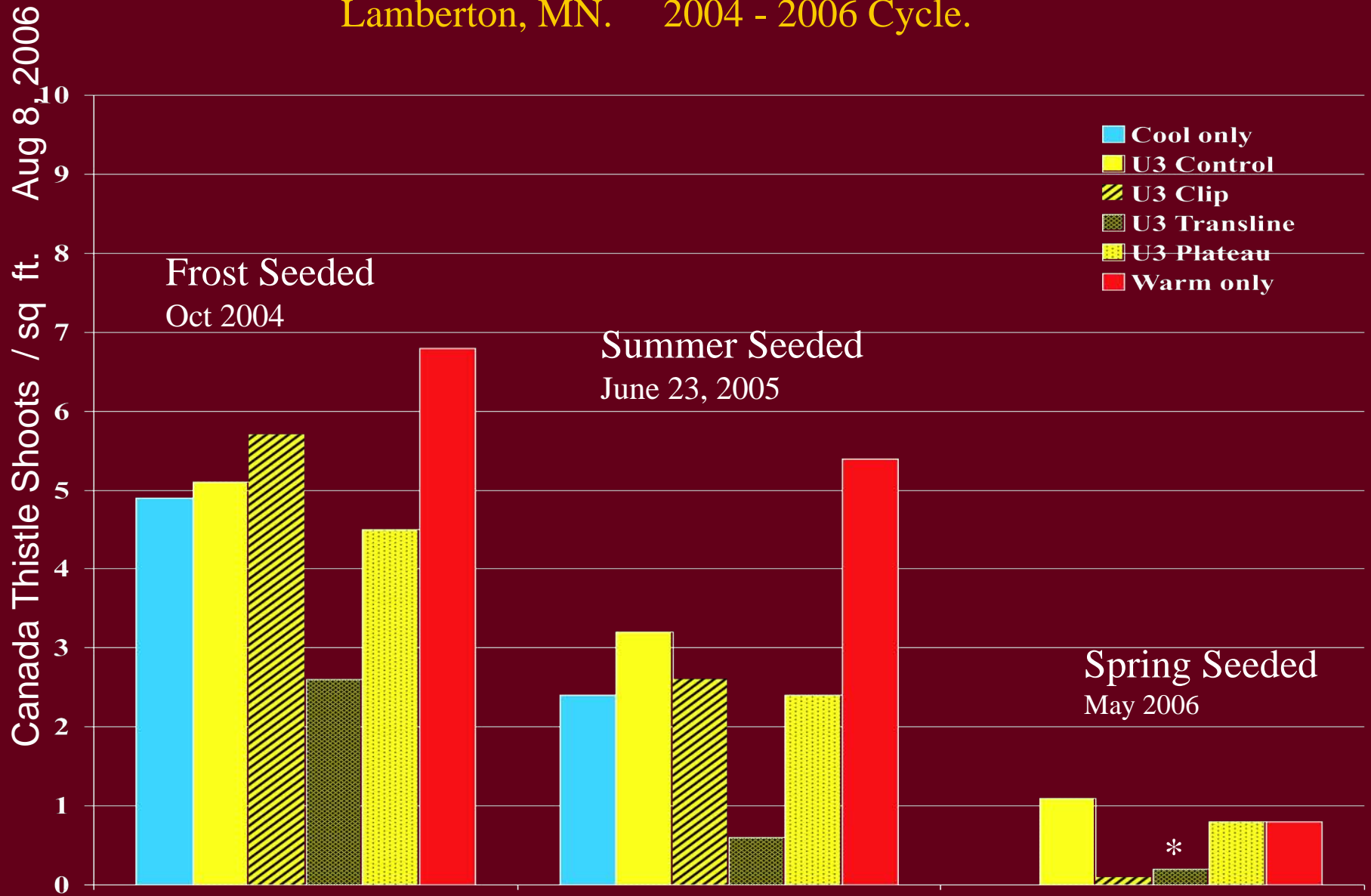
Summary

- Plateau not an effective treatment
- Important to include cool season grasses and forbs in seed mixes
- Clopyralid best management option
- Multiple treatments necessary

Canth Shoot Counts

Functional Group x Canada Thistle Est.

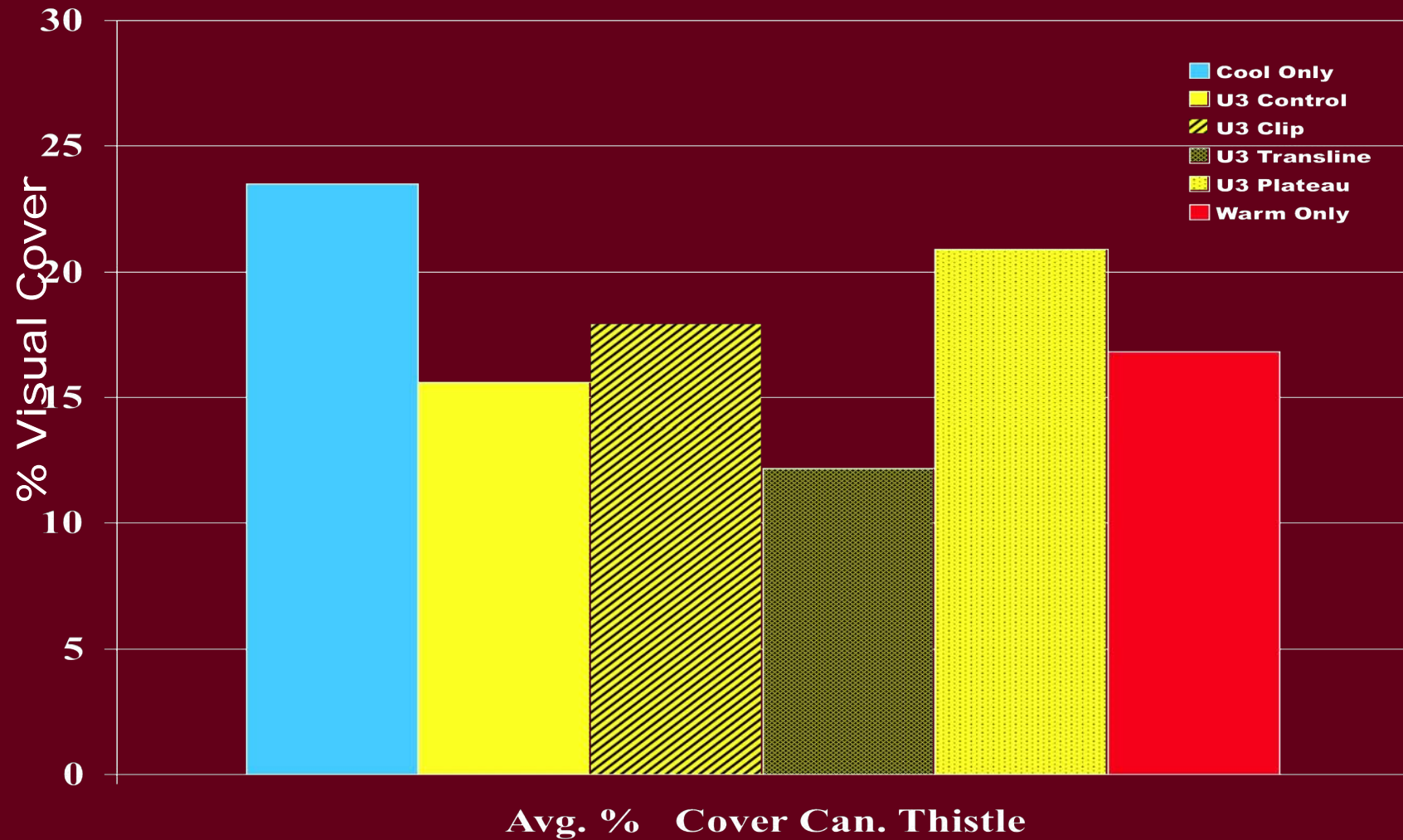
Lamberton, MN. 2004 - 2006 Cycle.



n = 4.

* Transline not applied yet to Spring Seeded 2006 planting.

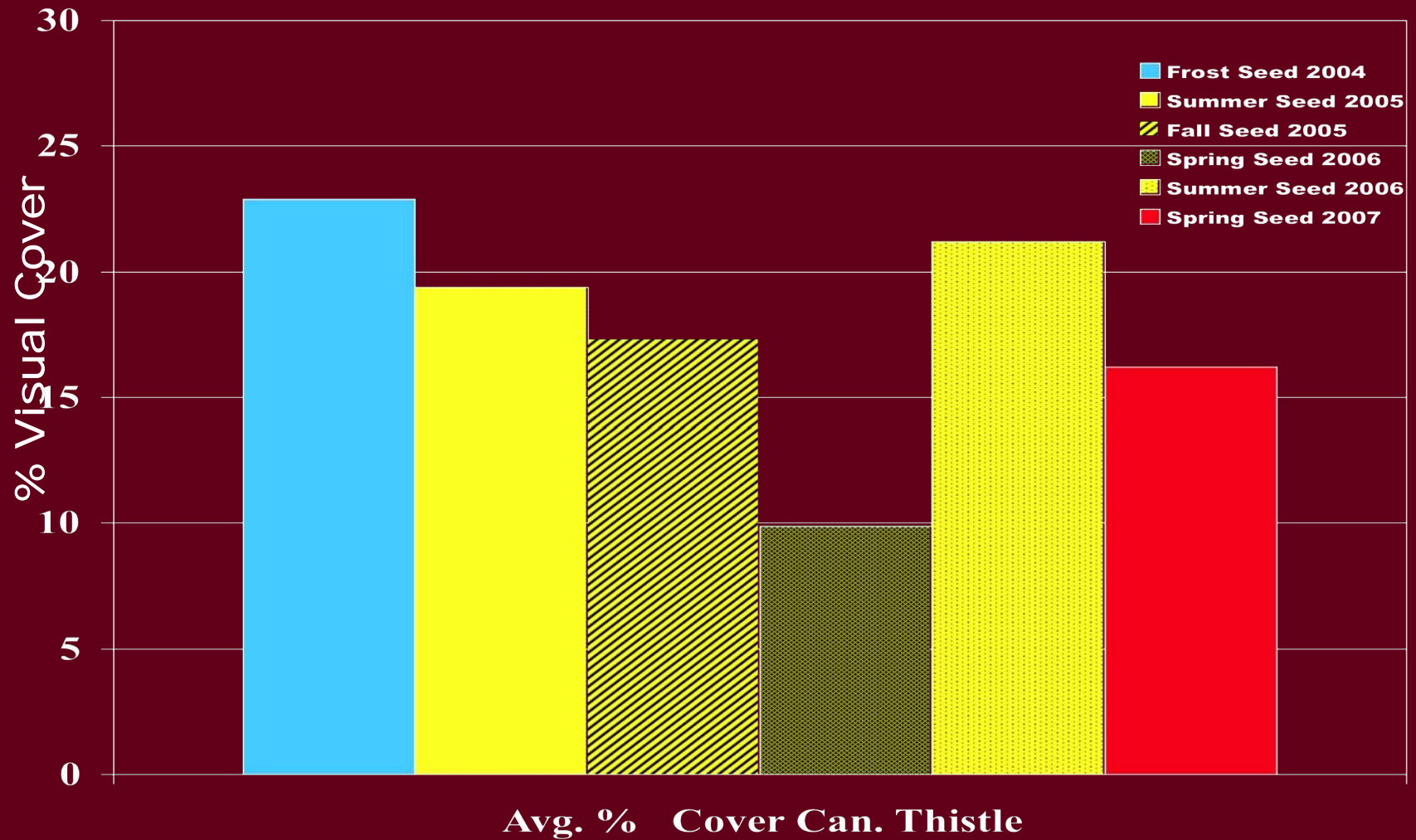
Functional Group x Canada Thistle Est. Lamberton, MN. Sept 17, 2009 Ratings



n = 24.

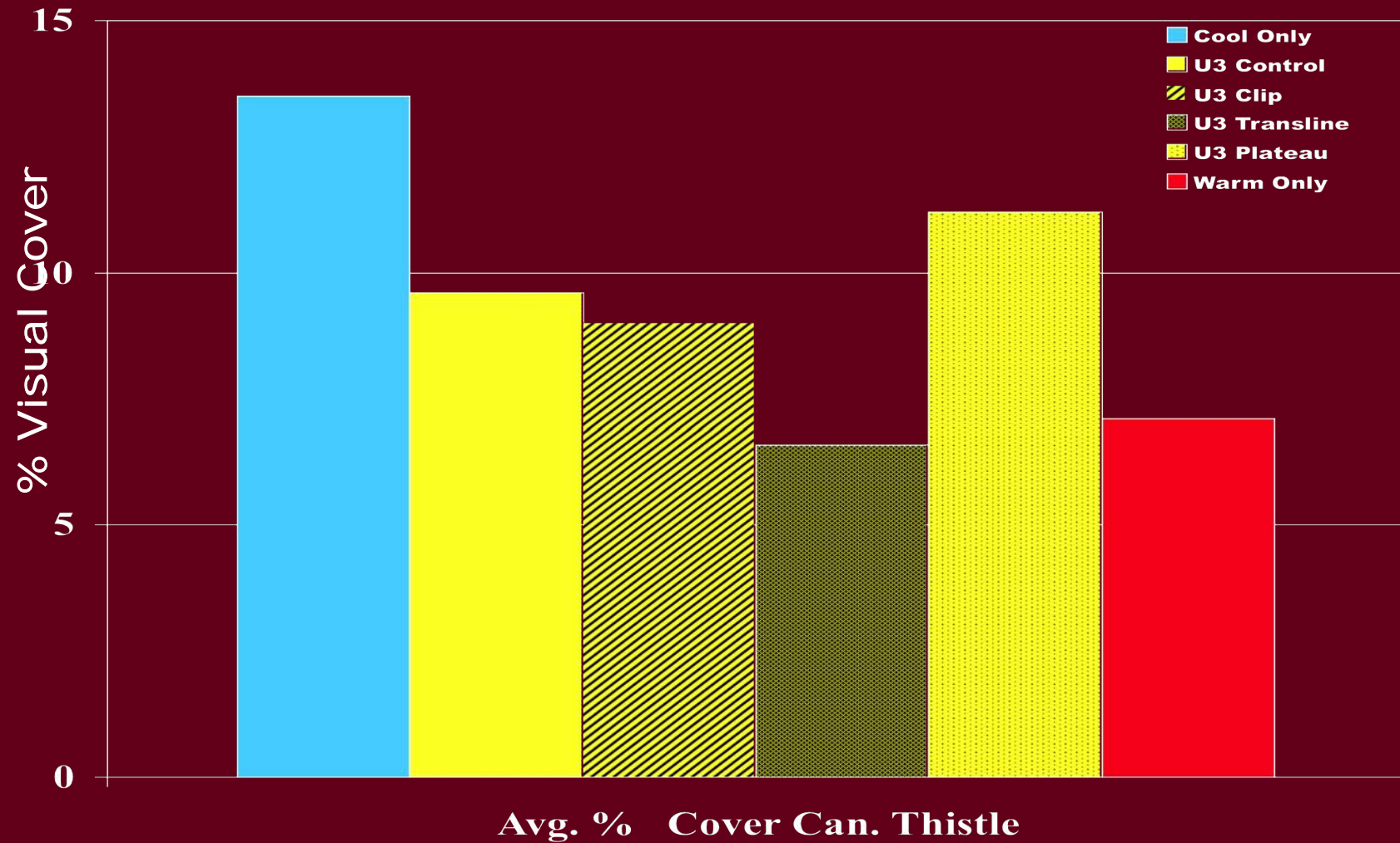
Functional Group x Canada Thistle Est.

Lamberton, MN. Sept 17, 2009 Ratings



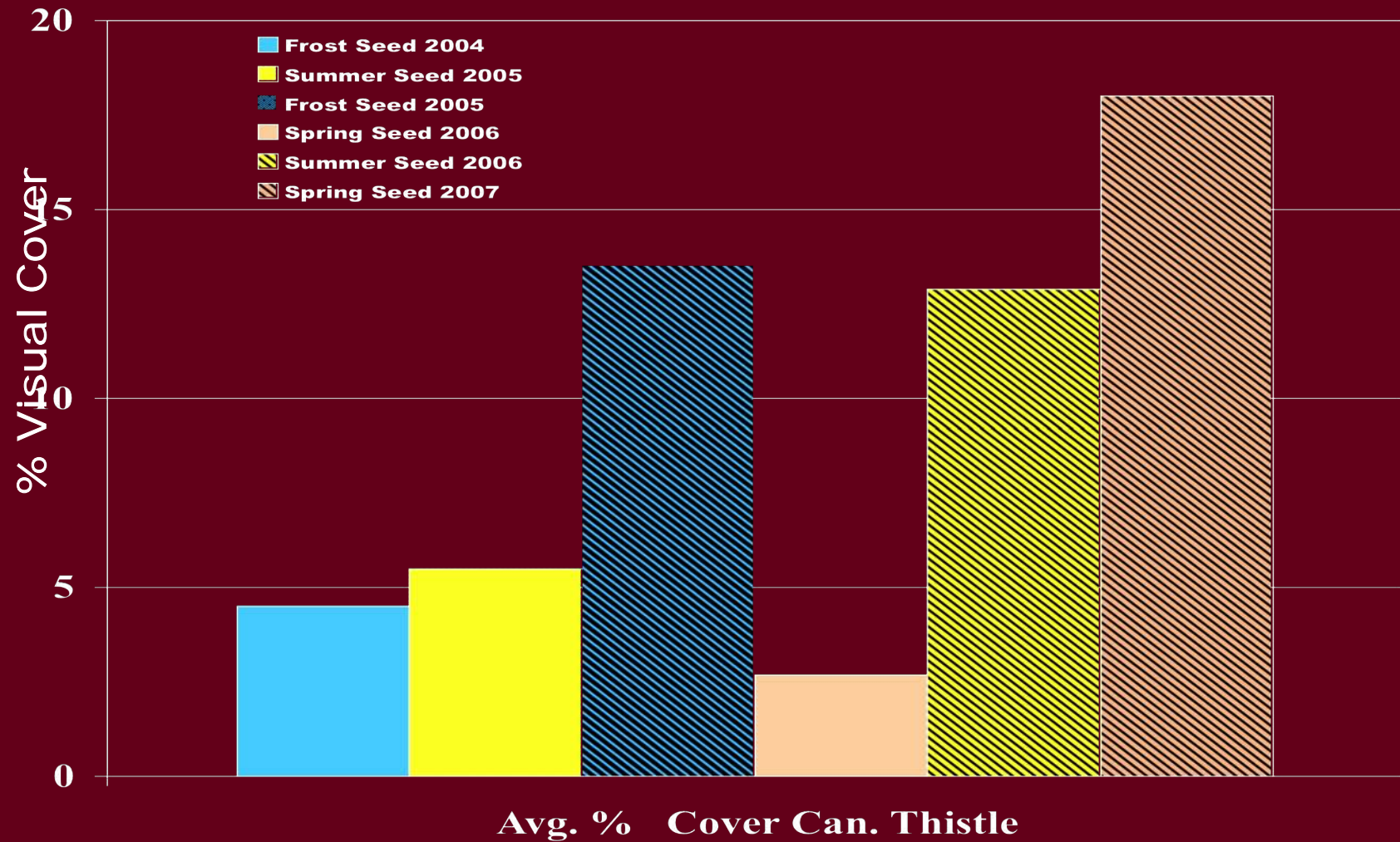
Functional Group x Canada Thistle Est.

Lamberton, MN. Avg. Across Seeding Dates June 9 2010 Ratings



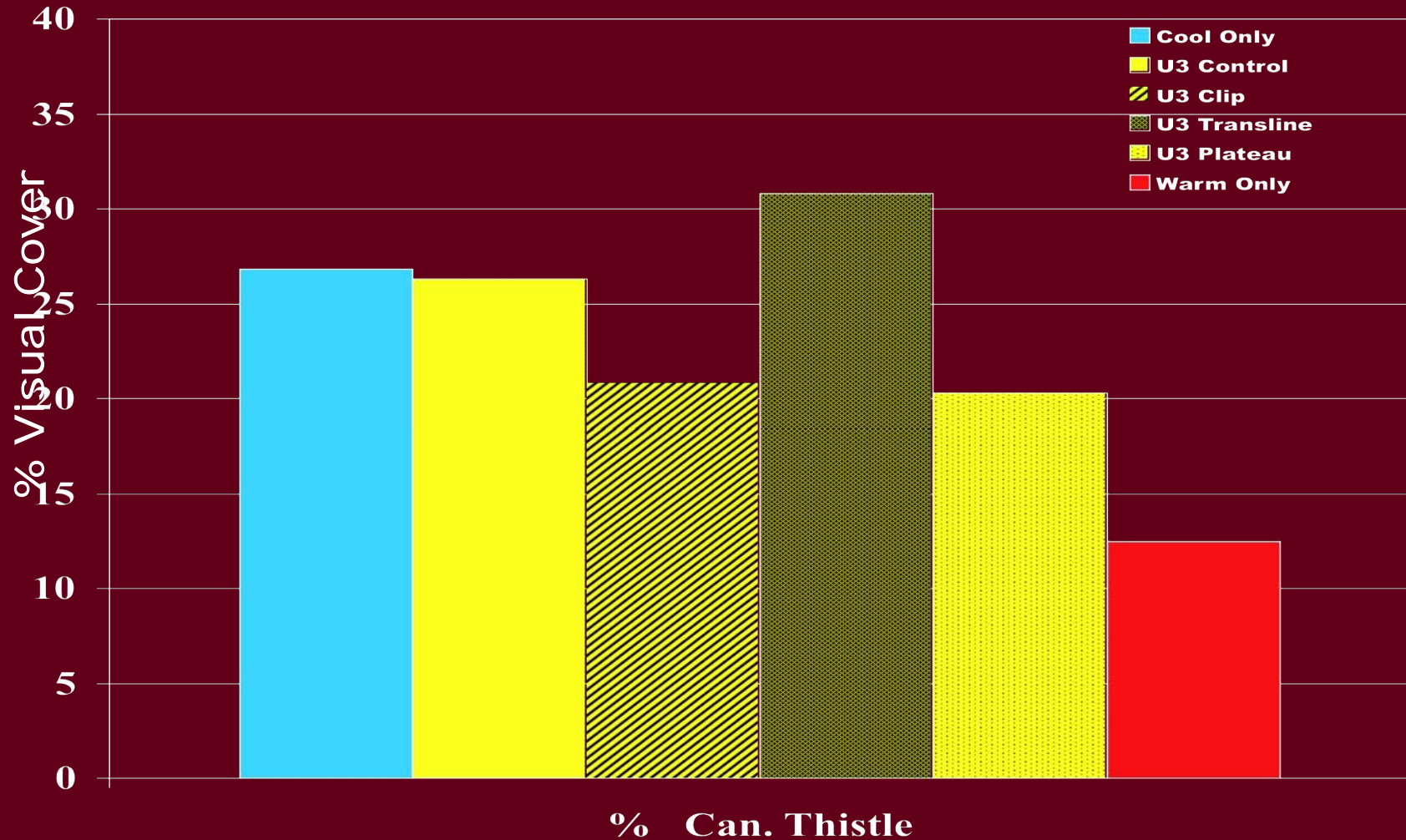
Functional Group x Canada Thistle Est.

Lamberton, MN. Avg. Across Funct. Groups June 9 2010 Ratings



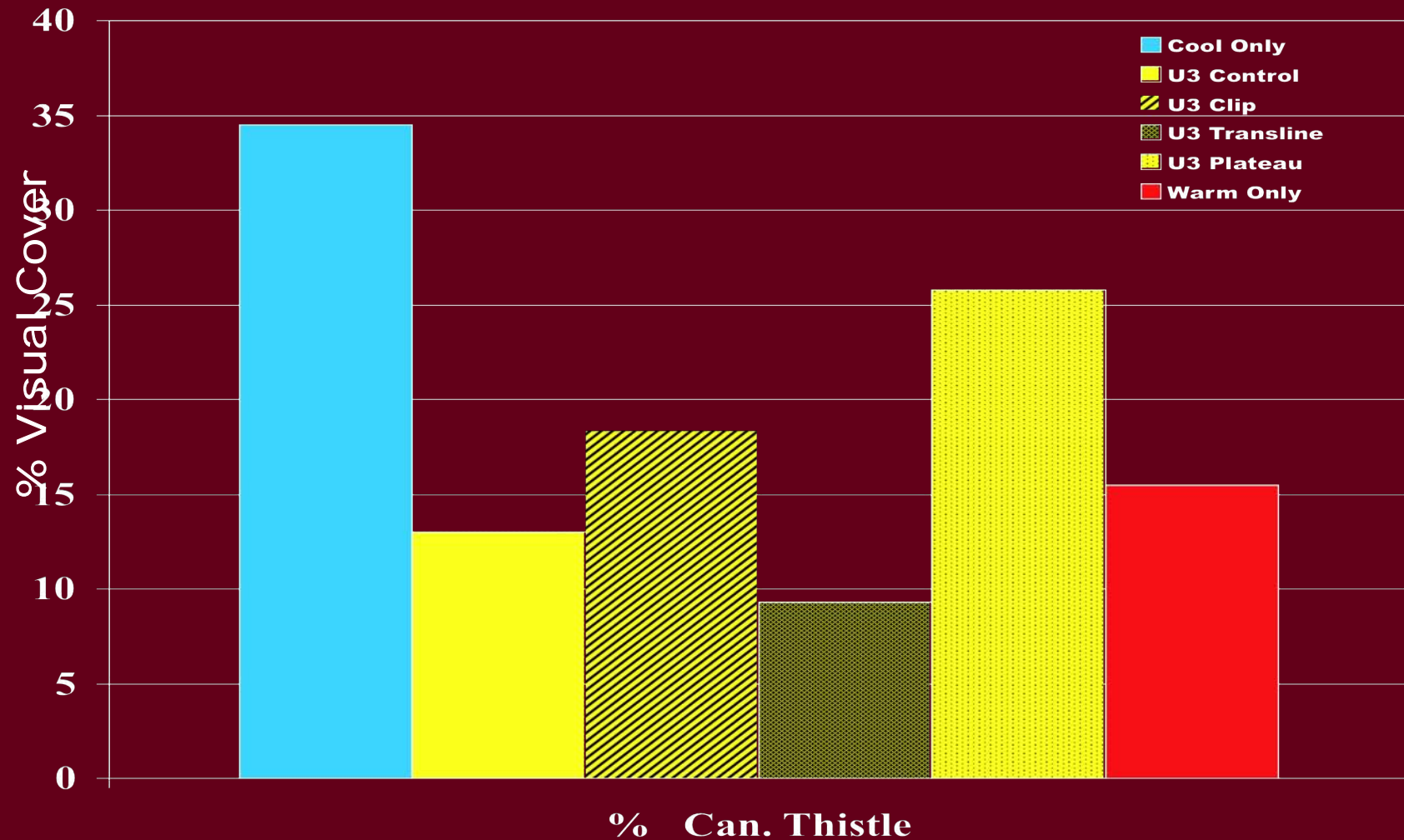
Functional Group x Canada Thistle Est.

Lamberton, MN. Frost Seeded 2004 Sept 17, 2009 Ratings



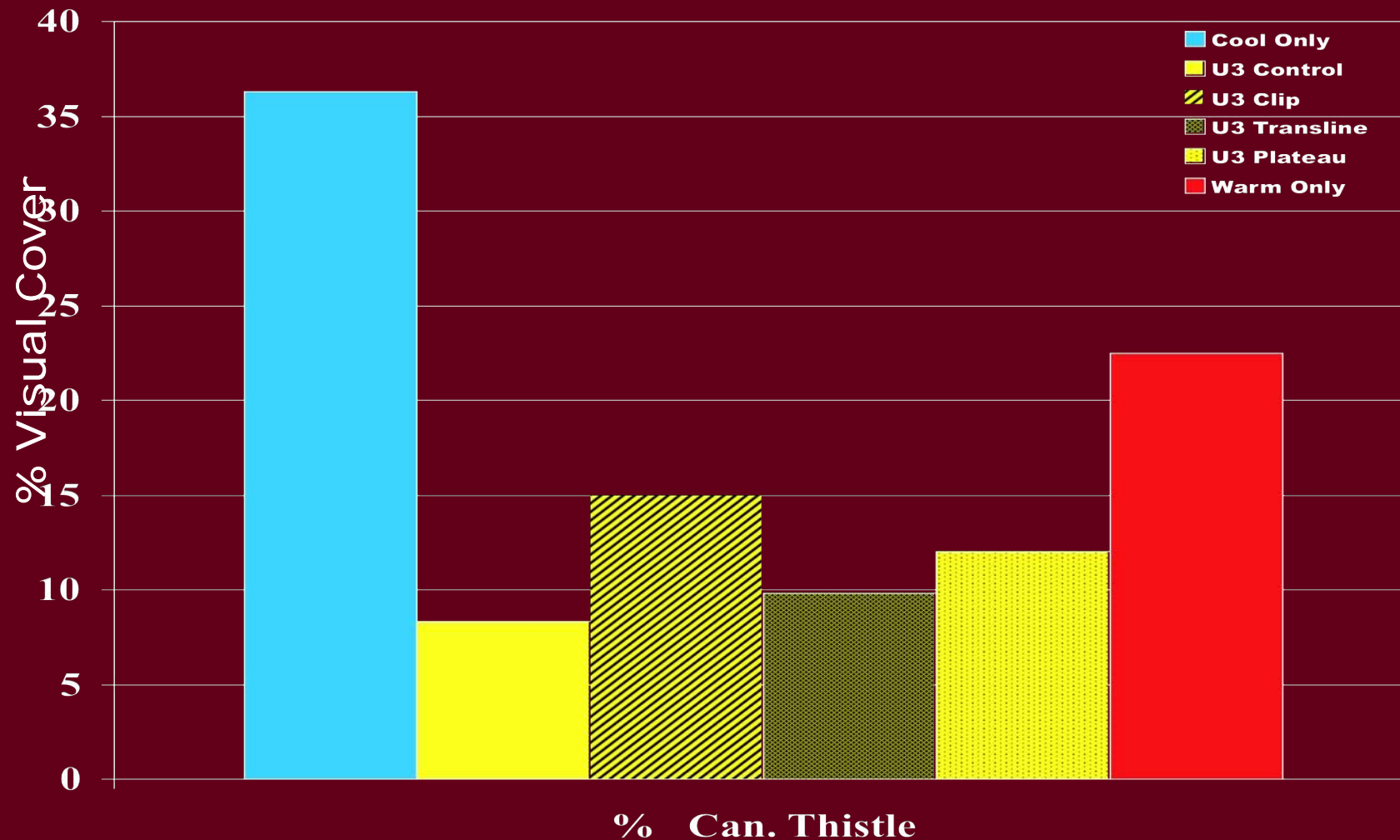
Functional Group x Canada Thistle Est.

Lamberton, MN. Summer Seeded 2005 Sept 17, 2009 Ratings



Functional Group x Canada Thistle Est.

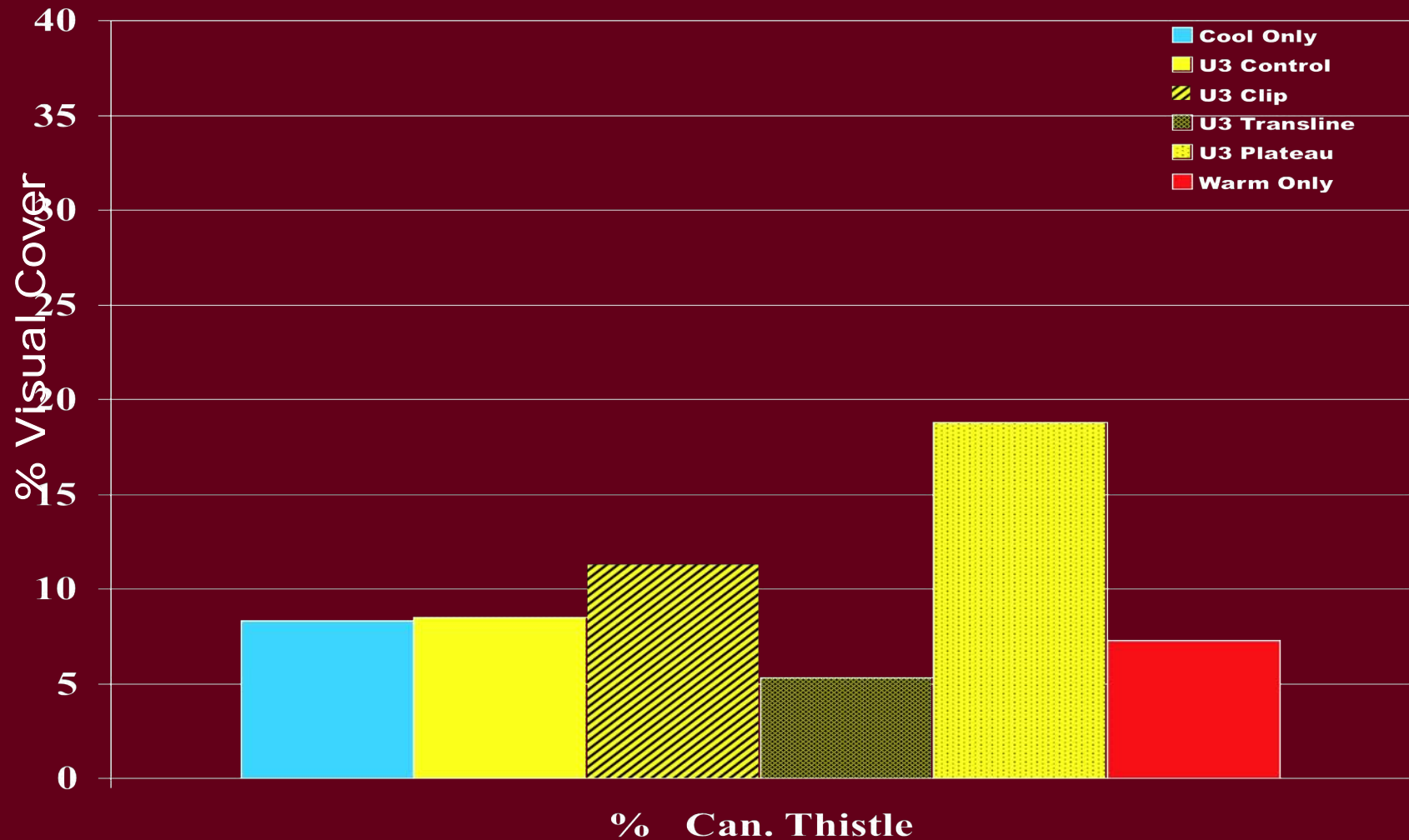
Lamberton, MN. Fall Seeded 2005 Sept 17, 2009 Ratings



n = 24.

Functional Group x Canada Thistle Est.

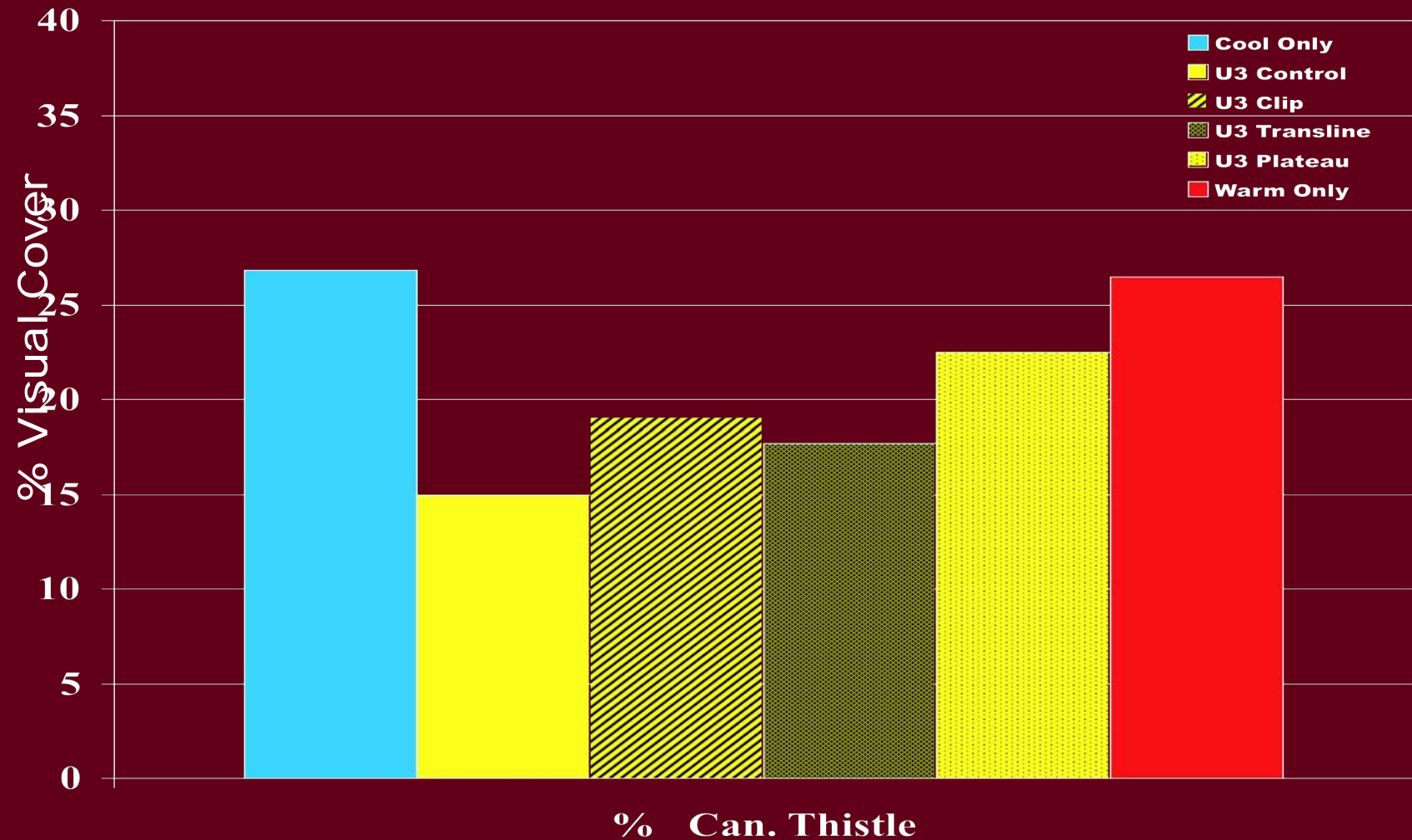
Lamberton, MN. Spring Seeded 2006 Sept 17, 2009 Ratings



n = 24.

Functional Group x Canada Thistle Est.

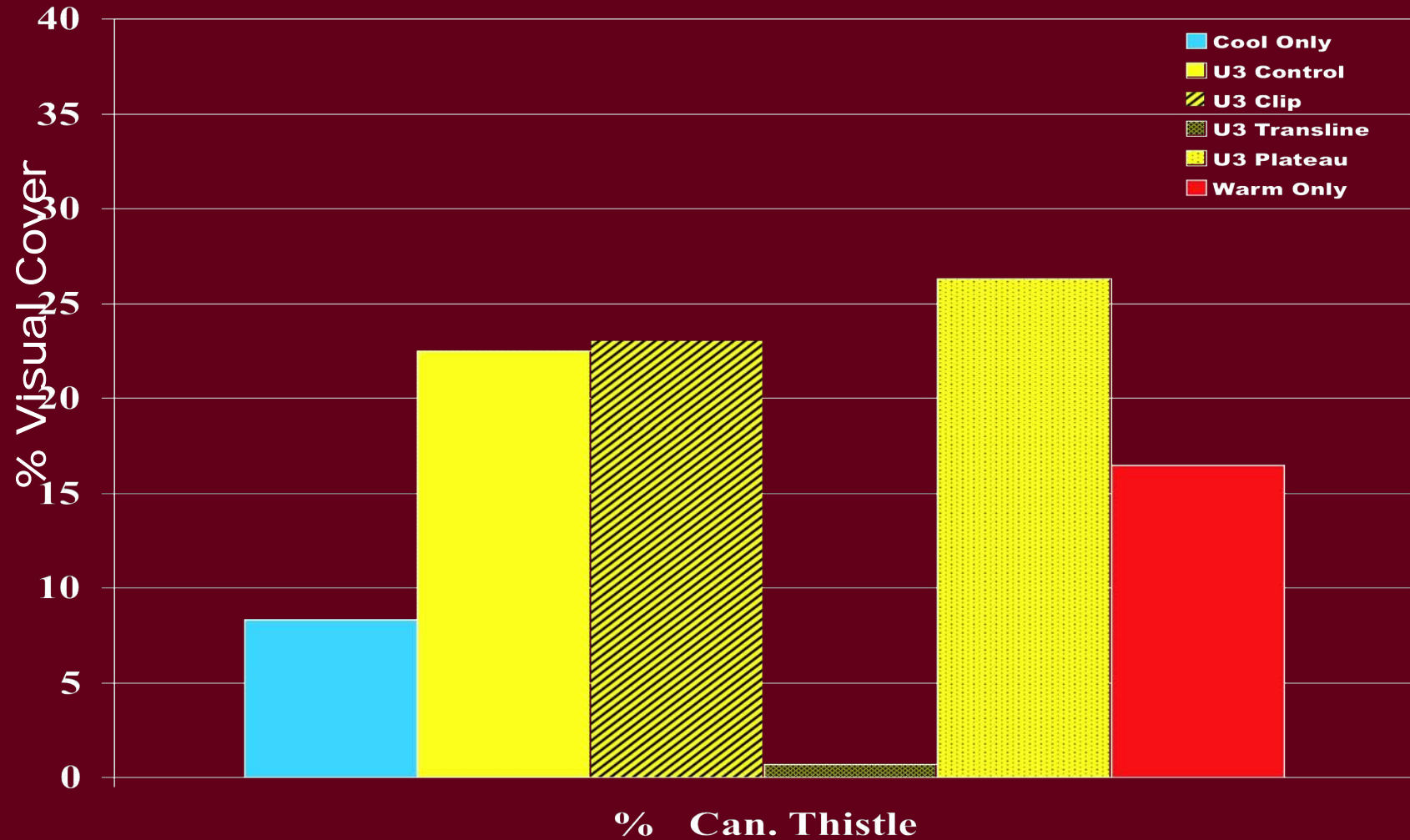
Lamberton, MN. Summer Seeded 2006 Sept 17, 2009 Ratings



n = 24.

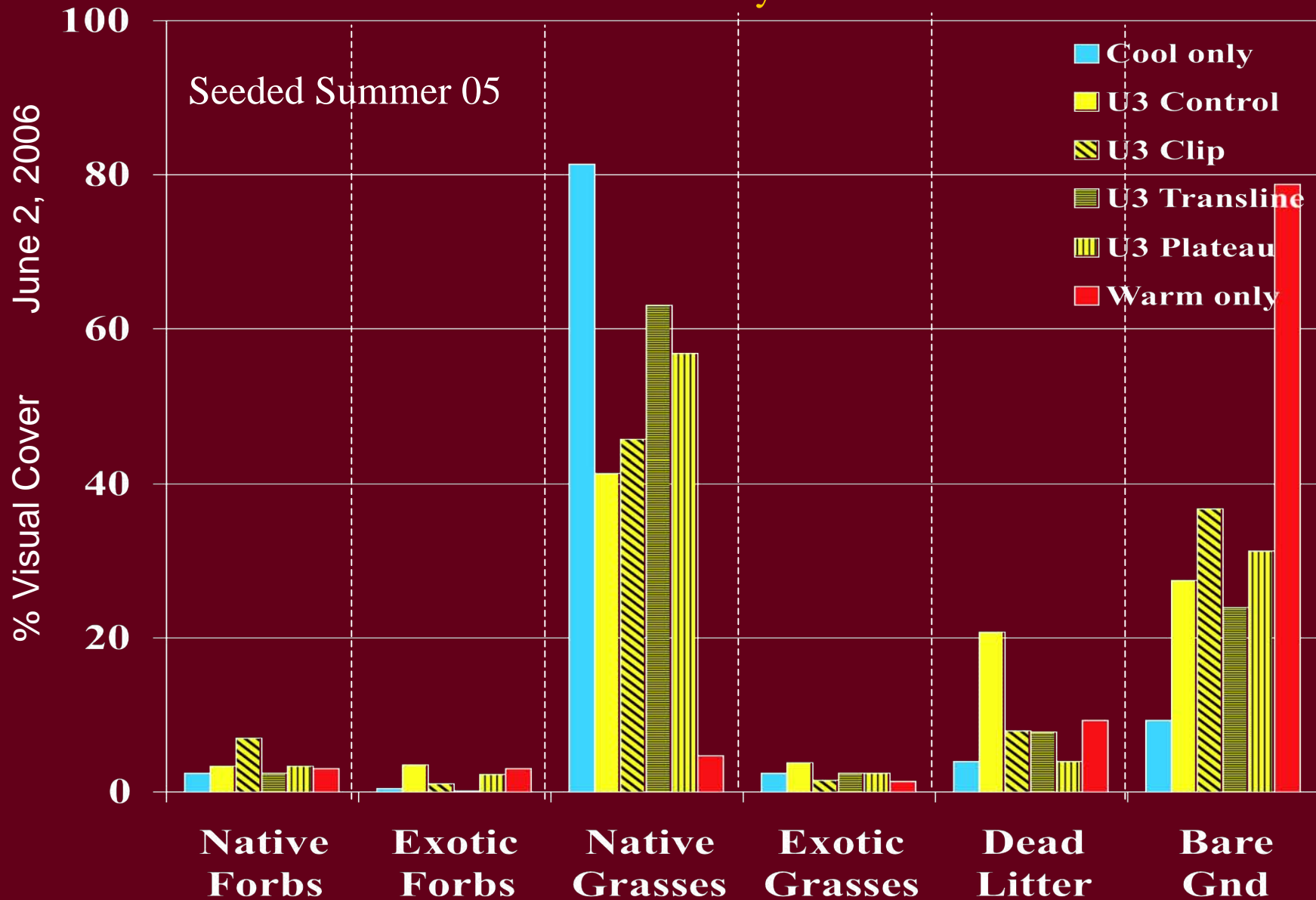
Functional Group x Canada Thistle Est.

Lamberton, MN. Fall Seeded 2007 Sept 17, 2009 Ratings



n = 24.

Functional Group x Canada Thistle Est. Lamberton, MN. 2004 - 2006 Cycle.



U3 Transline trts. Just applied n = 4.

Rosemount Trial Location by 2005



Right to the line.....

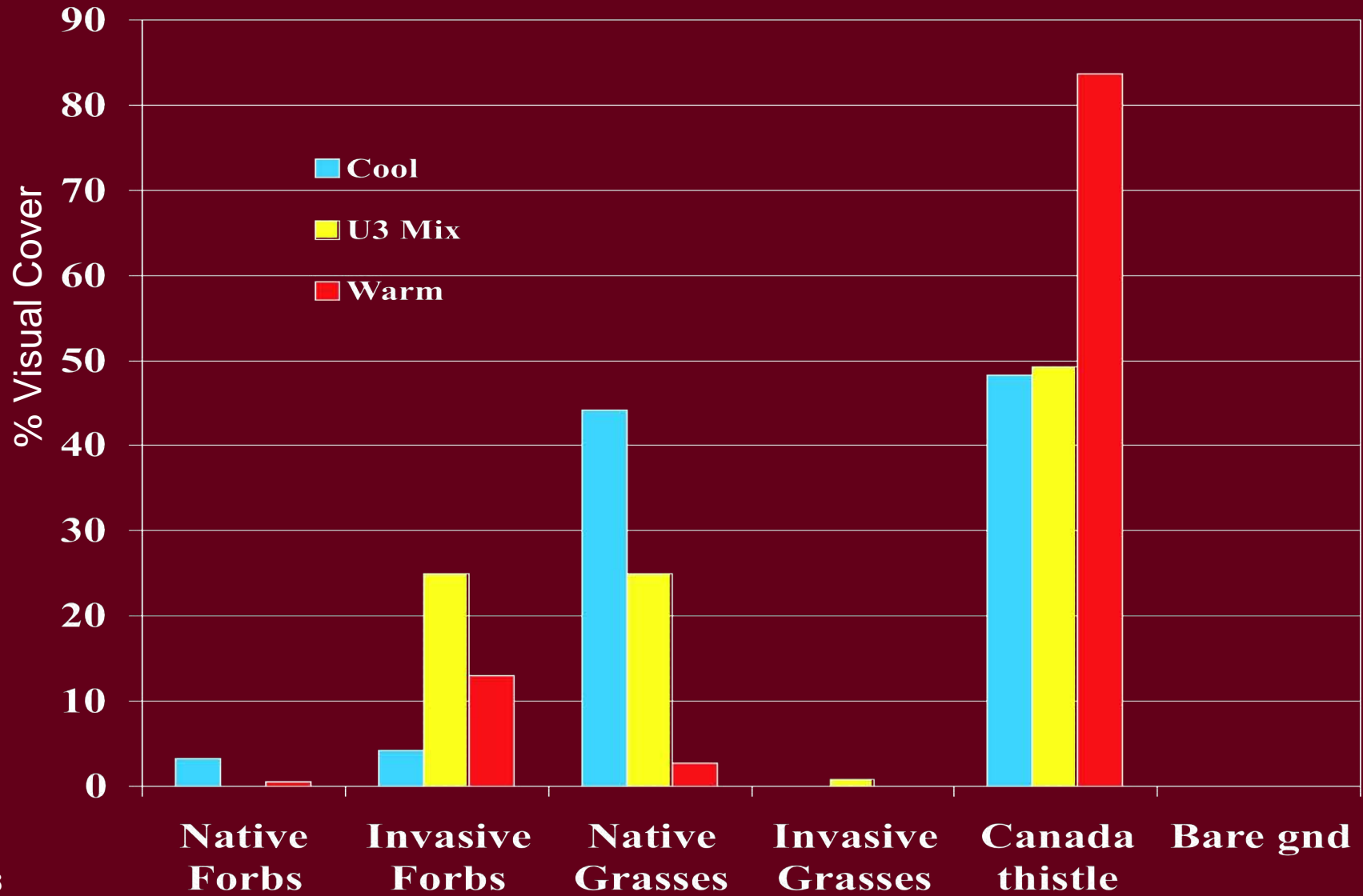
Rosemount Canth/Native Est Trial 2004
Canth Seedlings to Perenniated by Summer 2005



Functional Group x Canada Thistle Est. Rosemount, MN.

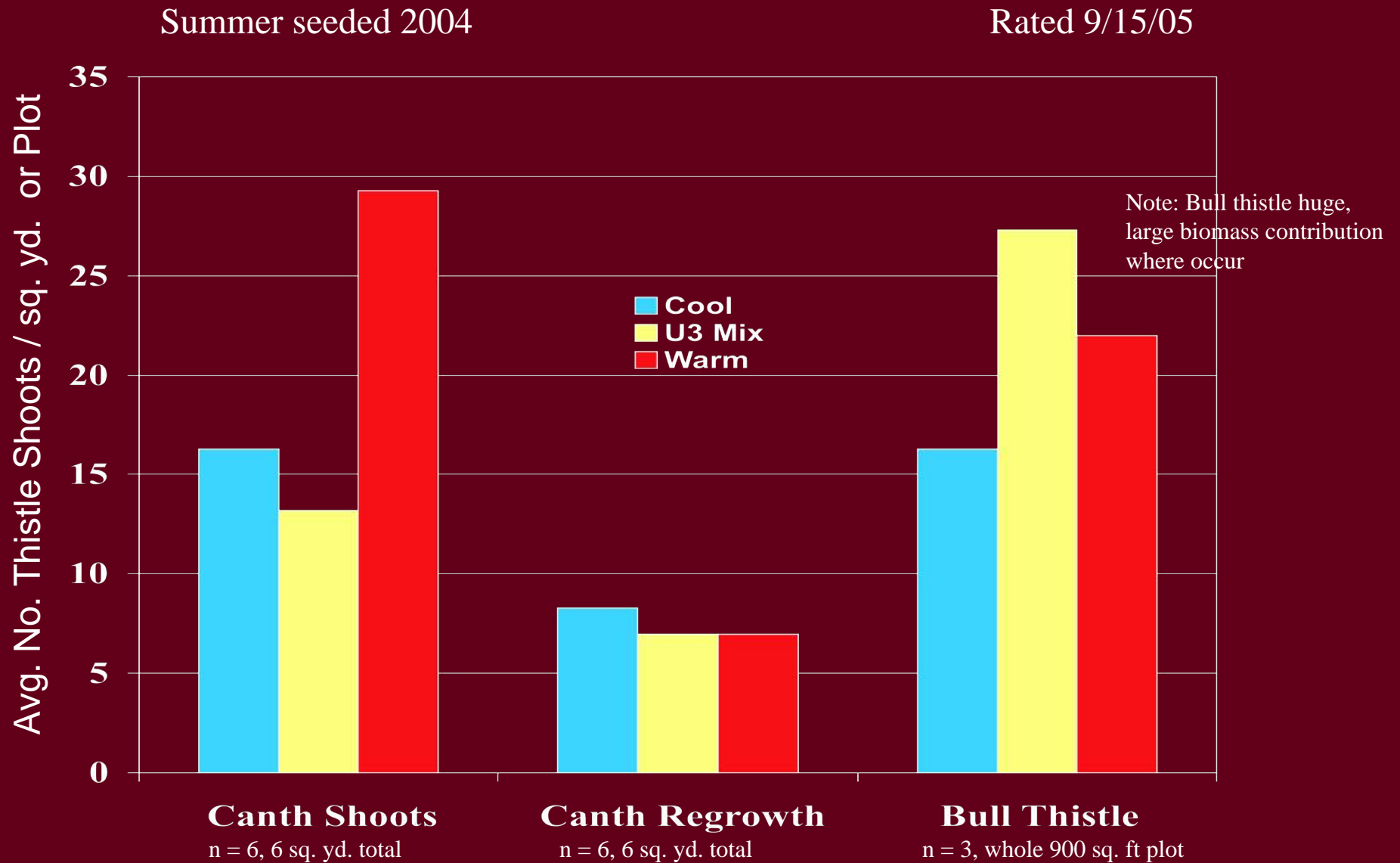
Summer seeded 2004

Rated 9/15/05



n = 3

Functional Group x Canada Thistle Est. Rosemount, MN.



Put it in the bank



- Best time to seed?
 - It depends!
- Best functional mix?
 - It depends!

THANK YOU!

Special thanks to:

MnDNR: Luke Skinner

Initial Funding

Talcot Lake DNR

Mark Gulick, Judy Markl

Equipment loan



**Virtual Tour for the
Functional Group Field Day Site
September 15th, 2010**

Rep 3 and Rep 5 on plot handout

Fall Seeded 2004



U3 Mix, Clipped Yr. 1, Transline 16 oz/A (0.375 lb. a.e.) POST fall of Yr 1



U3 Mix, Plant and walk away (not clipped, no herbicide)



Cool Season Only, Clipped Yr. 1



Warm Season Only, Clipped Yr. 1



U3 Mix, Clipped Yr. 1, Plateau 3 oz/A (0.047 lb a.i.) PRE at planting



U3 Mix, Clipped Yr. 1

Spring Seeded 2006



U3 Mix, Plant and walk away (not clipped, no herbicide)



Cool Season Only, Clipped Yr. 1



U3 Mix, Clipped Yr. 1, Transline 16 oz/A (0.375 lb. a.e.) POST fall of Yr 1



U3 Mix, Clipped Yr. 1, Plateau 3 oz/A (0.047 lb a.i.) PRE at planting



Warm Season Only, Clipped Yr. 1



U3 Mix, Clipped Yr. 1

Summer Seeded 2005



U3 Mix, Clipped Yr. 1, Plateau 3 oz/A (0.047 lb a.i.) PRE at planting



Warm Season Only, Clipped Yr. 1



U3 Mix, Clipped Yr. 1



Cool Season Only, Clipped Yr. 1



U3 Mix, Plant and walk away (not clipped, no herbicide)



U3 Mix, Clipped Yr. 1, Transline 16 oz/A (0.375 lb. a.e.) POST fall of Yr 1

Summer Seeded 2006



U3 Mix, Clipped Yr. 1



Cool Season Only, Clipped Yr. 1



U3 Mix, Clipped Yr. 1, Transline 16 oz/A (0.375 lb. a.e.) POST fall of Yr 1



U3 Mix, Plant and walk away (not clipped, no herbicide)



U3 Mix, Clipped Yr. 1, Plateau 3 oz/A (0.047 lb a.i.) PRE at planting



Warm Season Only, Clipped Yr. 1

Fall Seeded 2005



U3 Mix, Clipped Yr. 1



U3 Mix, Plant and walk away (not clipped, no herbicide)



Warm Season Only, Clipped Yr. 1



Cool Season Only, Clipped Yr. 1



U3 Mix, Clipped Yr. 1, Transline 16 oz/A (0.375 lb. a.e.) POST fall of Yr 1



U3 Mix, Clipped Yr. 1, Plateau 3 oz/A (0.047 lb a.i.) PRE at planting

Spring Seeded 2007



U3 Mix, Clipped Yr. 1, Plateau 3 oz/A (0.047 lb a.i.) PRE at planting



Cool Season Only, Clipped Yr. 1



U3 Mix, Plant and walk away (not clipped, no herbicide)



Warm Season Only, Clipped Yr. 1



U3 Mix, Clipped Yr. 1, Transline 16 oz/A (0.375 lb. a.e.) POST fall of Yr 1



U3 Mix, Clipped Yr. 1