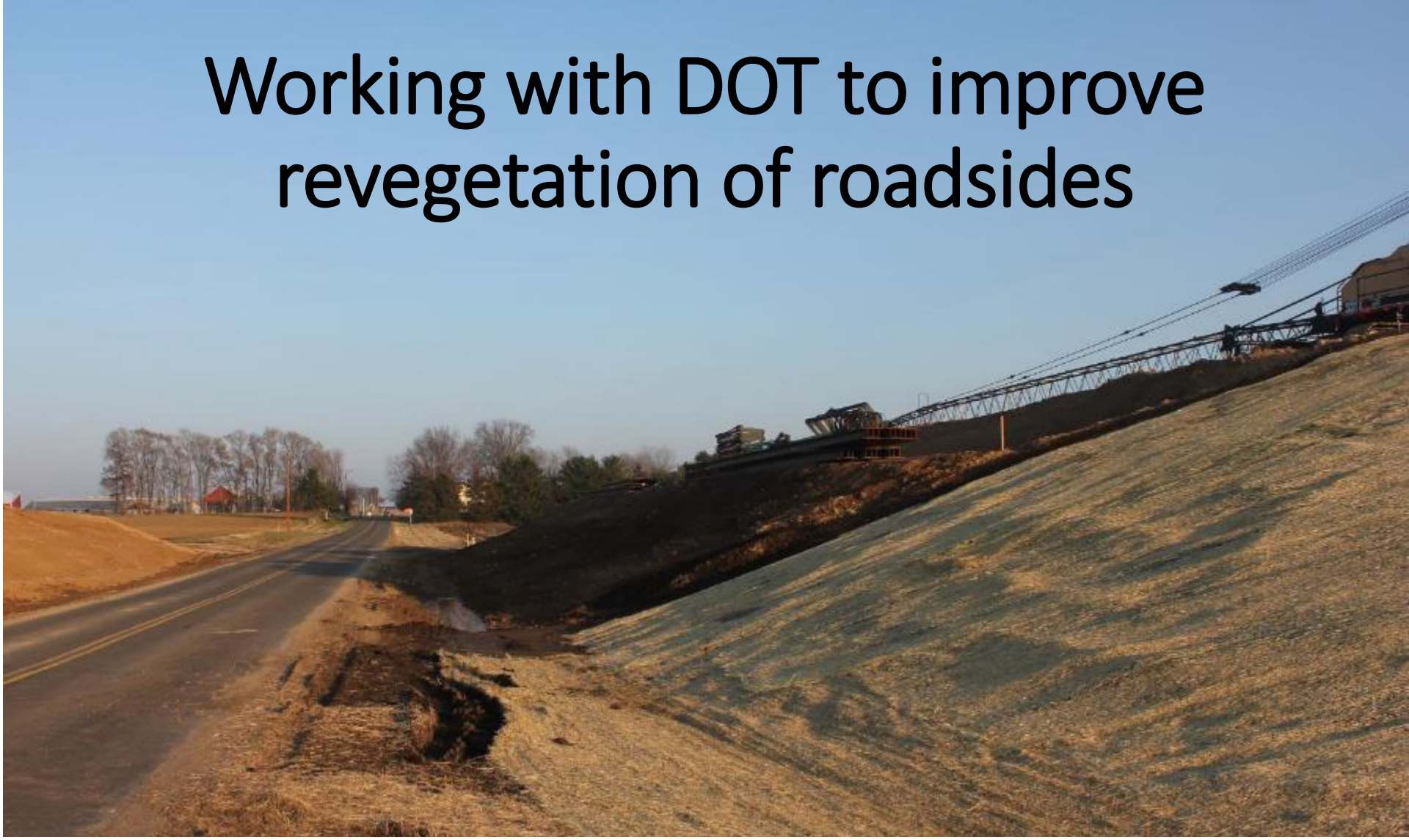
Working with DOT to improve revegetation of roadsides



Mark Renz, John Stier and Neils Jorgensen

UW Extension

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

Goal is to improve consistency of establishment on roadsides

Revegetation Goals - DOT

- Prevent erosion/runoff
  - NPDES mandate of >70% perennial vegetation (EPA)
- Prevent establishment of invasive species
  - Federal, state, local
- Minimize costs associated with management of vegetation

- Confined by budgets

Objective #1 :Can mowing improve establishment and cover of planted turfgrass?

Methods

- Selected sites seeded previous fall with poor spring turf cover
    - Total of 5 locations (Two 2014-15;Three 2015-16)
- Mowed at three distinct timings
    - Early (Late June), Late (Mid July), Early then when weeds regrew to 6 inches tall (late July)
    - Compared to non treated control

Effect of Mowing on Cover

Fall, 1 year after planting

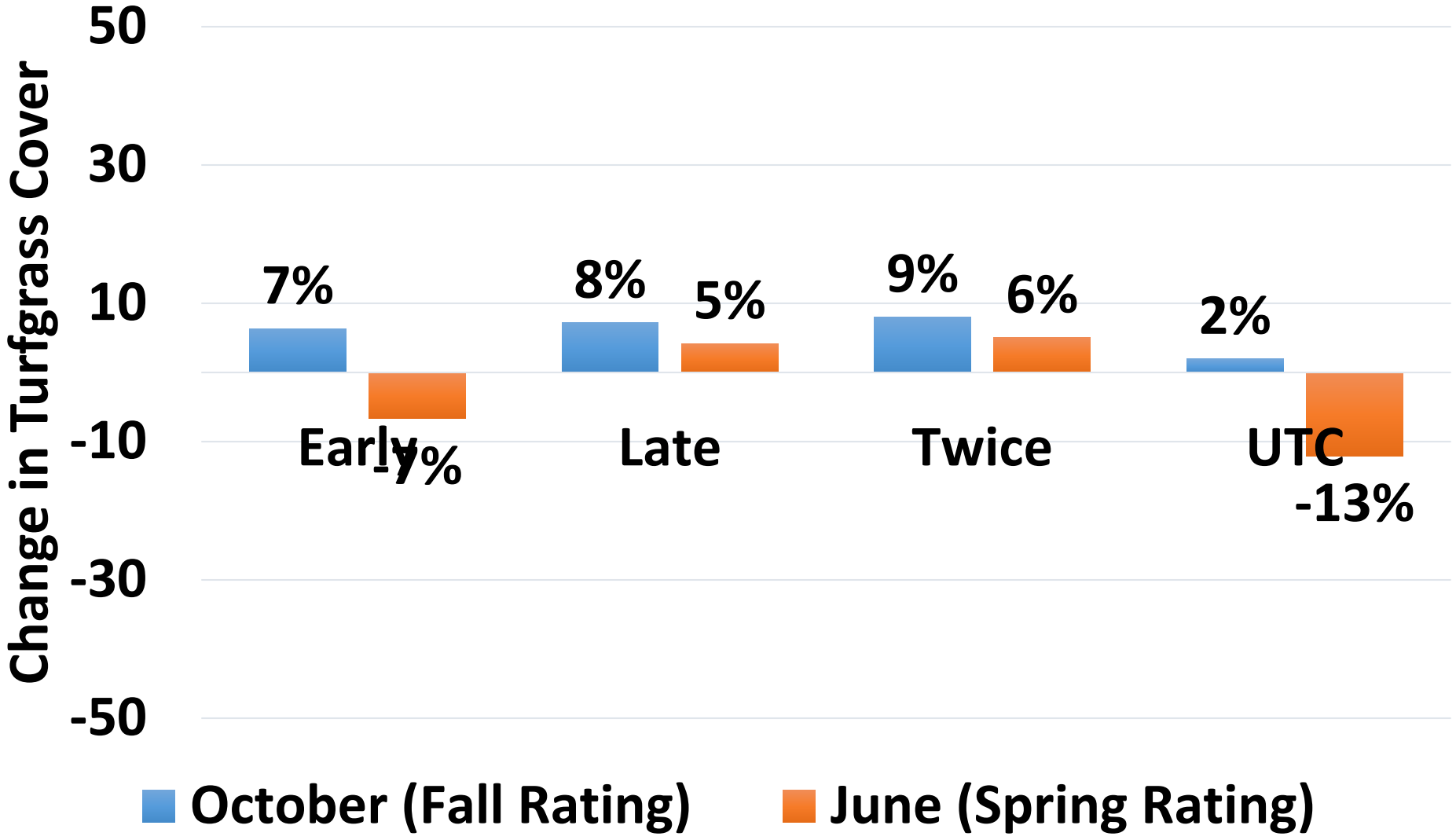
	Turf-grass	Non-planted grass	Annual broadleaf weeds	Perennial broadleaf weeds	
Early	96	36	62	73	a
Late	91	40	58	61	b
Twice	93	40	61	57	b
UTC	94	38	57	78	a
p-value	0.26	0.31	0.55	0.02	

Effect of Mowing on Cover

Spring, 1.5 year after planting

	Turfgrass	Non-planted grass	Annual broadleaf weeds	Perennial broadleaf weeds
Early	84	23	45	80
Late	91	25	49	73
Twice	92	20	55	71
UTC	81	30	43	70
p-value	0.46	0.55	0.69	0.67

Did turfgrass cover change from any treatment?



Objective #1 summary

- Mowing timing or frequency does NOT dramatically improve cover of turfgrass 1-1.5 Years after planting

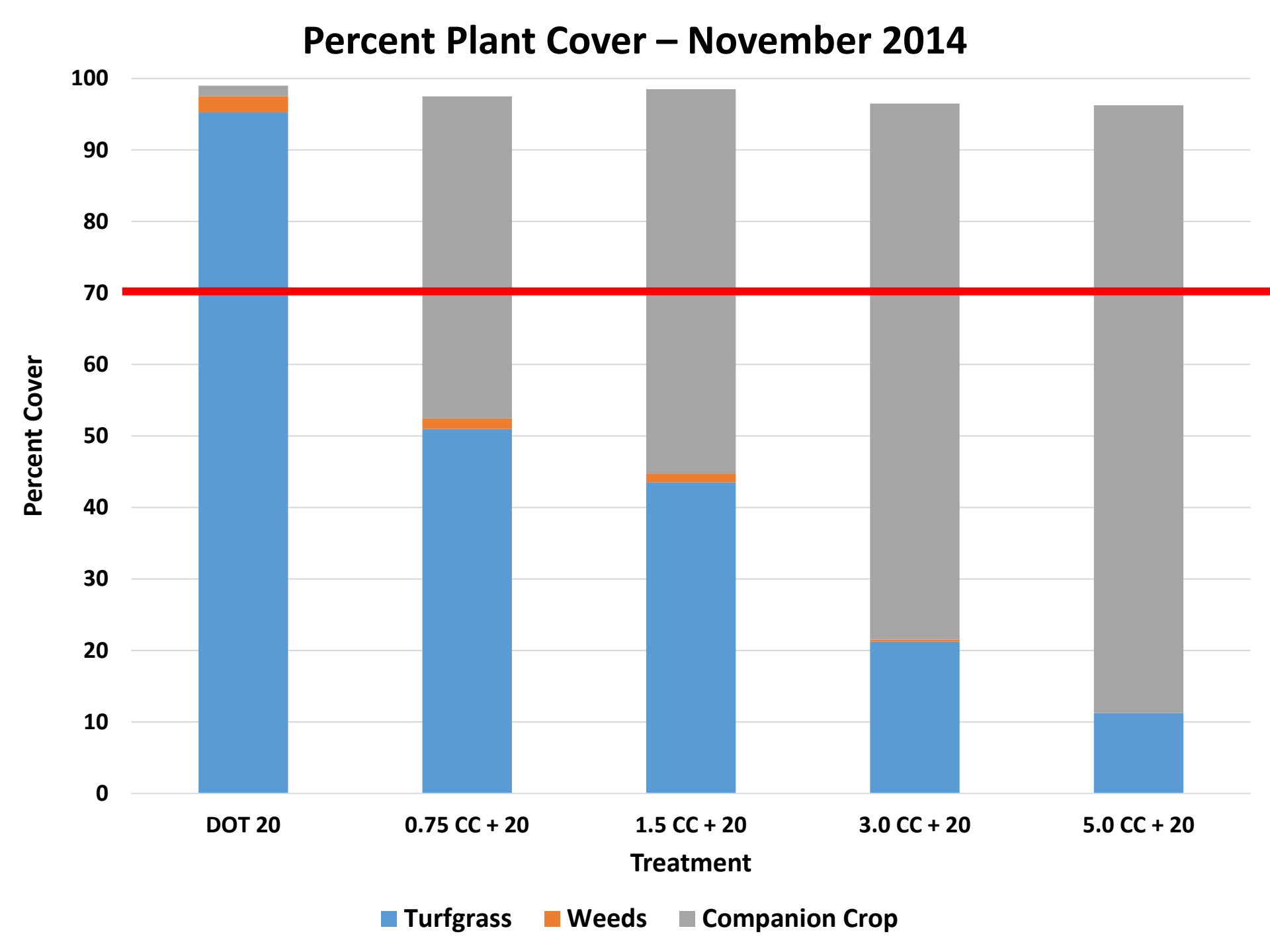
- Mowing late or 2x provides some perennial weed suppression

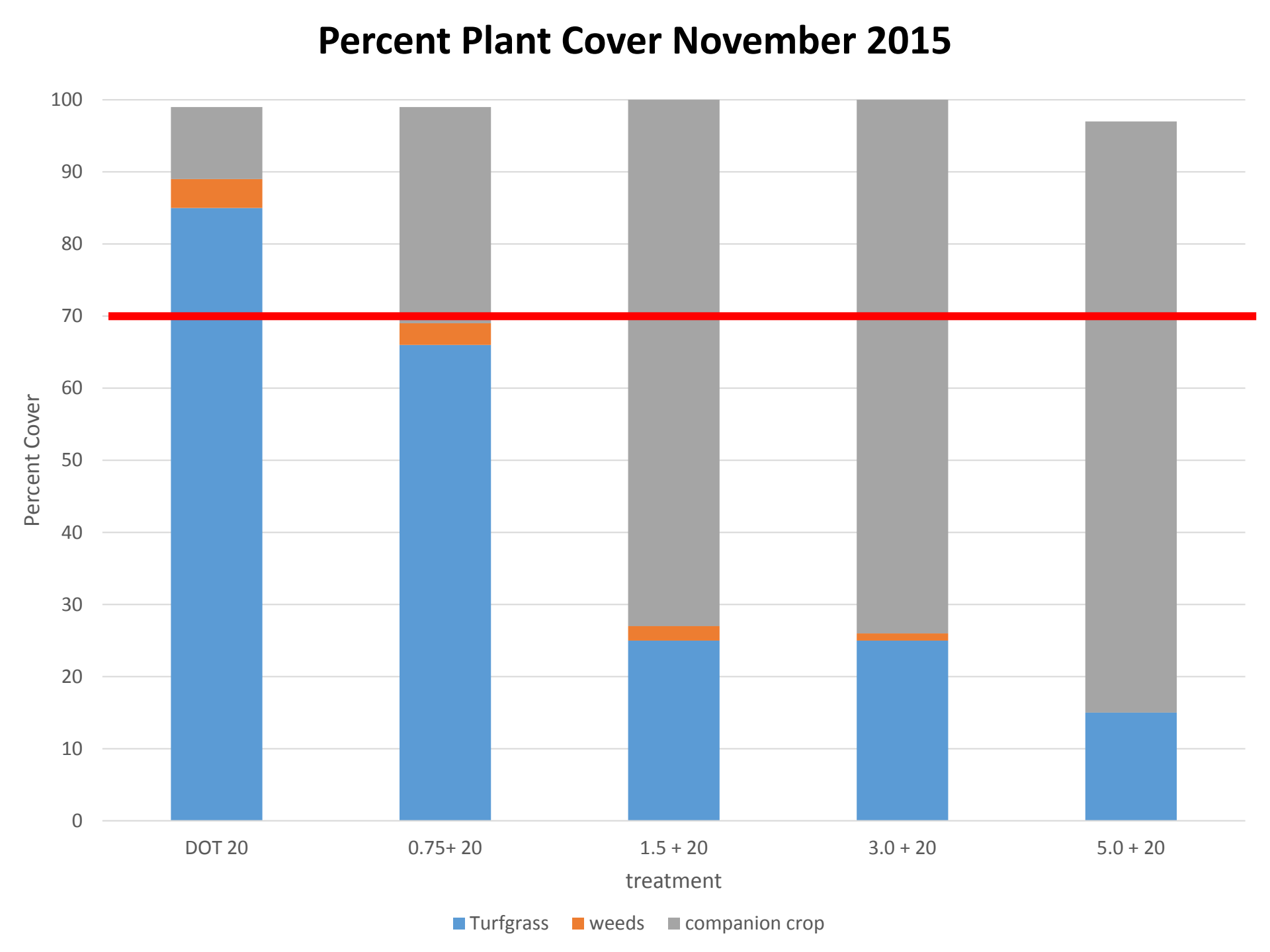
Objective #2 : Determine the effect of varying the level of companion crop in a seed mixture (DOT 20) on the cover of vegetation over time

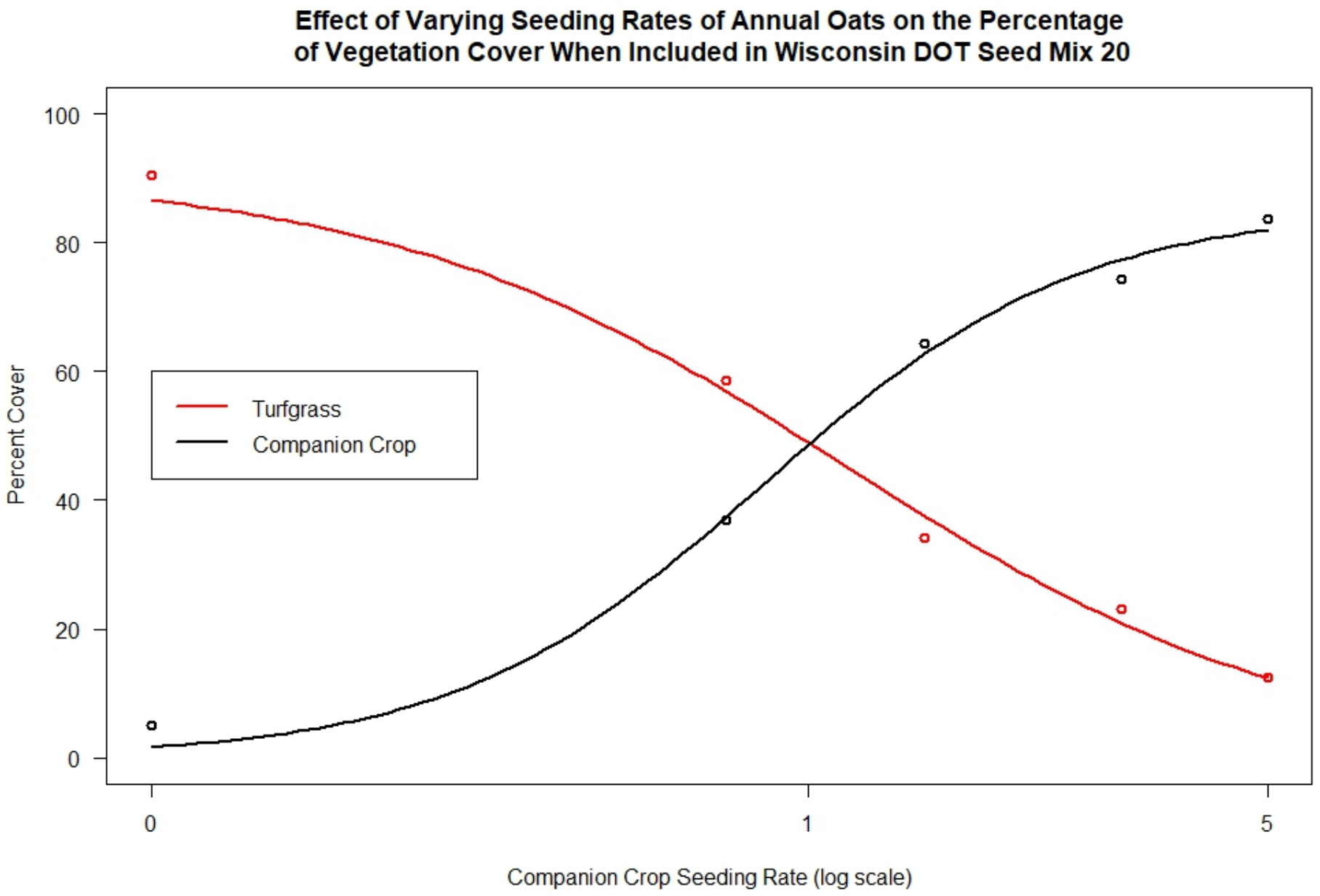
- Two experiments
  - Early fall seeding = Oats planted 8/14/14, repeated on 8/20/15
  - Late fall seeding = Winter wheat planted 10/9/14, repeated on 10/20/15
- Five companion crop seeding rates + DOT 20
  - 0, **0.75**, 1.5, 3.0, 5.0 (lbs/1000sq ft)
- Percent cover taken monthly
- Mowed at end of June

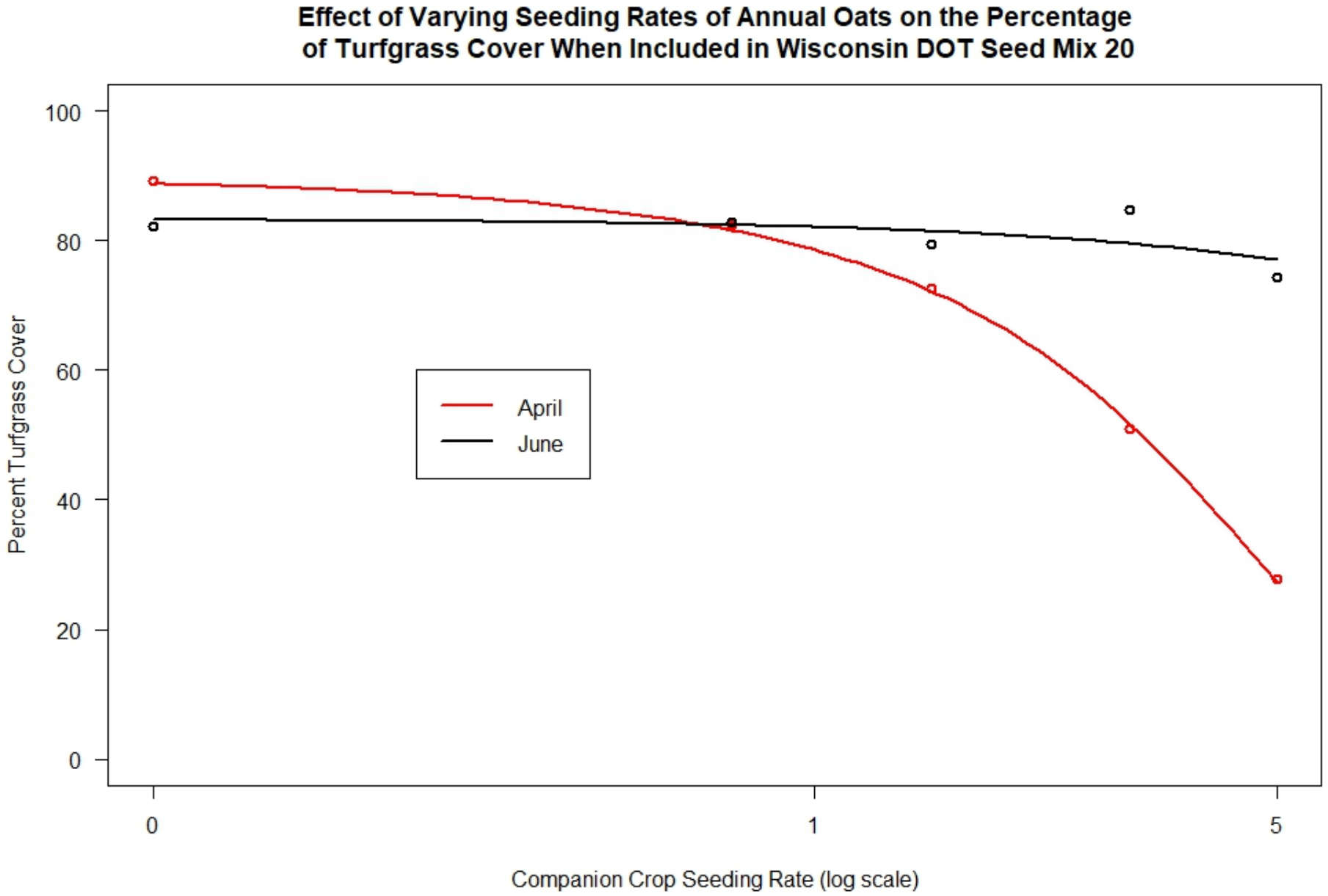
EARLY SEEDING (OATS)

Picture taken 9/18/14 (35 DA seeding)


Percent Plant Cover – November 2014
100
90
80
70
60
50
40
30
20
10
0
Percent Cover
DOT 20
0.75 CC + 20
1.5 CC + 20
3.0 CC + 20
5.0 CC + 20
Treatment
Turfgrass
Weeds
Companion Crop


Percent Plant Cover November 2015
100
90
80
70
60
50
40
30
20
10
0
Percent Cover
DOT 20
0.75+ 20
1.5 + 20
3.0 + 20
5.0 + 20
treatment
Turfgrass
weeds
companion crop


Effect of Varying Seeding Rates of Annual Oats on the Percentage of Vegetation Cover When Included in Wisconsin DOT Seed Mix 20
Percent Cover
100
80
60
40
20
0
Turfgrass
Companion Crop
0
1
5
Companion Crop Seeding Rate (log scale)


Effect of Varying Seeding Rates of Annual Oats on the Percentage of Turfgrass Cover When Included in Wisconsin DOT Seed Mix 20
Percent Turfgrass Cover
100
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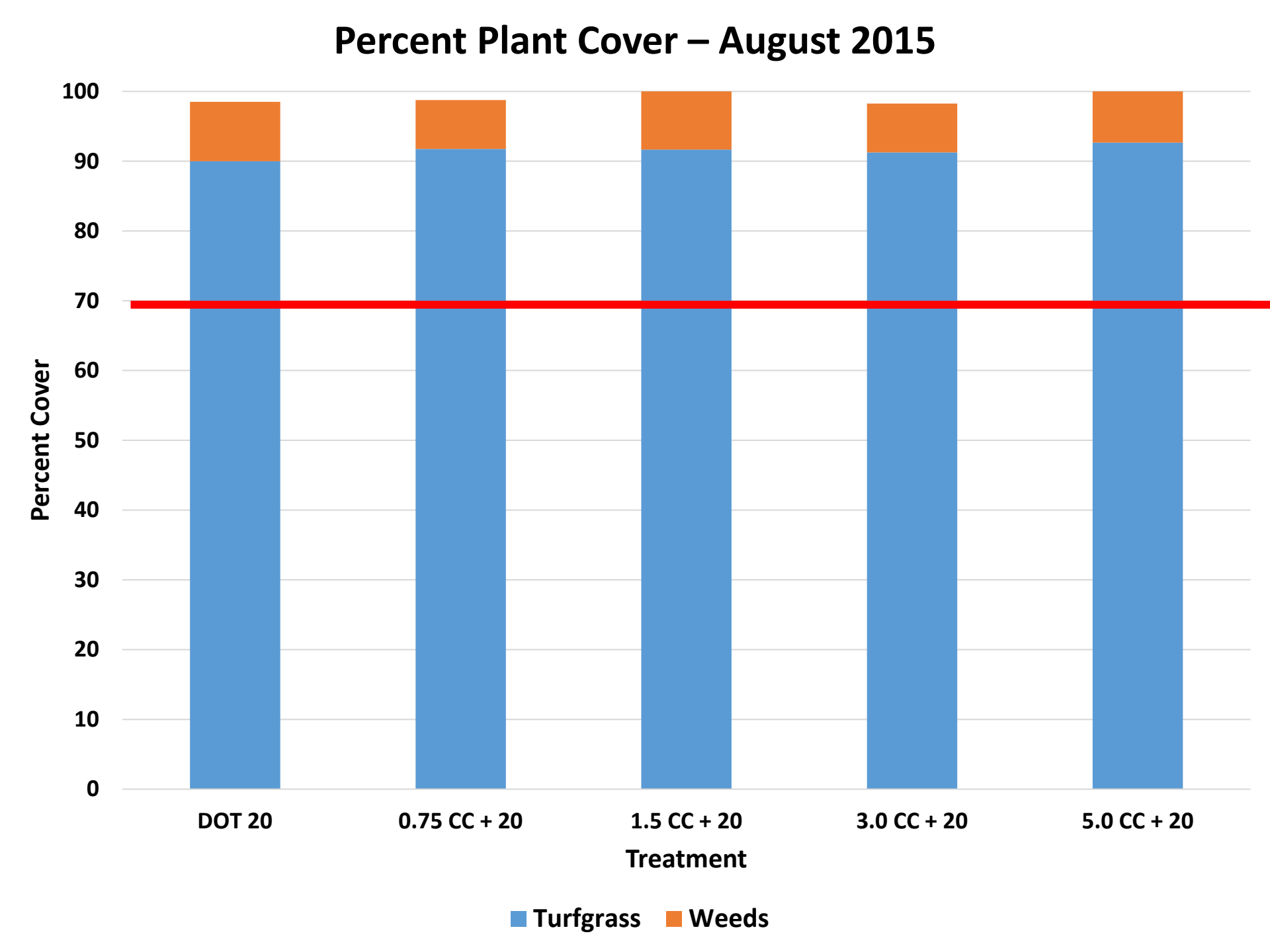
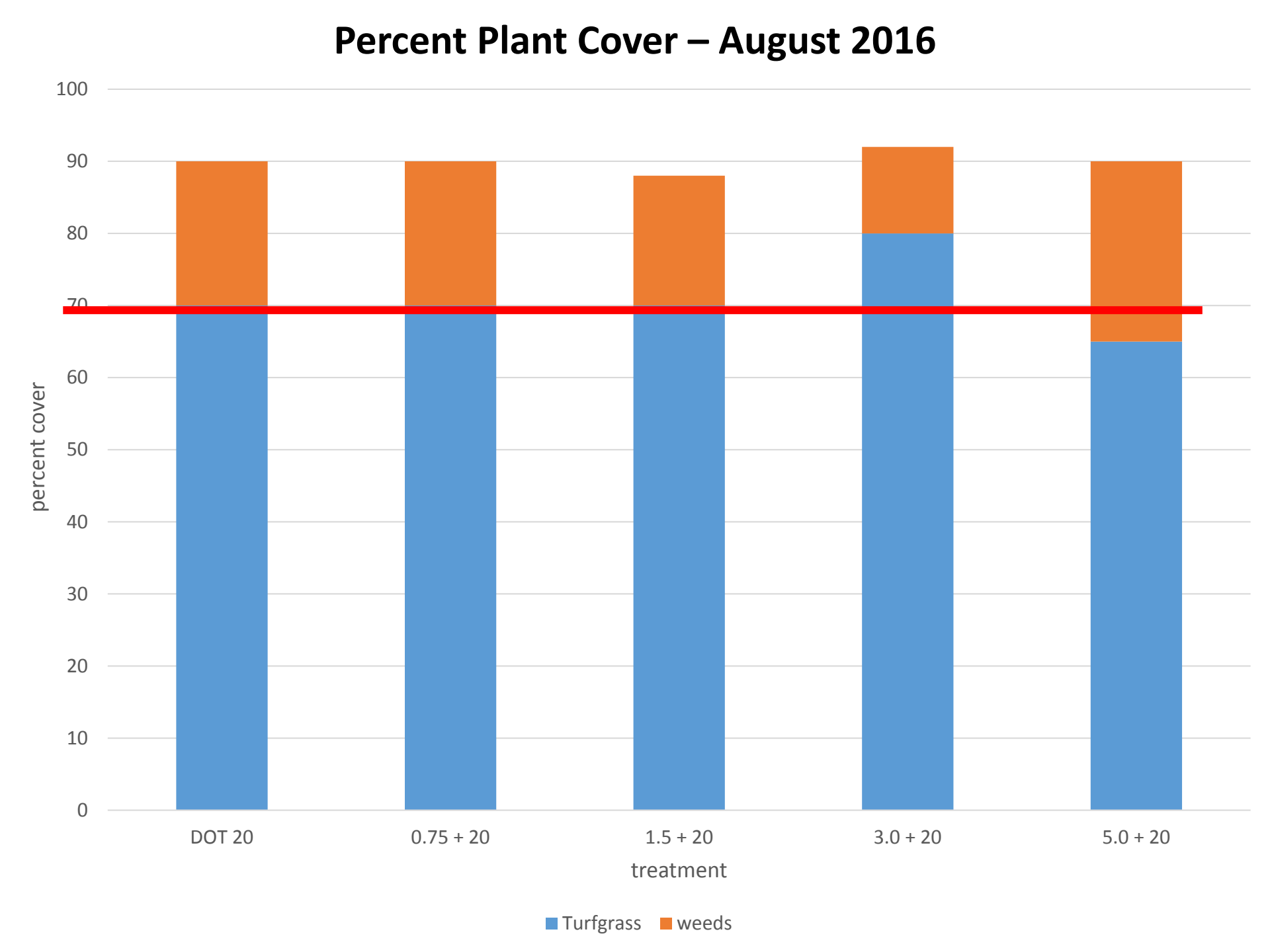
60
40
20
0
April
June
0
1
5
Companion Crop Seeding Rate (log scale)


Percent Plant Cover – August 2015
100
90
80
70
60
50
40
30
20
10
0
Percent Cover
DOT 20
0.75 CC + 20
1.5 CC + 20
3.0 CC + 20
5.0 CC + 20
Treatment
Turfgrass
Weeds


Percent Plant Cover – August 2016
100
90
80
70
60
50
40
30
20
10
0
percent cover
DOT 20
0.75 + 20
1.5 + 20
3.0 + 20
5.0 + 20
treatment
Turfgrass
weeds

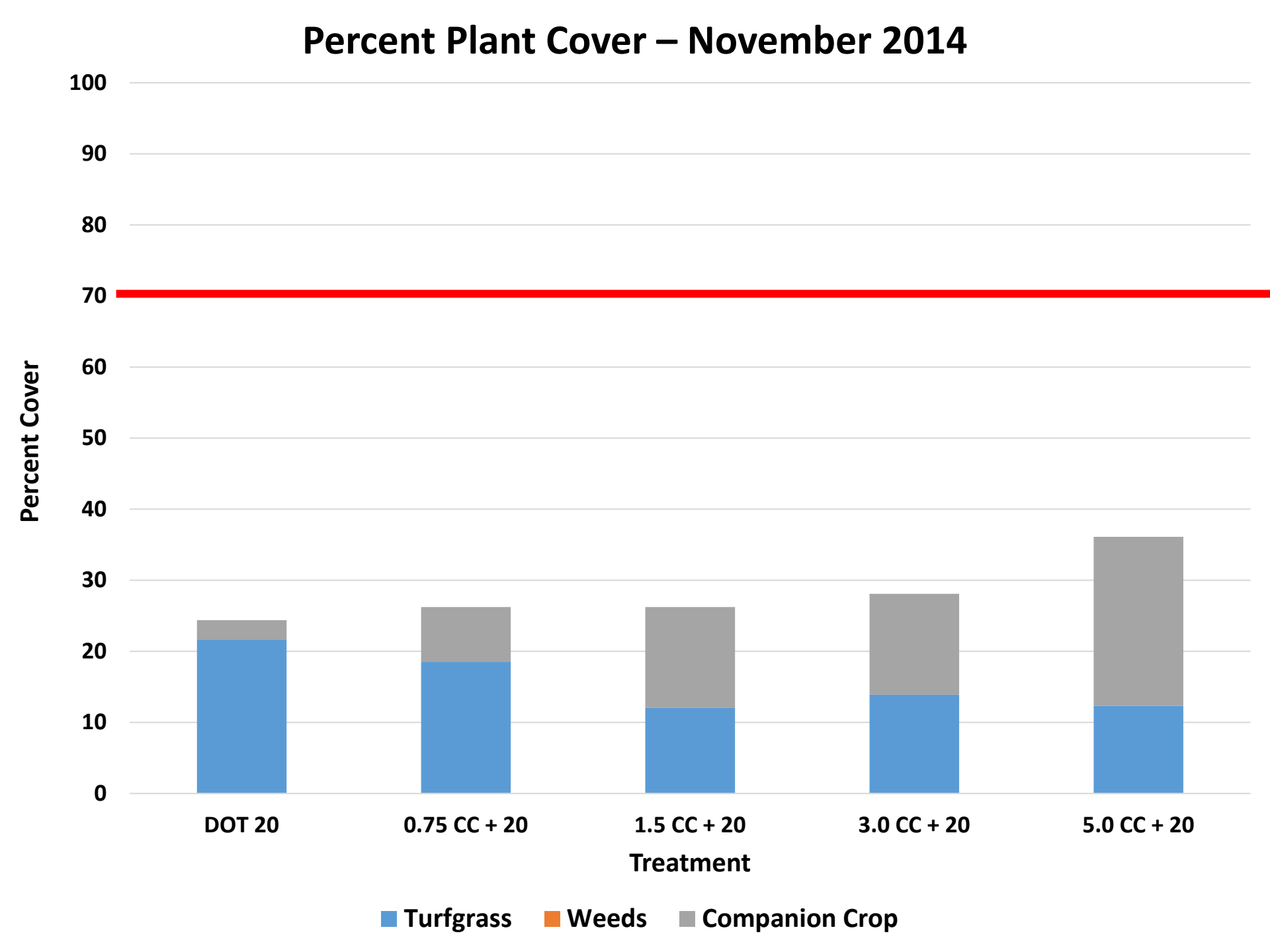
Takeaways – Early fall seeding (Oats)

- Planted species quickly established in fall/winter
  - Oats winter-killed and tall fescue filled in
- In fall of establish. >70% cover reached in all trts
- Spring after >70% cover reached in all trts
  - In April Turf cover <70 when increase CC above 1.5 lbs
- No differences in turf and weed cover 1 YAT among trts
  - Turfgrass = 70-90%, Weeds = 10-20%

LATE SEEDING (WINTER WHEAT)

Seeded on 10/9/14

Picture taken 12/29/14 (80 DA seeding)


Percent Plant Cover – November 2014
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10
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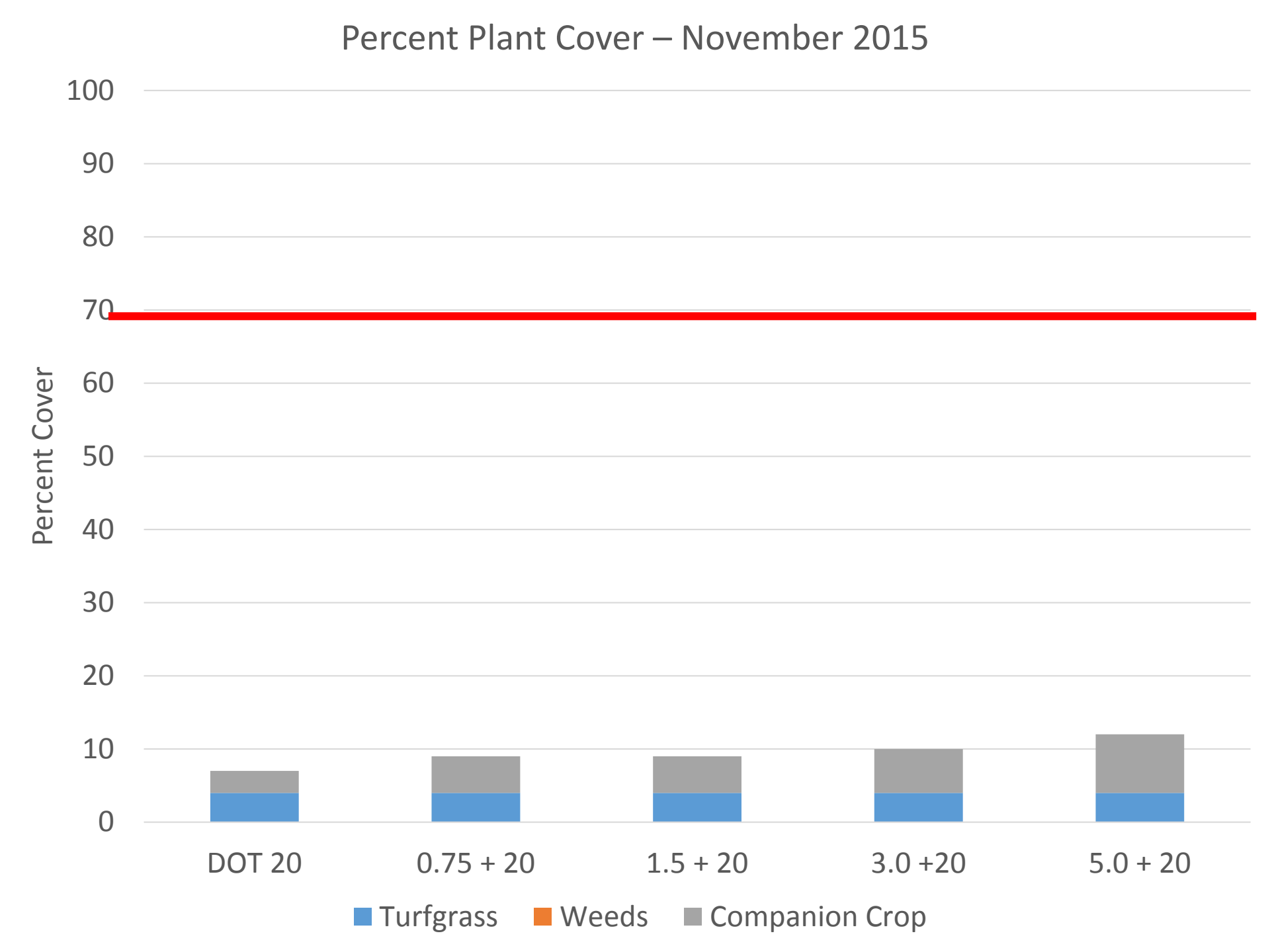
Percent Cover
DOT 20
0.75 CC + 20
1.5 CC + 20
3.0 CC + 20
5.0 CC + 20
Treatment
Turfgrass
Weeds
Companion Crop


Percent Plant Cover – November 2015
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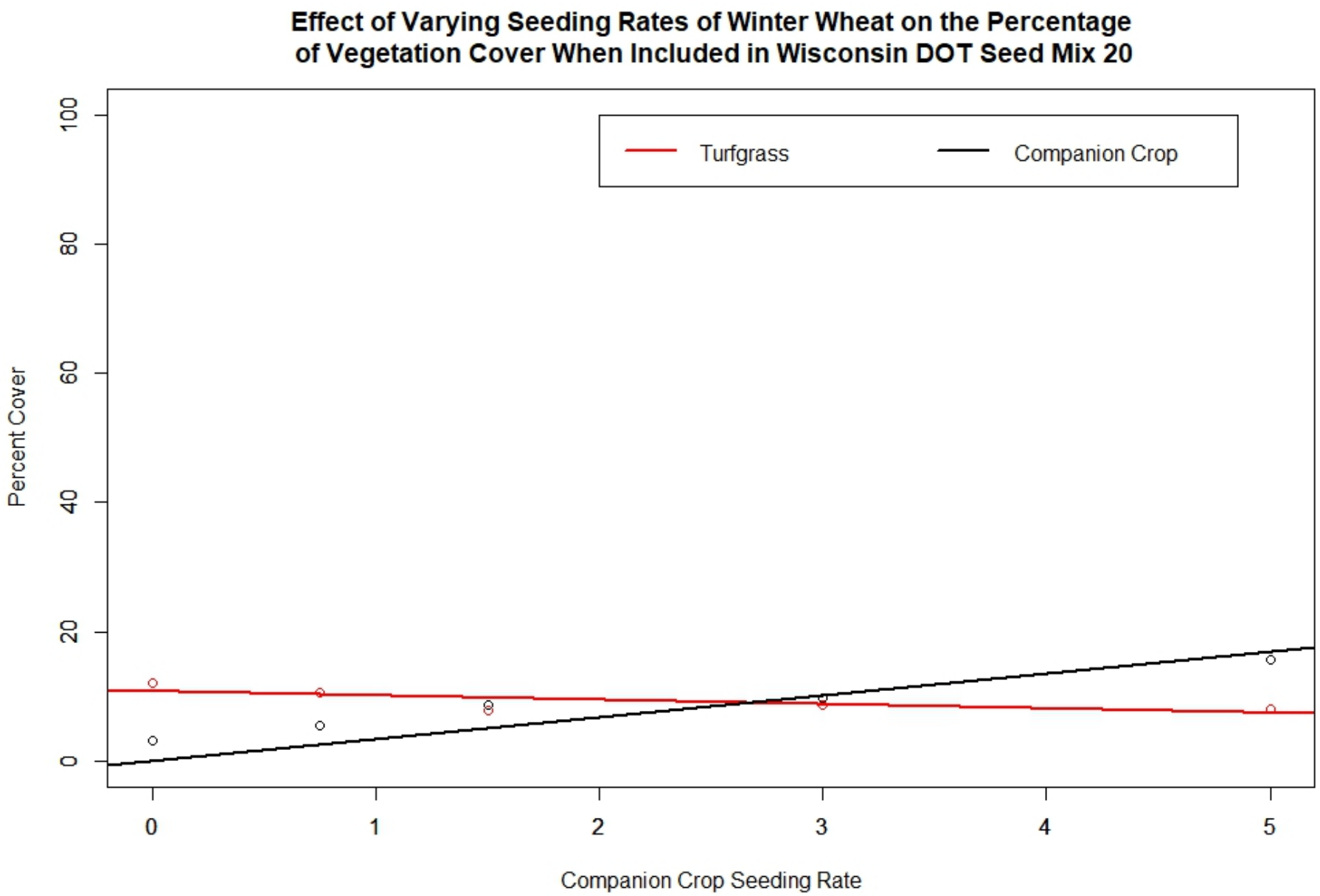
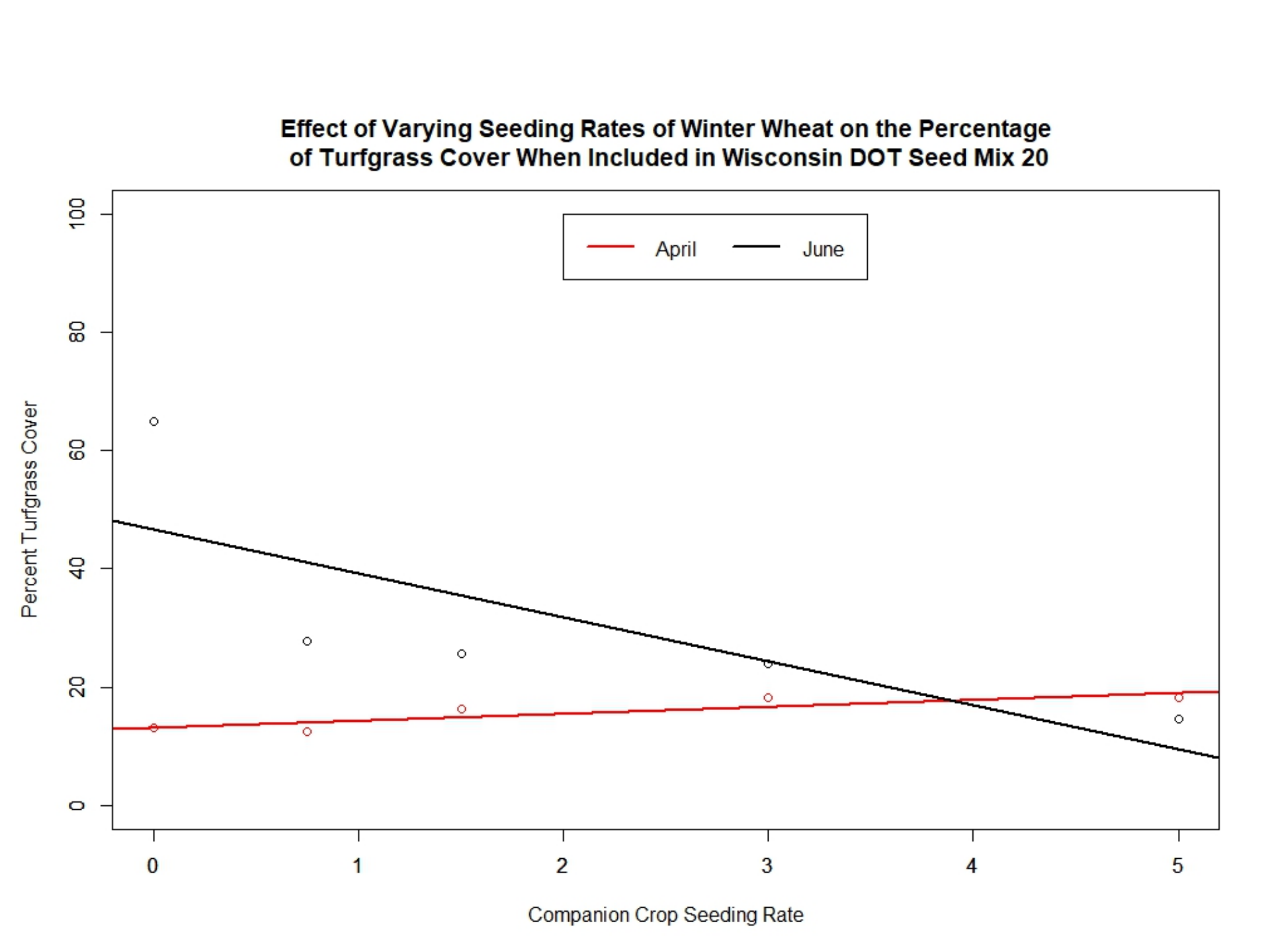
90
80
70
60
50
40
30
20
10
0
Percent Cover
DOT 20
0.75 + 20
1.5 + 20
3.0 +20
5.0 + 20
Turfgrass
Weeds
Companion Crop


Effect of Varying Seeding Rates of Winter Wheat on the Percentage of Vegetation Cover When Included in Wisconsin DOT Seed Mix 20
Turfgrass
Companion Crop
Percent Cover
0
20
40
60
80
100
0
1
2
3
4
5
Companion Crop Seeding Rate


Effect of Varying Seeding Rates of Winter Wheat on the Percentage of Turfgrass Cover When Included in Wisconsin DOT Seed Mix 20
April
June
Percent Turfgrass Cover
0
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100
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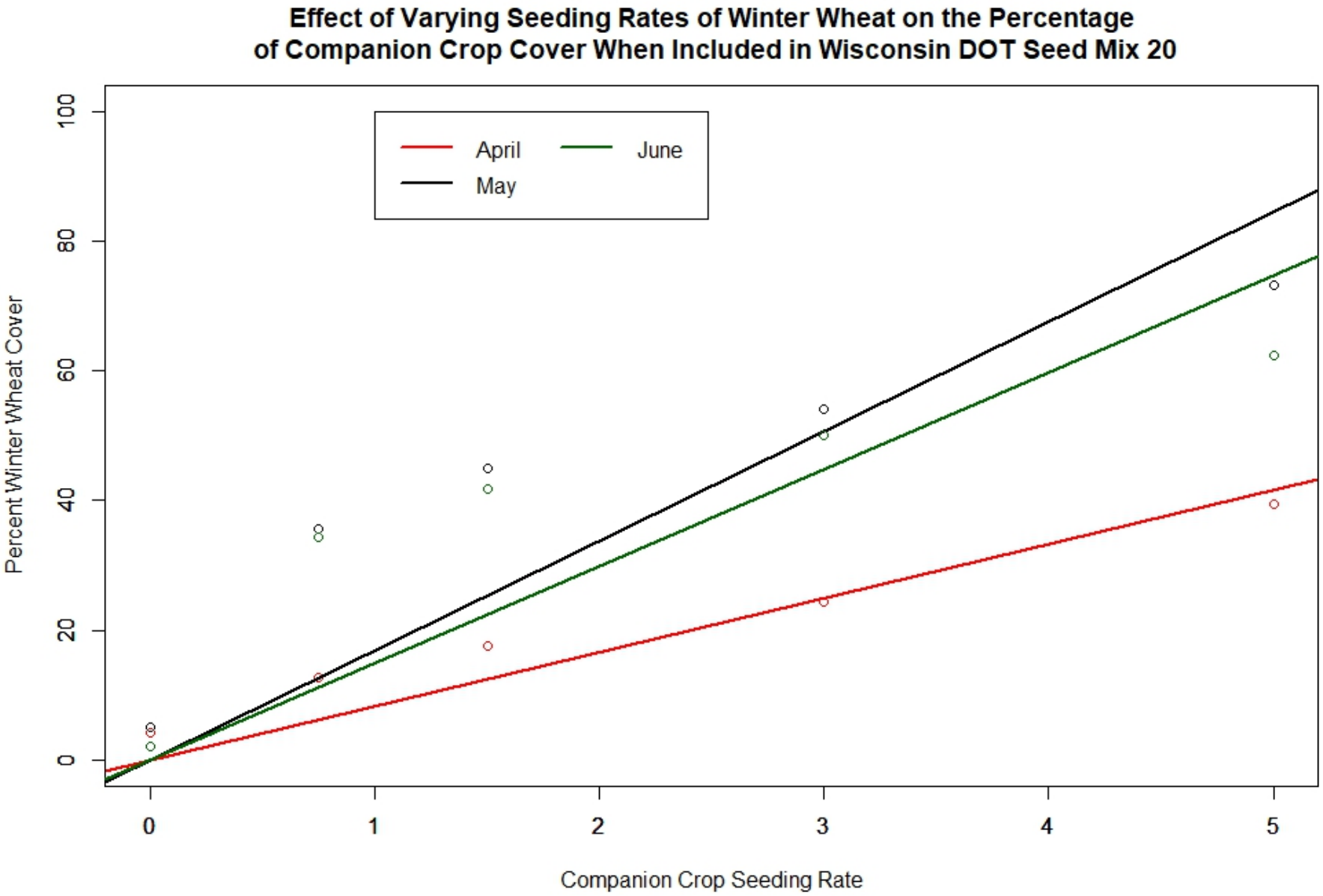
1
2
3
4
5
Companion Crop Seeding Rate


Effect of Varying Seeding Rates of Winter Wheat on the Percentage
of Companion Crop Cover When Included in Wisconsin DOT Seed Mix 20
April
June
May
Percent Winter Wheat Cover
0
20
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100
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1
2
3
4
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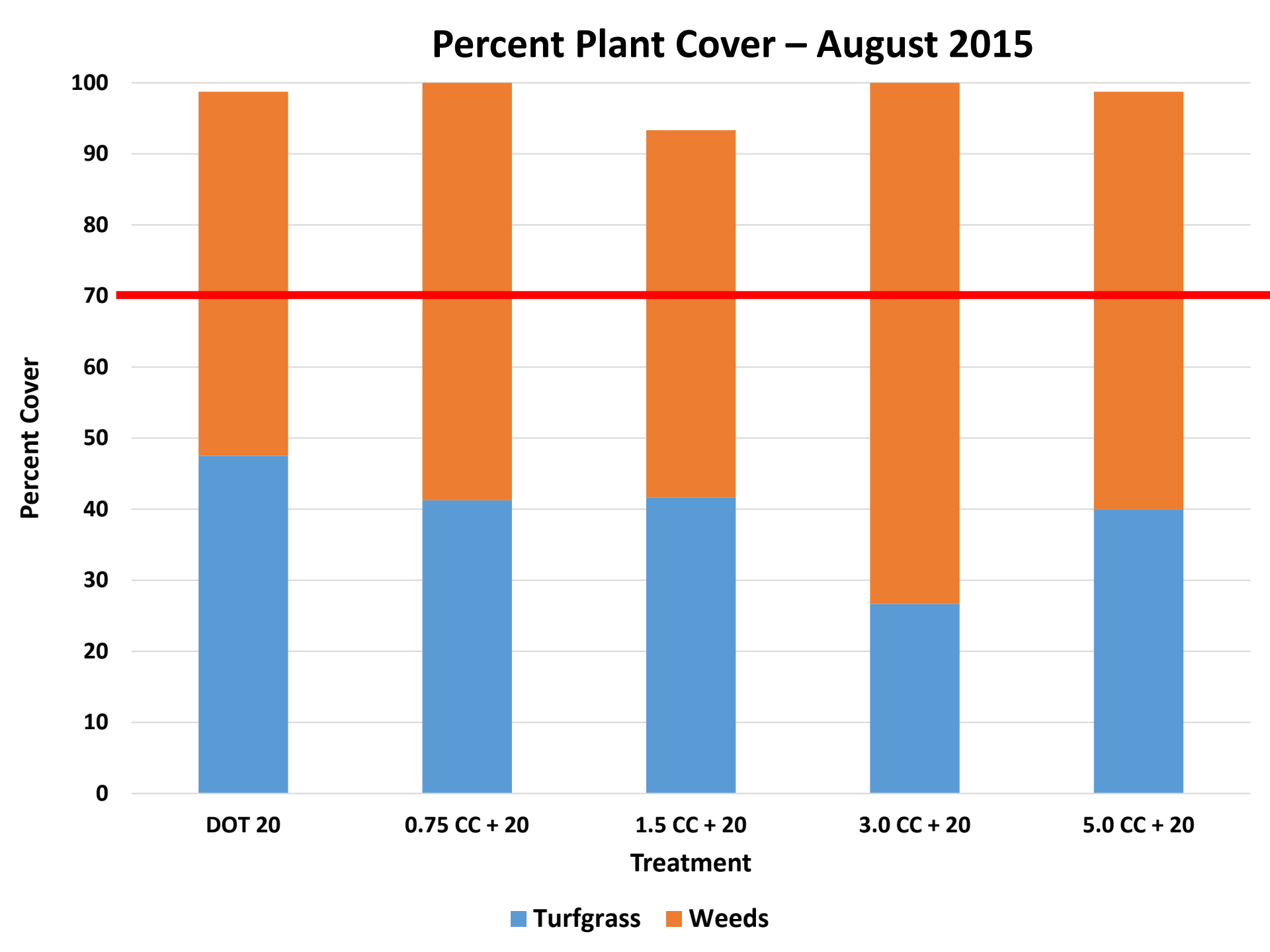
Companion Crop Seeding Rate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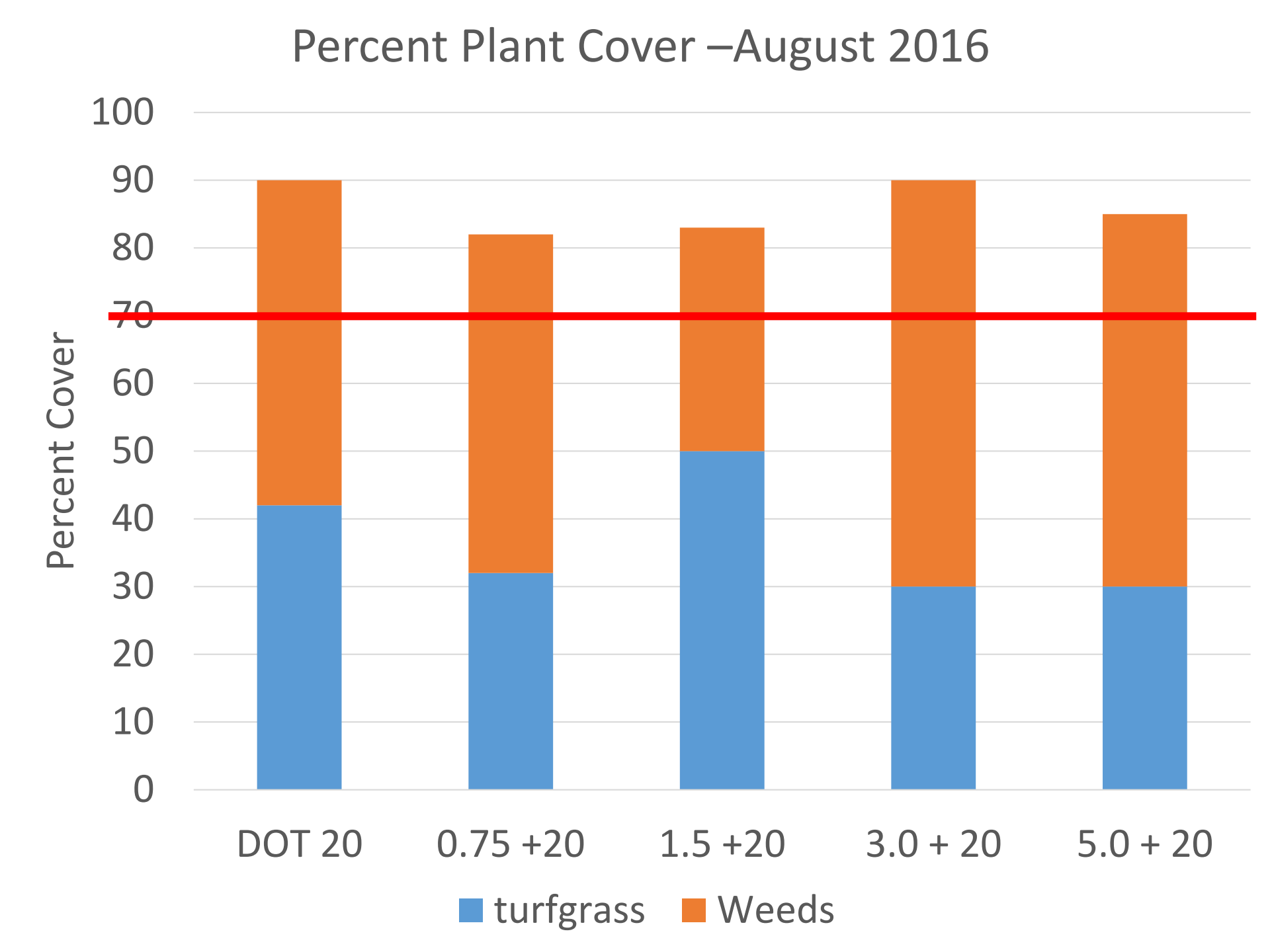
Treatment
Turfgrass
Weeds


Percent Plant Cover –August 2016
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80
70
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50
40
30
20
10
0
Percent Cover
DOT 20
0.75 +20
1.5 +20
3.0 + 20
5.0 + 20
turfgrass
Weeds

Takeaways – late fall seeding (wheat)

- Planted species had low cover in fall
- >70% cover not achieved until June
- Turfgrass cover 25-50% 10 months after seeding (Aug)
  - Mostly fine fescues
- Weed cover 30-75% 10 months after seeding (Aug)
  - Mostly annual broadleaf weeds
- Patterns and composition continued through 20 MAP
  - Mix of weeds and turfgrass…..

Tracking revegetation projects on WI DOT roads

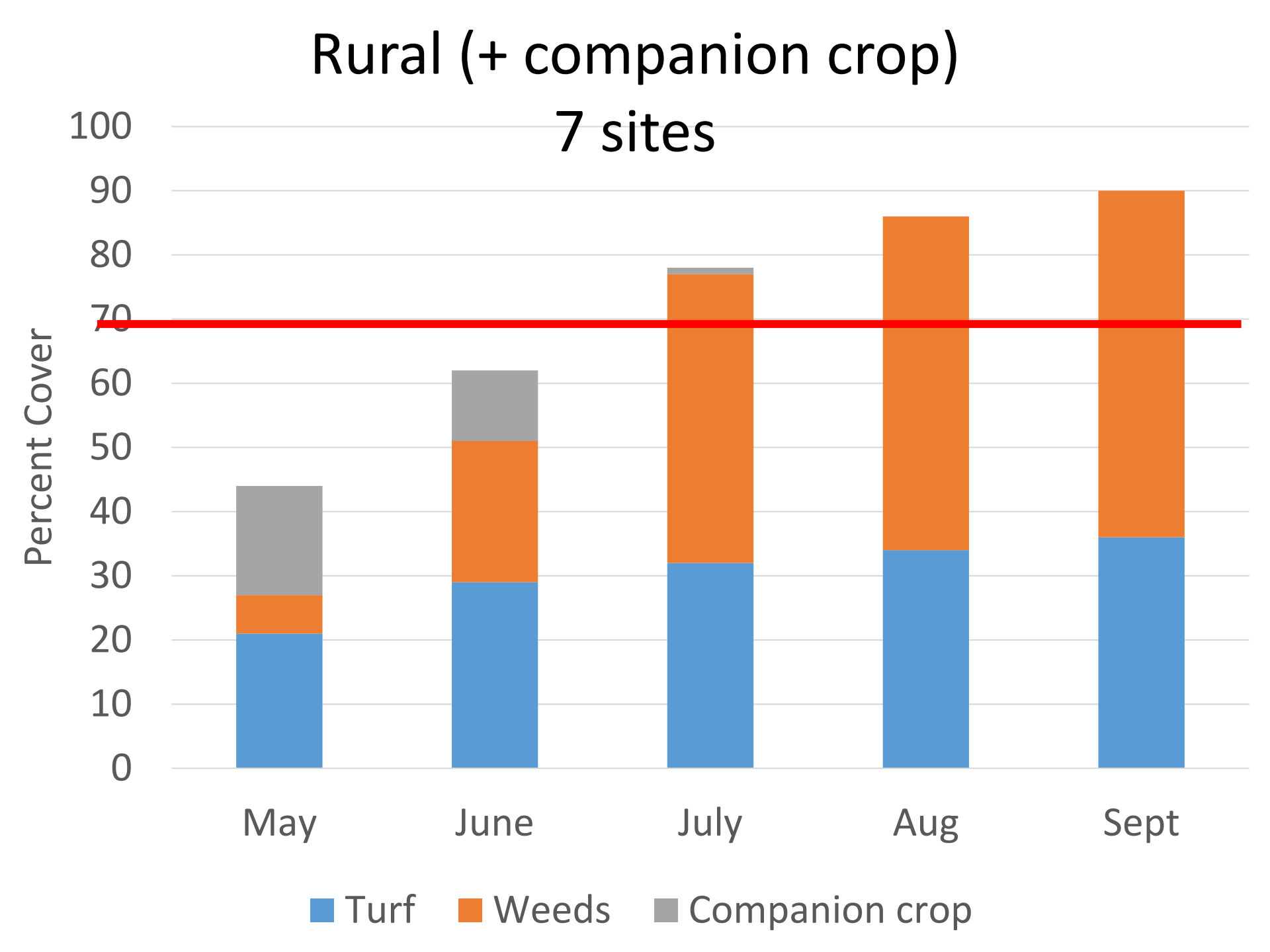
Visited 12 sites in WI (also sites in MN involved)

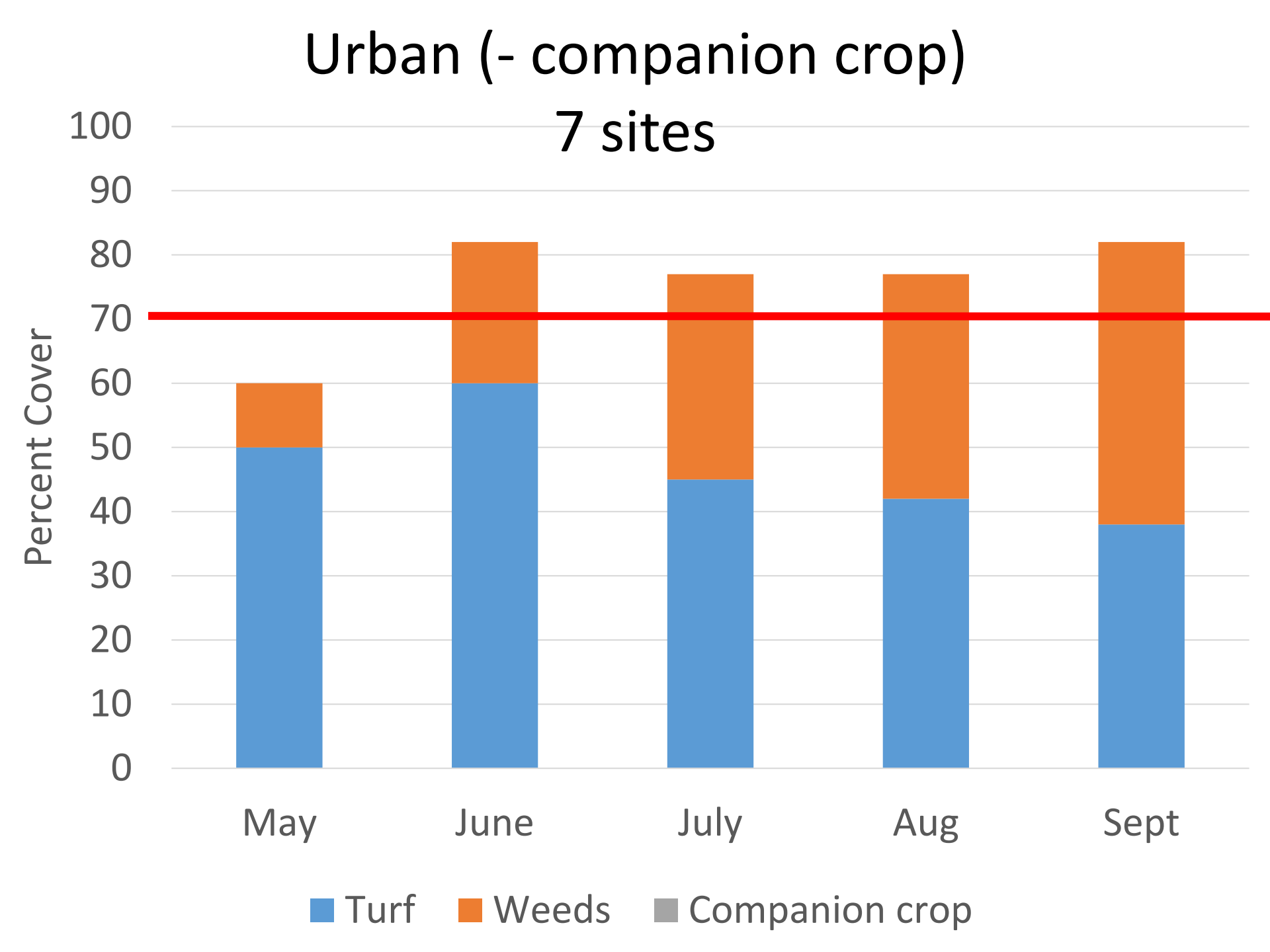
5 Urban areas (- companion crops)

7 rural areas (+ companion crops)

Locations Visited

Site Name	Urban /Rural	Year Seeded	Seeding Date	Date
UW Greenhouses	Urban	2014	240	Aug 28
Verona - Hwy J	Rural	2014	260	Sept 17
Hwy 83 #1	Urban	2014	261	Sept 18
Hwy 73 - Craig Road	Rural	2014	285	Oct 12
Middleton	Urban	2014	287	Oct 14
Hwy 83 #2	Urban	2014	288	Oct 15
Sauk City #1	Rural	2015	266	Sept 23
Hwy 12 - Baraboo	Urban	2015	266	Sept 23
Sauk City #2	Rural	2015	289	Oct 16
Hwy 73 #1	Rural	2015	292	Oct 19
Hwy 73 #2	Rural	2015	306	Nov 2
Sauk City #3	Rural	2015	320	Nov 16


Rural (+ companion crop)
7 sites
100
90
80
70
60
50
40
30
20
10
0
Percent Cover
May
June
July
Aug
Sept
Turf
Weeds
Companion crop


Urban (- companion crop)
7 sites
100
90
80
70
60
50
40
30
20
10
0
Percent Cover
May
June
July
Aug
Sept
Turf
Weeds
Companion crop

But results were variable across locations….

Site Name		Year Seeded	Seeding Date	September turf % cover		
				Zone 2	Zone 3	Zone 4
UW Greenhouses	Urban	2014	240	76	90	65
Verona - Hwy J	Rural	2014	260	31	51	52
Hwy 83 #1	Urban	2014	261	5	6	9
Hwy 12 - Baraboo	Urban	2015	266	45	42	19
Sauk City #1	Rural	2015	266	25	69	9
Hwy 73 - Craig Road	Rural	2014	285	55	58	56
Middleton	Urban	2014	287	53	63	55
Hwy 83 #2	Urban	2014	288	20	10	7
Sauk City #2	Rural	2015	289	27	5	39
Hwy 73 #1	Rural	2015	292	43	58	57
Hwy 73 #2	Rural	2015	306	15	30	17
Sauk City #3	Rural	2015	320	5	10	40

Used these variables to determine what impacts establishment

Planting	Weather	Site Specific
Soil Moisture	Growing Degree Days Post Seeding	% Sand
Soil Temperature	Precipitation Four Weeks Post Seeding	% Silt
Soil Salinity		% Clay
Soil Surface Hardness		Soil pH
Mulch Weight (/m2)		Soil Organic Matter
		Soil Phosphorus
		Soil Potassium

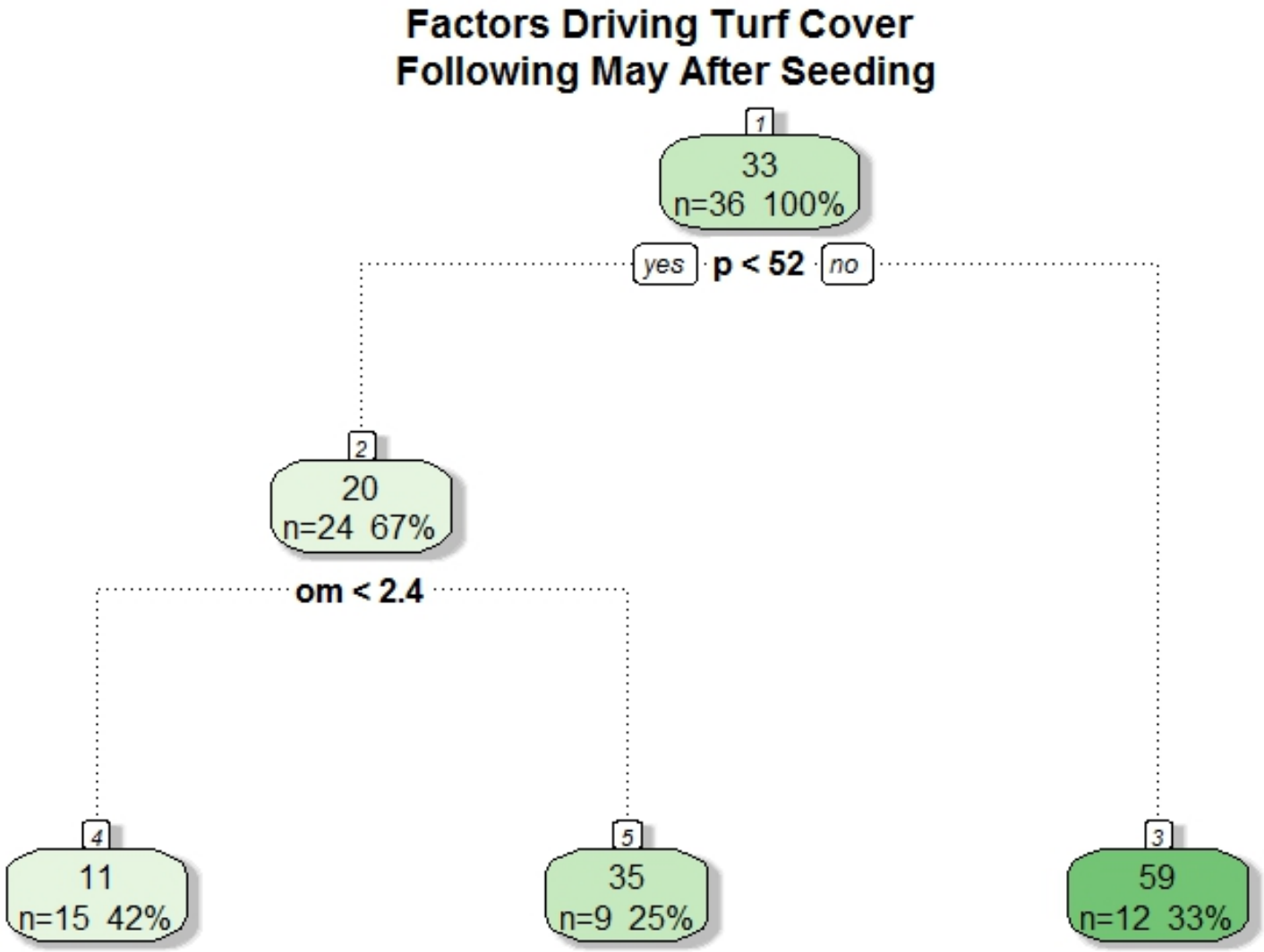
Cover was taken 30 days after seeding, and monthly the following year beginning in April, until 1 year after seeding

Used 2 methods to analyze results

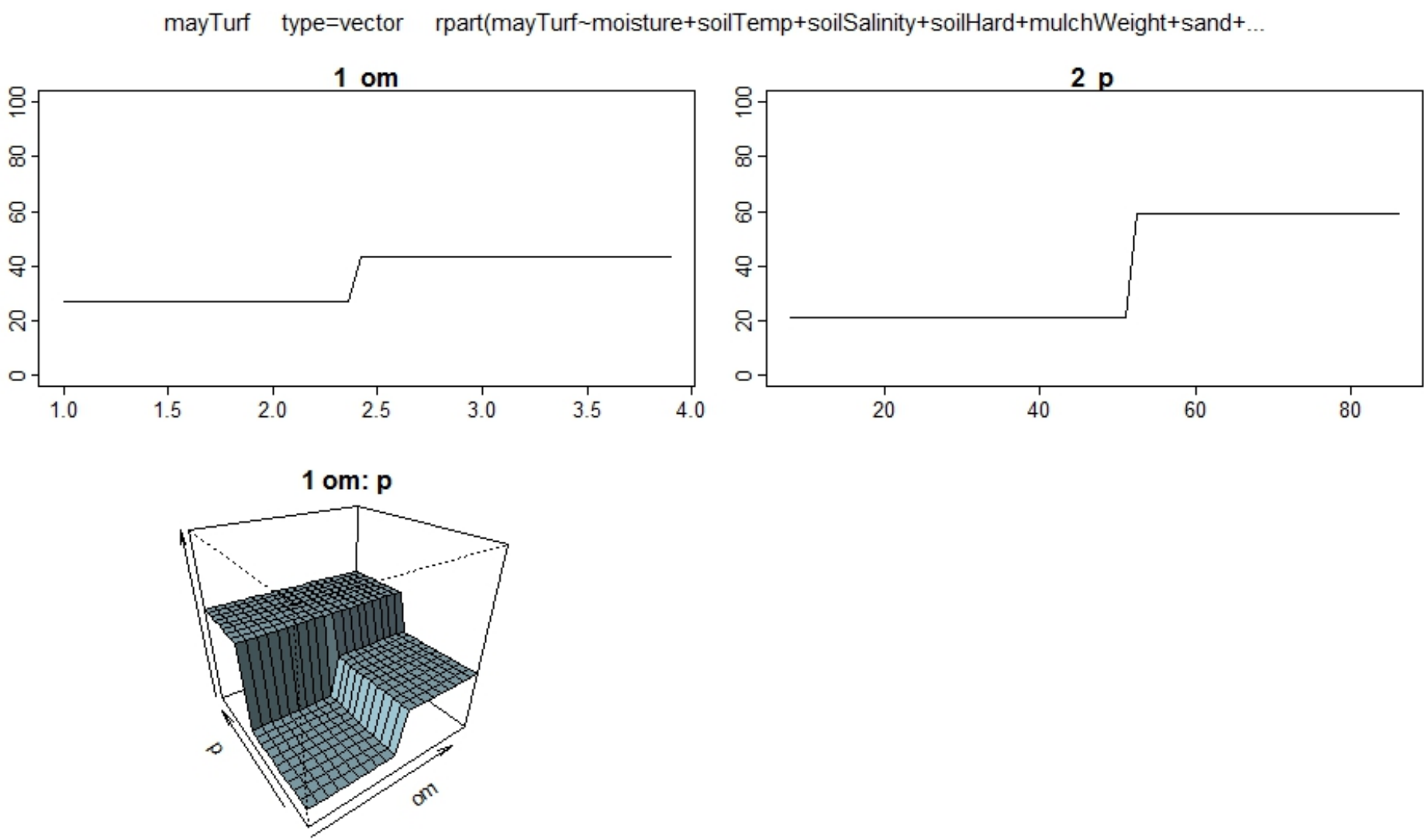
- Regression Tree analysis (a form of CART)
  - Explains variability in the results from the response variables measured.
    - Variables can be numerical or categorical
  - Builds a tree which can explain how response variables are related
    - Tree determines value where a change in response is observed (node)
  - Can “prune” tree to eliminate variables with limited importance

- Random forest (repeated regression tree analysis)
  - Run many regression trees and document the number of times and importance of each response variable (“votes”)
  - Determines response of independent variables
  - A benefit when you have limited locations

May – Turf Cover

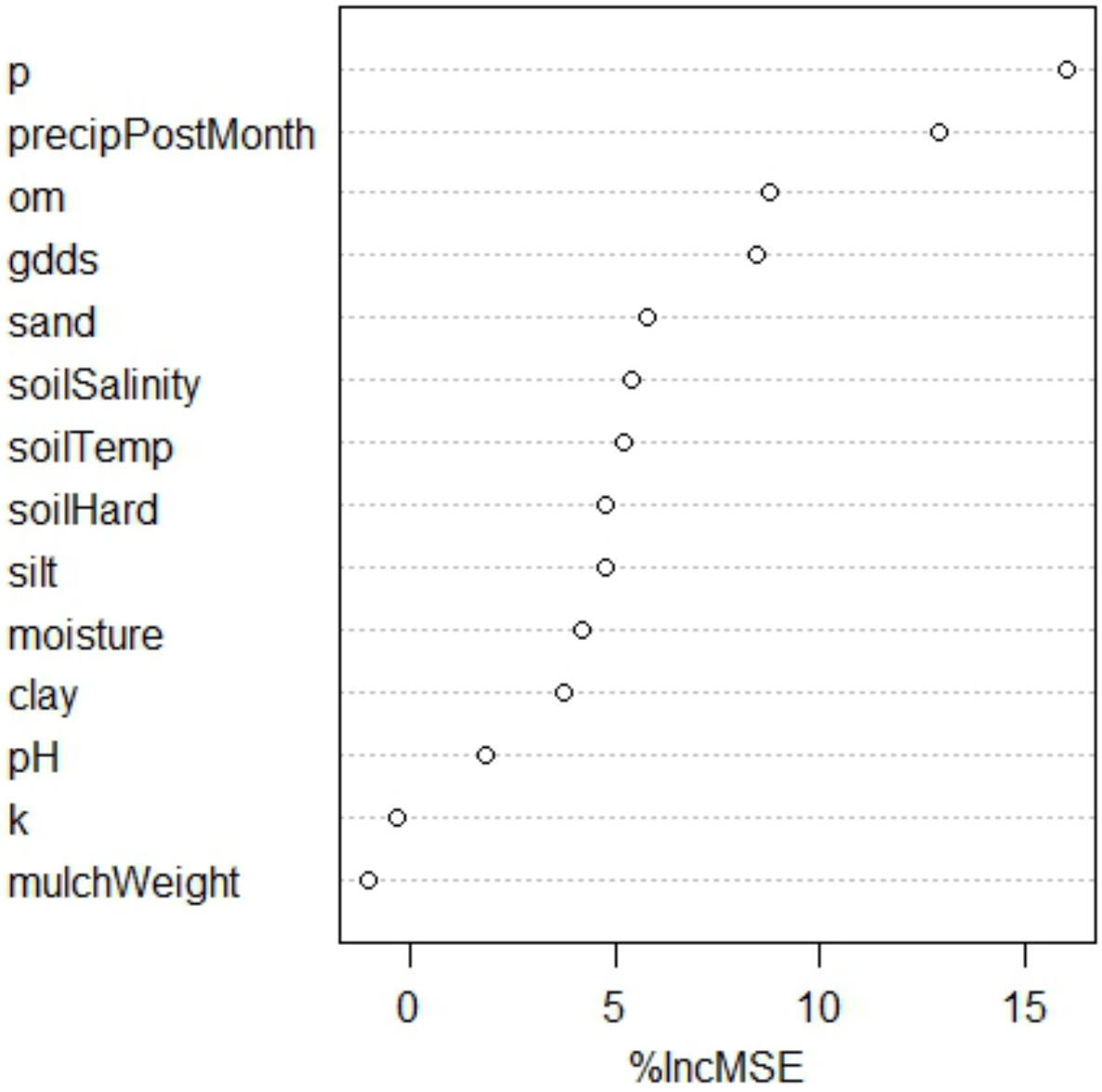


May – Turf Cover

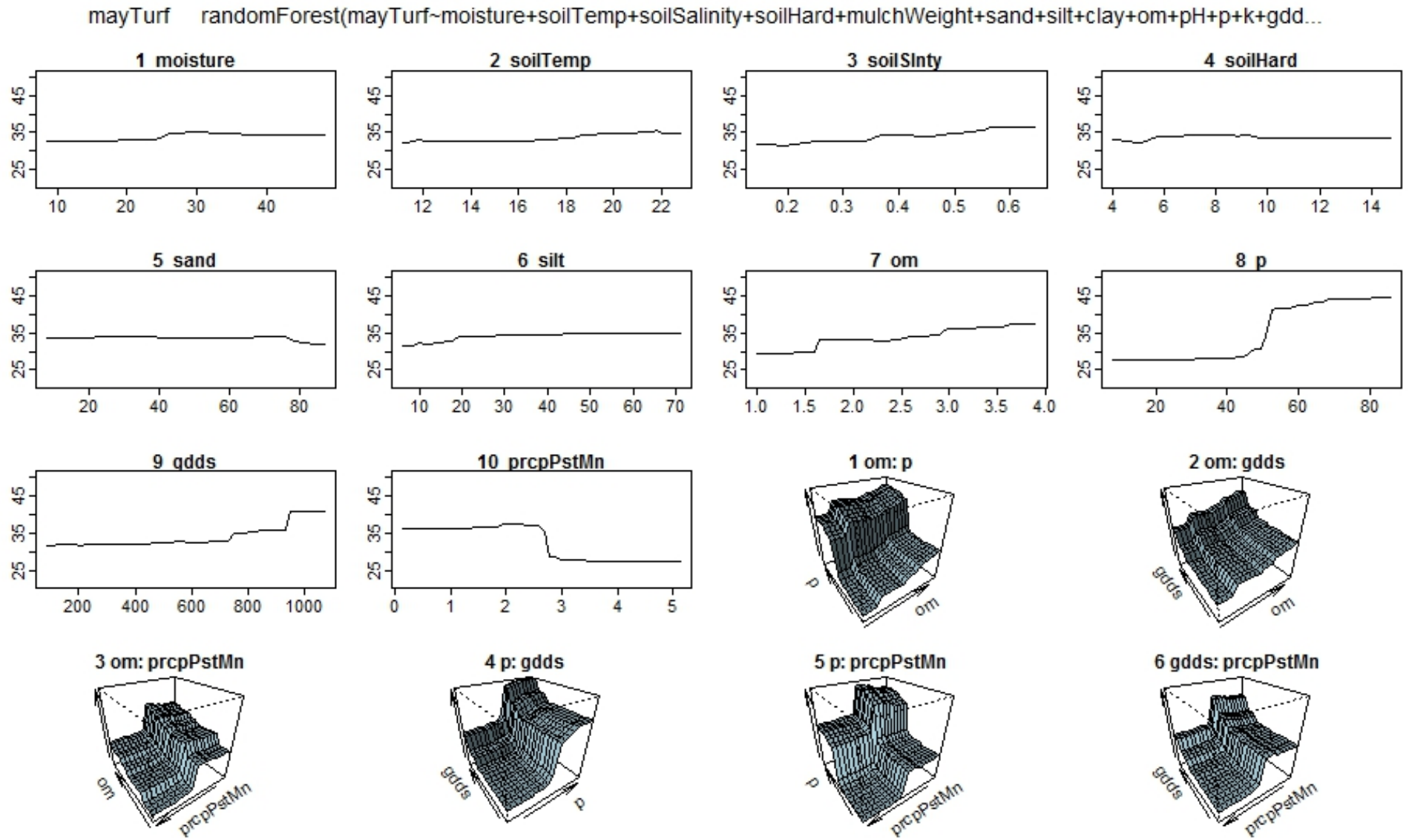


Regression Tree Analysis using Random Forests

May – Turf Cover



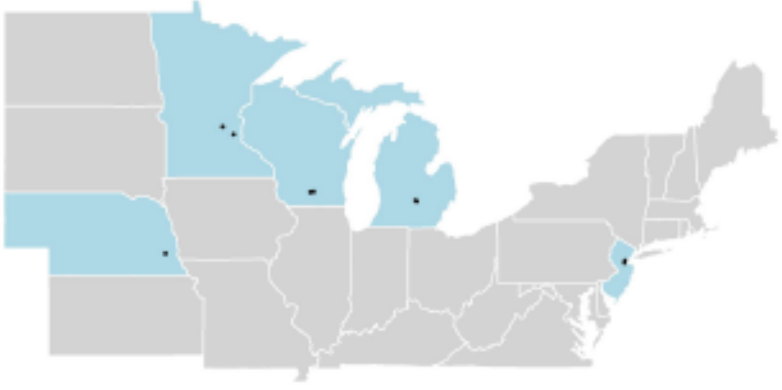
May – Turf Cover RESPONSES



POOLED FUNDING REGIONAL PROJECT

Objective

Assess potential roadside turfgrasses across multiple states in the northern U.S. to generate unbiased data for use by public agencies



Material and Methods

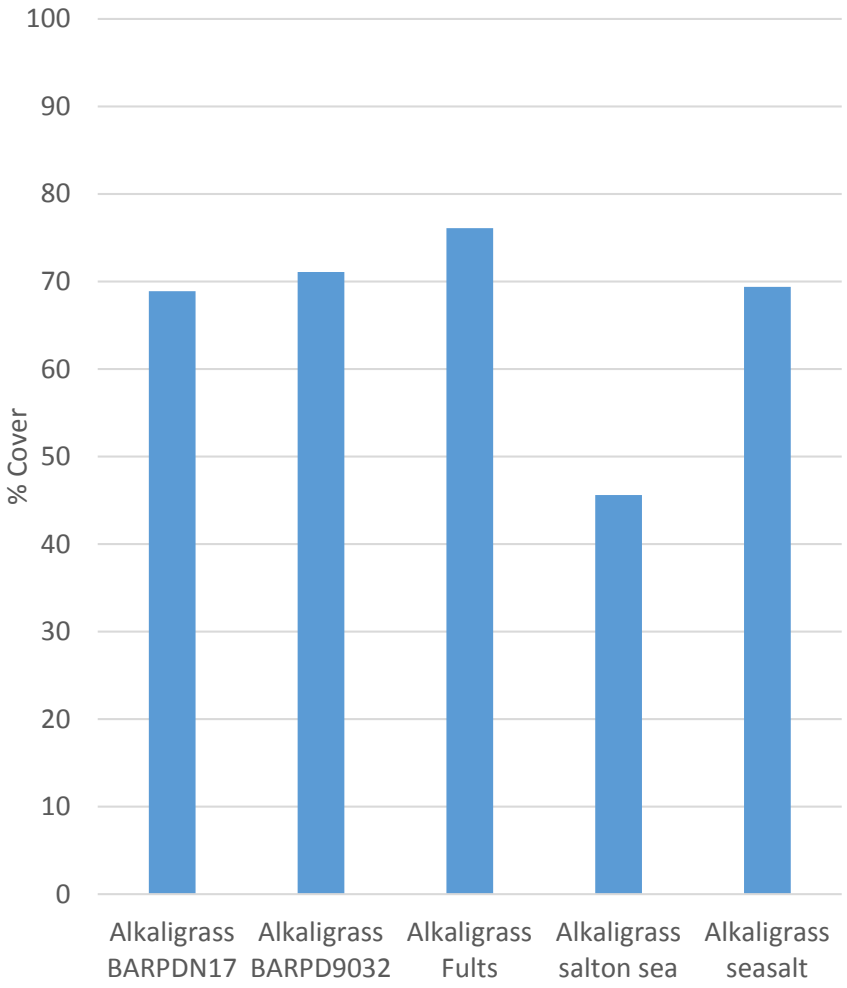
Table 1. Research sites included in a multi-state roadside turfgrass trial. Precipitation and snowfall is cumulative from seeding through second spring data collection unless noted by *italics*.

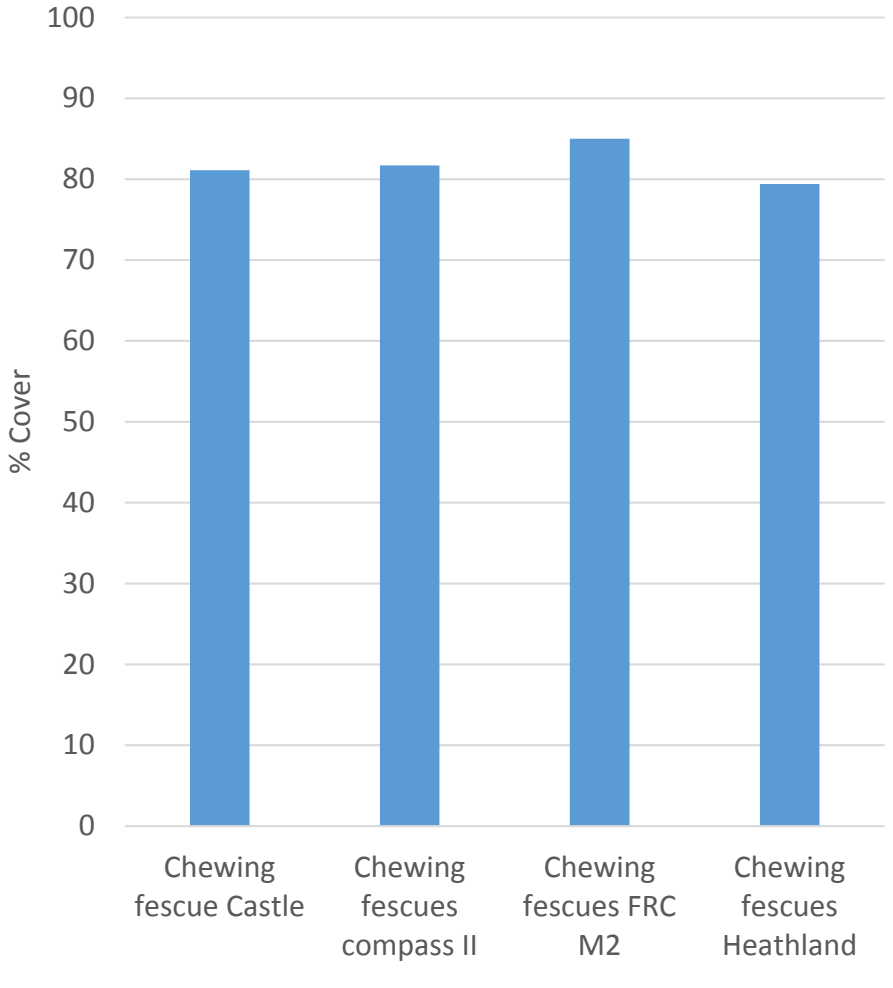
Location	Site	Seeding Date	Avg. Monthly Max. Temp (°C)	Avg. Monthly Min. Temp (°C)	Total Precip. (cm)	Snowfall (cm)	Soil Type	Soil Organic Matter (%)
Michigan	Rural	9/21/16	13.5	3.3	154.7	189.7	Gilford sandy loam	1.9
	Urban	9/16/16	13.5	3.3	170.9	212.3	Metea loamy sand	3.5
Minnesota	Rural	8/24/17	*11.2**	*1.0*	*52.8*	*70.6*	Cordova loam	3.4
	Urban	8/26/16	10.9	1.3	169.7	286.5	Kingsley sandy loam	3.5
Nebraska	Rural	10/15/16	15.5	2.2	112.4	125.5	Wymore silty clay loam	-
	Urban	10/15/16	15.5	2.2	116.2	73.4	Aksarben silty clay loam	-
New Jersey	Rural	10/4/16	16.4	5.6	180.3	126.5	Klinesville channery loam	3.7
	Urban	10/5/16	16.4	5.6	232.7	168.4	Matapeake silt loam	3.8
Wisconsin	Rural	10/6/16	10.7	0.6	142.1	209.8	Orion silt loam	4.1
	Urban	9/10/17	*6.9*	*-3.0*	*32.46*	*94.7*	McHenry silt loam	3.9

Use results to

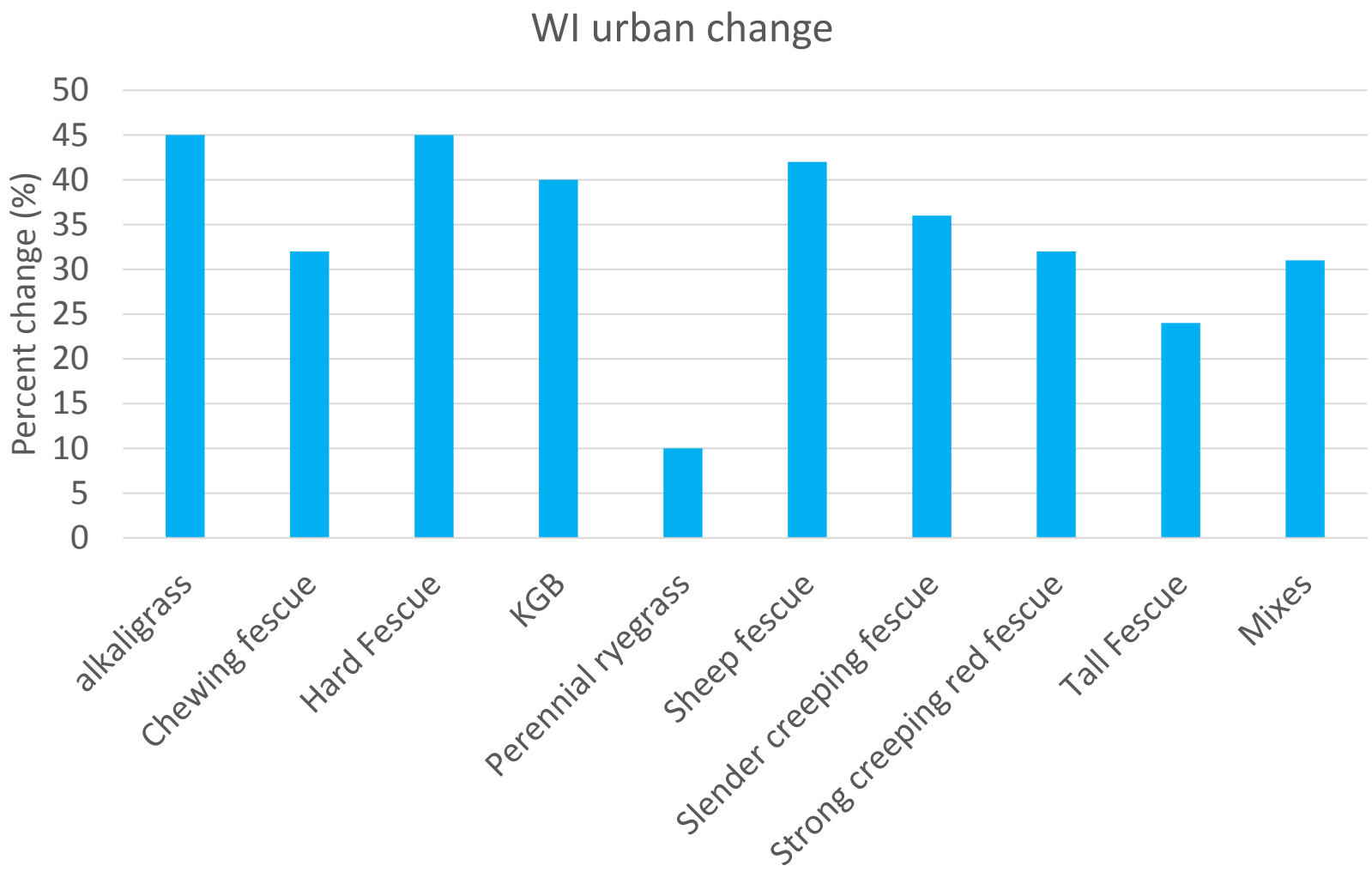
- **Identify species and varieties that perform best**
  - alkaliagrass (6), chewing fescue (4), hard fescue (5), Kentucky bluegrass (8), perennial ryerass (6), sheep fescue (3), smooth brome (1), Slender creeping red fescuce (4), strong creeping red fescue (5), Tall Fescue (8)
- **Compare current DOT mixes of states involved**
  - MIDOT (THV & TUV), MNDOT (25-131 & MNST-12), NEDOT (rural & urban/turf), NJDOT (A-4 &Type B), WIDOT (20 & 40)
- **Compare performance in urban vs rural settings**

Initial results are promising
Urban turfgrass cover
spring 2018 cover **6 months** after planting



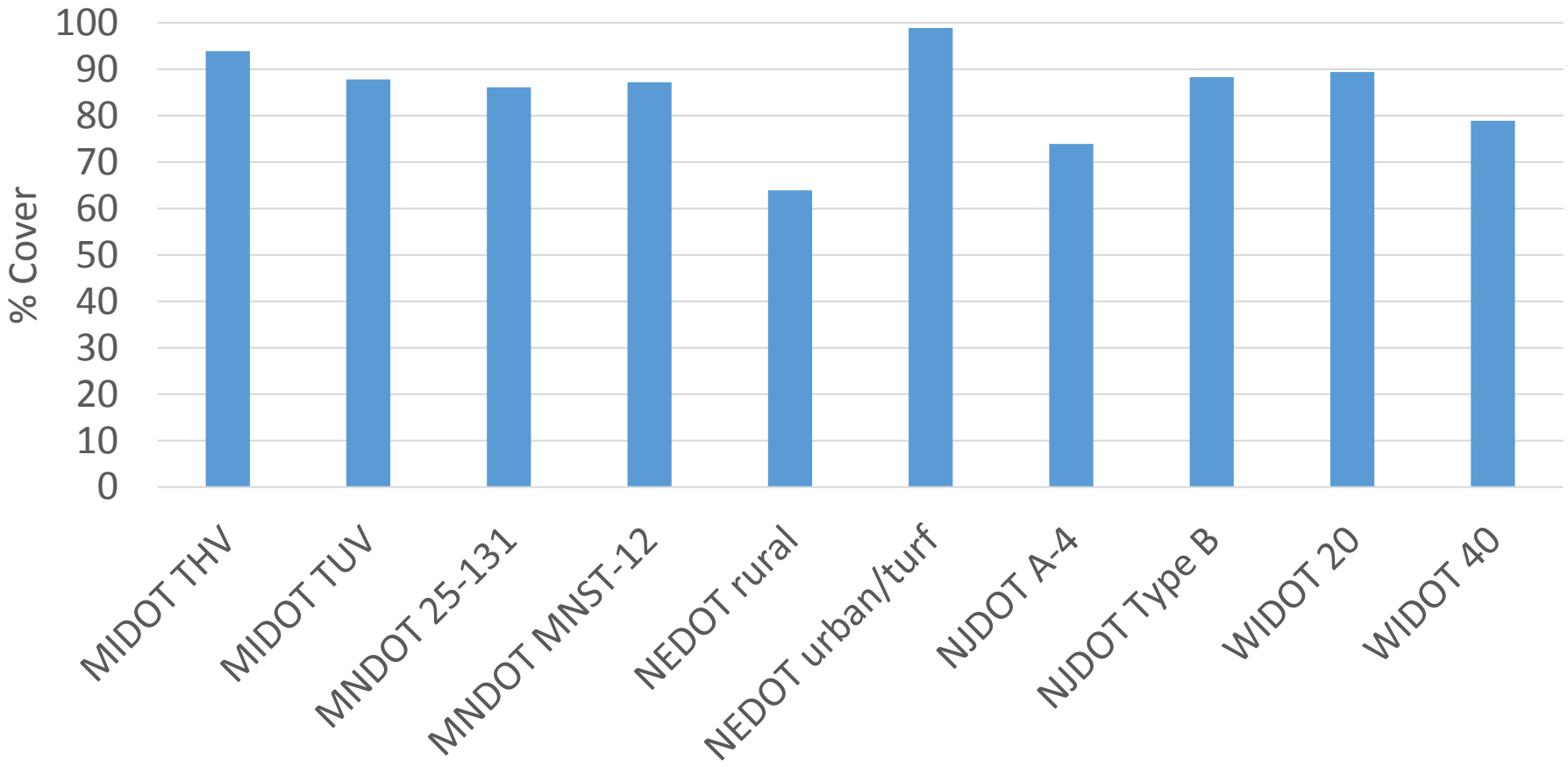


How are these changing over time? % change in cover from 1-6 MAP

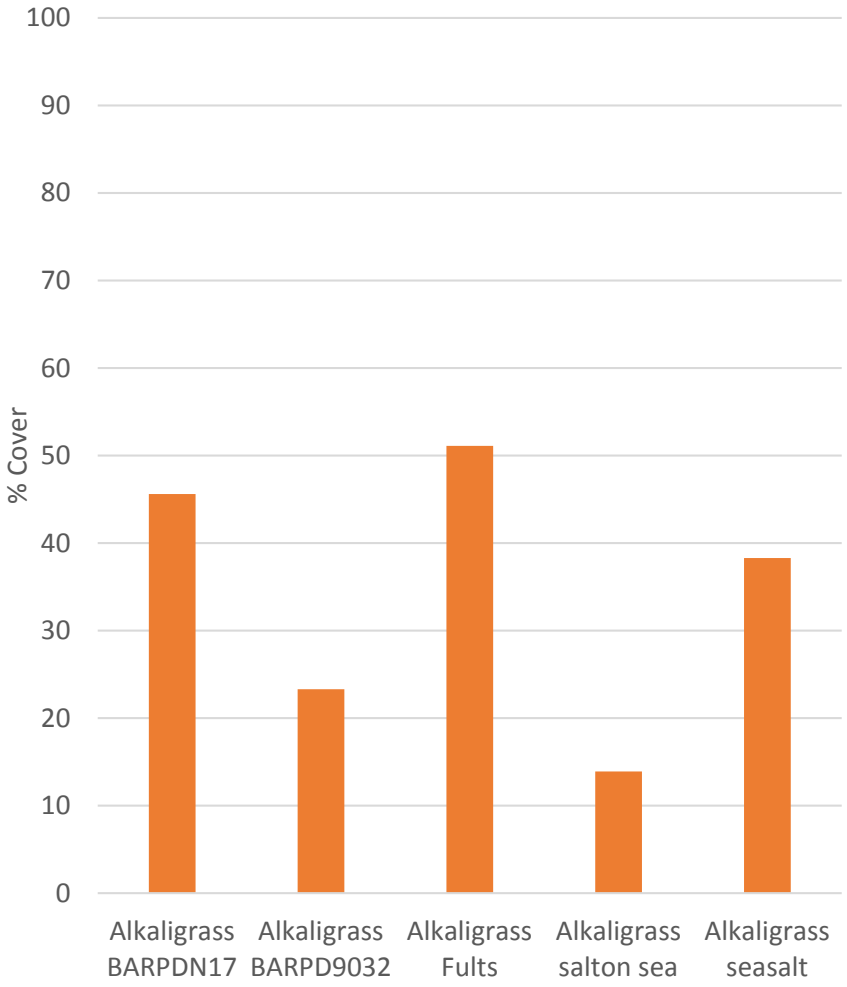


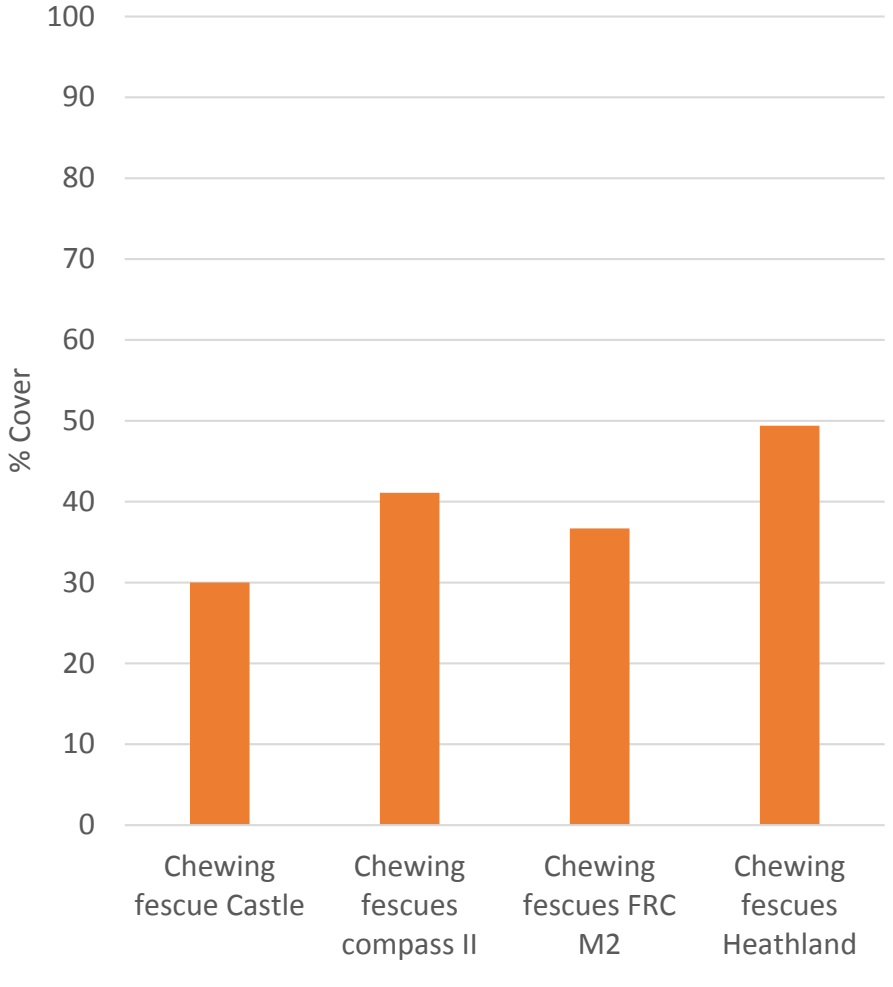
URBAN DOT Mix Performance

spring 2018 cover **6 months** after planting

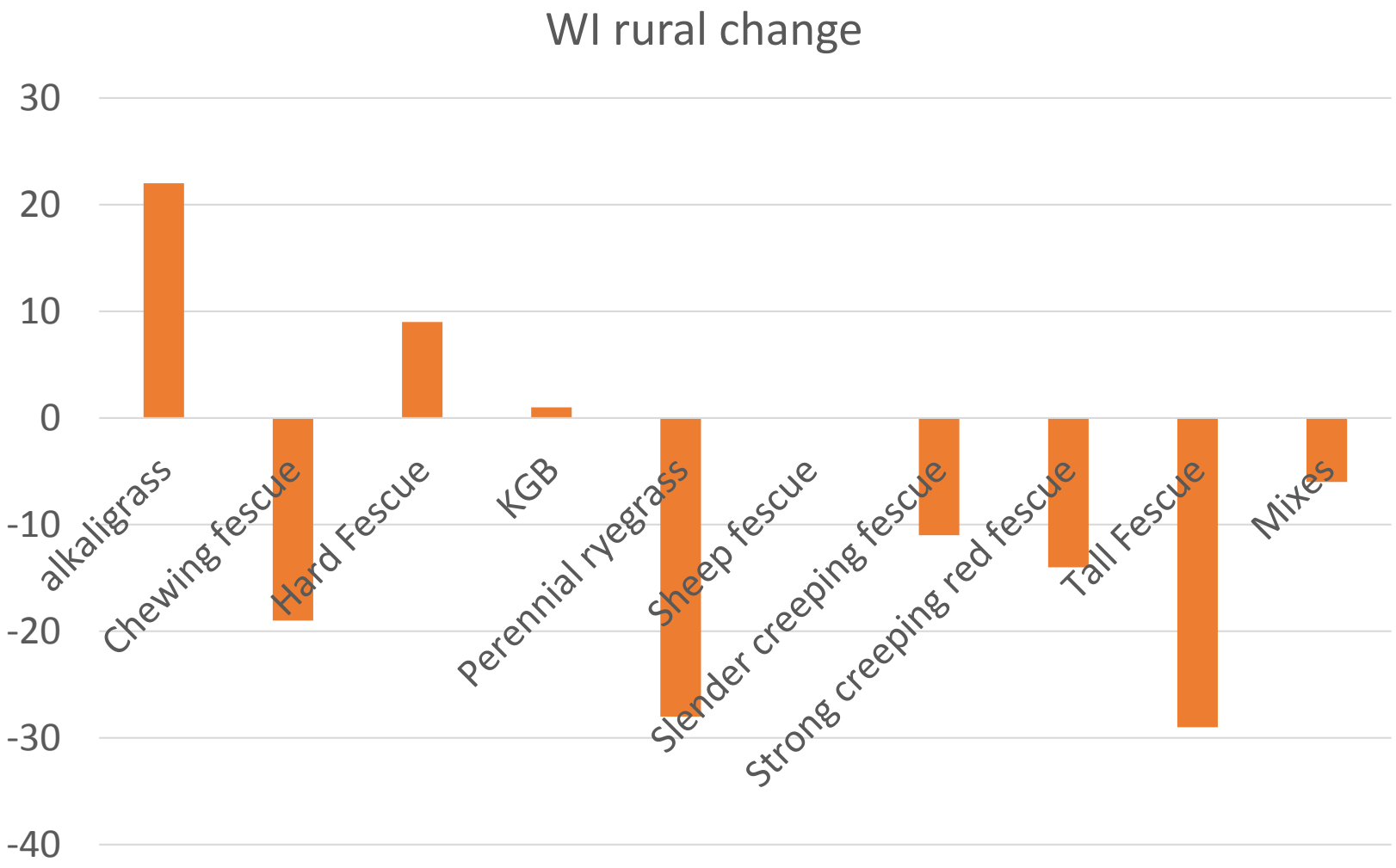


Initial results are promising
Rural turfgrass cover
spring 2018 cover 1.5 years after planting



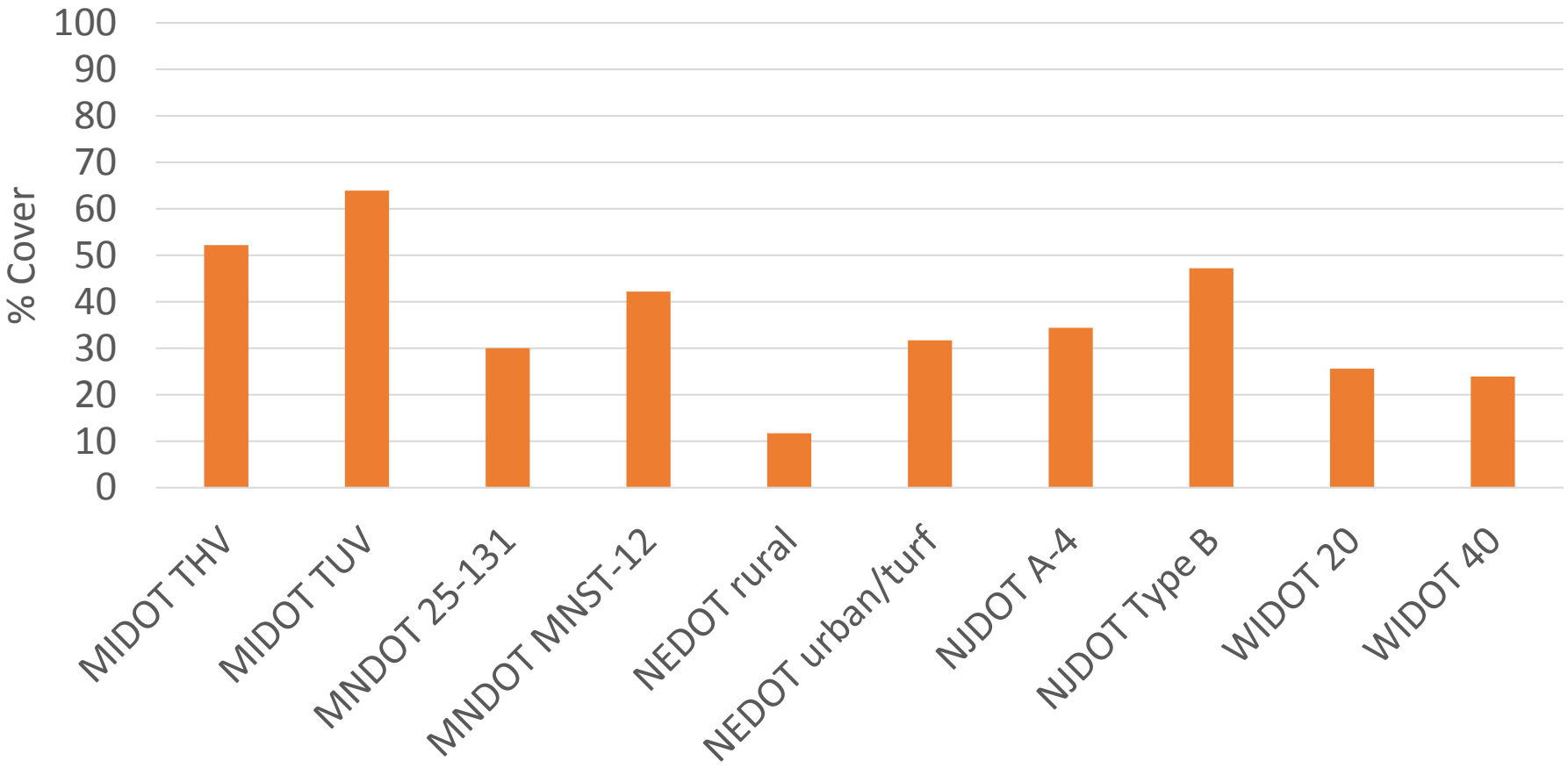


How are these changing over time? % change in cover from 12-18 MAP



RURAL DOT Mix Performance

spring 2018 cover 1.5 years after planting



Future efforts with this project

- Evaluate factors responsible for species success
  - Physical factors: Soil type, Fertility, % Organic matter, traffic load
  - Environmental factors: Precipitation, Growing degree days,
  - Variety

- Evaluate factors responsible for mix success
  - Physical factors: Soil type, Fertility, % Organic matter, traffic load
  - Environmental factors: Precipitation, Growing degree days
  - Species in mixture

Thank you WI-DOT for Funding!

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