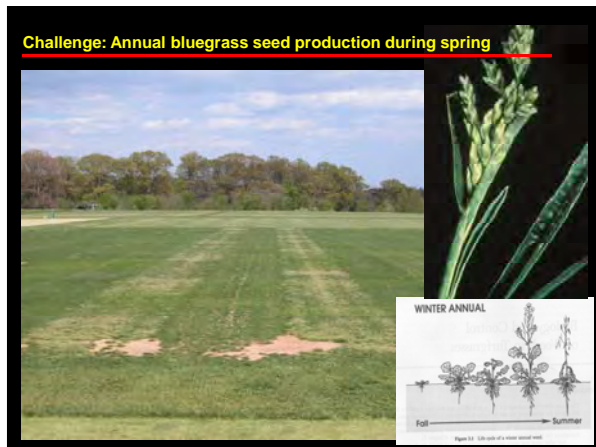
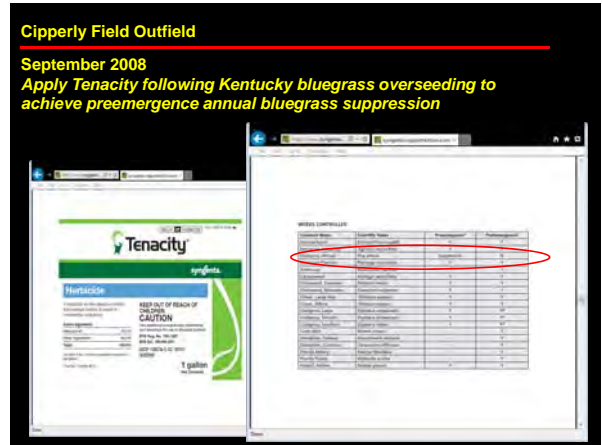


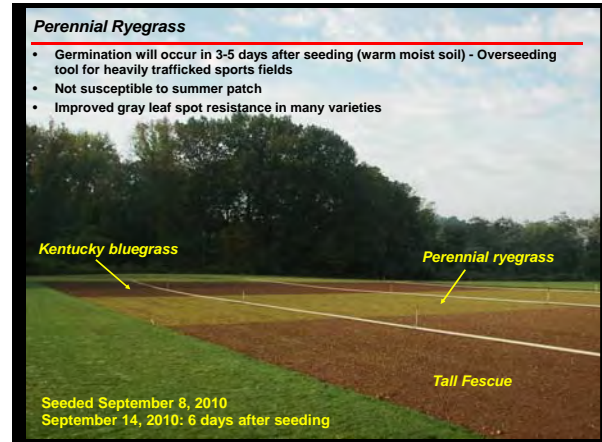
RUTGERS
New Jersey Agricultural
Experiment Station

**Renovating Cool-Season Turf Dominated by
Annual Bluegrass**

Brad Park
Rutgers University, New Brunswick, NJ







Use research data to select improved perennial ryegrass varieties/blends

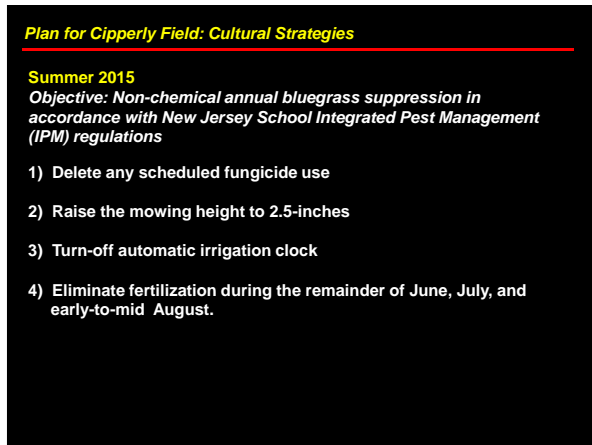
Trade Name PERENNIAL RYEGRASS
 PURE SEED 99.14% GERMINATION 99%
 PURITY INDEX 1.004
 EMERGENT SEED 1.004
 WEED SEED 0.004
 CUP NUMBER: 5158-10-197

CHAMPION GLS
 PERENNIAL RYEGRASS BLEND
 Purity: 99.97%
 34.35% SINGLES PERENNIAL RYEGRASS
 35.70% CHIFFER II PERENNIAL RYEGRASS
 34.95% SIDEWAYS PERENNIAL RYEGRASS

00.00% Other Crop Seed
 00.00% Other Weeds
 00.00% Other Weeds

LOWLAND PRODUCTS, INC
 PO BOX 128
 GREELEY, CO 80632-0128

Lot No. L20M-15-2610





Plan for Cipperly Field: Cultural & Chemical Strategies

Late summer and autumn 2015
Objective: Introduction of improved perennial ryegrass varieties in conjunction with pre/post chemical control of annual bluegrass

- 1) Late August: Begin irrigating to encourage Kentucky bluegrass (and remaining annual bluegrass) growth

Goal: Selective, postemergence control of annual bluegrass

- 2) September 7, 2015
 Apply Xonerate WDG (2.0 oz/Acre) + Tenacity (4.0 oz/Acre) + Nonionic surfactant (NIS) at 0.25% v:v

Plan for Cipperly Field: Cultural & Chemical Strategies

Late summer and autumn 2015
Objective: Introduction of improved perennial ryegrass varieties in conjunction with pre/post chemical control of annual bluegrass

September 14, 2015
 Slit-seed a gray leaf spot resistant perennial ryegrass blend at 10 lbs seed/1000 ft². Apply 0.5 to 0.7 lbs N/1000 ft²

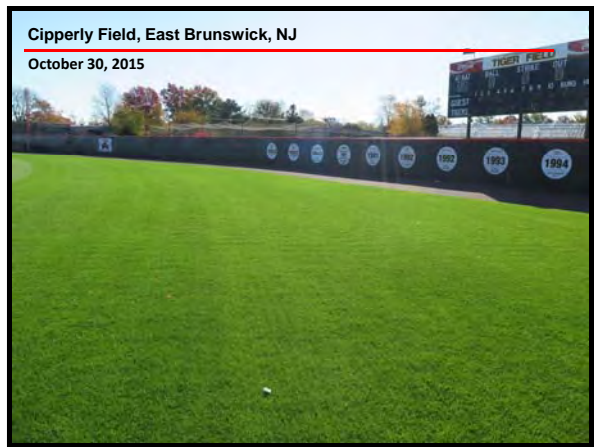
Plan for Cipperly Field: Cultural & Chemical Strategies

Late summer and autumn 2015
Objective: Introduction of improved perennial ryegrass varieties in conjunction with pre/post chemical control of annual bluegrass

Goal: Preemergence suppression of annual bluegrass following perennial ryegrass overseeding during autumn 2015

Apply Tenacity at 4.0 oz/Acre with NIS at 0.25% v:v

- 1) October 12, 2015
- 2) October 26, 2015
- 3) November 9, 2015





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Materials and Methods
Field management

- A study was initiated on a loam during September 2015 and repeated in September 2016 on a mature stand of annual bluegrass in North Brunswick, NJ.
- Adjacent test areas were core cultivated with soil reincorporated on September 3, 2015 and September 7, 2016.

Photo: E. Chen



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Materials and Methods

'Manhattan 5 GLR' perennial ryegrass was slit-seeded at 11 lbs/1000 ft² on September 14, 2015 and September 16, 2016.

Photos: C. Mansue

Photos: B. Park

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Research Objective:
To assess the effectiveness of herbicide programs designed to suppress annual bluegrass in turf overseeded with perennial ryegrass

Rutgers Hort. Farm No. 2
North Brunswick, NJ

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New Jersey Agricultural Experiment Station

Materials and Methods

Treatments consisted of 13 herbicide programs and an untreated check (CHK).

Herbicide programs included applications of
KleenUp Pro (glyphosate)
Xonerate (amicarbazone)
Tenacity (mesotrione)
Prograss EC (ethofumesate)

Treatments were applied using an air induction nozzle (9506EVS) during Sep. 4 through Dec. 3, 2015 and Sep. 7 through Dec. 2, 2016 using a CO₂ backpack sprayer calibrated to deliver 40 gal/Acre at 40 psi.

Experimental design
Treatments were arranged in a randomized complete block design with four replications.

Materials and Methods

Core cultivation on September 3, 2015 'Manhattan 5 GLR' perennial ryegrass was silt-seeded at 11 lbs/1000 ft² on September 14, 2015.

No.	Treatment	Rate (oz/A)	Application Dates (2015)											
			4-Sep	15-Sep	6-Oct	15-Oct	19-Oct	22-Oct	26-Oct	30-Oct	3-Nov	4-Dec		
2	Tenacity	5.0	-	Yes	-	Yes	-	-	-	-	-	Yes	-	-
3a	Tenacity	4.0	-	Yes	-	-	-	-	-	-	-	-	-	-
3b	Tenacity	3.0	-	-	-	Yes	Yes	Yes	Yes	Yes	-	-	-	-
4a	Tenacity	4.0	-	-	-	-	Yes	-	-	-	-	-	-	-
4b	Tenacity	3.0	-	-	-	-	-	Yes	Yes	Yes	Yes	-	-	-
5a	Tenacity	4.0	Yes	-	-	-	-	-	-	-	-	-	-	-
5b	Tenacity	5.0	-	-	-	-	Yes	-	-	-	-	Yes	-	-
6a	Tenacity	4.0	Yes	-	-	-	-	-	-	-	-	-	-	-
6b	Tenacity	3.0	-	-	-	-	Yes	Yes	Yes	Yes	-	-	-	-
7a	Tenacity + Xonerate	4.0	Yes	-	-	-	-	-	-	-	-	-	-	-
7b	Tenacity	5.0	-	-	-	-	Yes	-	-	-	-	Yes	-	-
8a	Tenacity + Xonerate	2.4	Yes	-	-	-	-	-	-	-	-	-	-	-
8b	Tenacity	5.0	-	-	-	-	Yes	-	-	-	-	Yes	-	-
9a	Tenacity + Xonerate	4.0	Yes	-	-	-	-	-	-	-	-	-	-	-
9b	Tenacity	3.0	-	-	-	-	Yes	Yes	Yes	Yes	-	-	-	-
10a	Tenacity + Xonerate	4.0	Yes	-	-	-	-	-	-	-	-	-	-	-
10b	Tenacity	2.4	Yes	-	-	-	-	-	-	-	-	-	-	-
10c	Tenacity	3.0	-	-	-	-	Yes	Yes	Yes	Yes	-	-	-	-
11	Prograss	174	-	-	Yes	-	-	-	-	-	-	Yes	Yes	-
12	KleenUp Pro	16.0	Yes	-	-	-	-	-	-	-	-	-	-	-
13a	KleenUp Pro	16.0	Yes	-	-	-	-	-	-	-	-	-	-	-
13b	Prograss	174	-	-	Yes	-	-	-	-	-	-	Yes	Yes	-
14a	KleenUp Pro	16.0	Yes	-	-	-	-	-	-	-	-	-	-	-
14b	Tenacity	4.0	-	-	-	-	Yes	-	-	-	-	-	-	-
14c	Tenacity	3.0	-	-	-	-	-	Yes	Yes	Yes	Yes	-	-	-

Materials and Methods

Fertilization schedule with 16-4-8:

Date	Rate
September 14, 2015	0.6 lbs N/1000 ft ²
September 16, 2016	0.6 lbs N/1000 ft ²
October 5, 2015	0.4 lbs N/1000 ft ²
October 5, 2016	0.5 lbs N/1000 ft ²
October 21, 2015	0.3 lbs N/1000 ft ²
October 17, 2016	0.5 lbs N/1000 ft ²
November 9, 2015	0.6 lbs N/1000 ft ²
November 2, 2016	0.3 lbs N/1000 ft ²
Total:	1.9 lbs N/1000 ft²
Total:	2.0 lbs N/1000 ft²



Materials and Methods

Core cultivation on September 7, 2016 'Manhattan 5 GLR' perennial ryegrass was silt-seeded at 11 lbs/1000 ft² on September 16, 2016.

No.	Treatment	Rate (oz/A)	Application Dates (2016)											
			7-Sep	16-Sep	7-Oct	21-Oct	24-Oct	28-Oct	31-Oct	4-Nov	2-Dec			
2	Tenacity	5.0	-	Yes	-	Yes	-	-	-	-	Yes	-	-	
3a	Tenacity	4.0	-	Yes	-	-	-	-	-	-	-	-	-	
3b	Tenacity	3.0	-	-	-	Yes	Yes	Yes	Yes	Yes	-	-	-	
4a	Tenacity	4.0	-	-	-	-	Yes	-	-	-	-	-	-	
4b	Tenacity	3.0	-	-	-	-	-	Yes	Yes	Yes	Yes	-	-	
5a	Tenacity	4.0	Yes	-	-	-	-	-	-	-	-	-	-	
5b	Tenacity	5.0	-	-	-	-	Yes	-	-	-	-	Yes	-	-
6a	Tenacity	4.0	Yes	-	-	-	-	-	-	-	-	-	-	-
6b	Tenacity	3.0	-	-	-	-	-	Yes	Yes	Yes	Yes	-	-	-
7a	Tenacity + Xonerate	4.0	Yes	-	-	-	-	-	-	-	-	-	-	-
7b	Tenacity	5.0	-	-	-	-	Yes	-	-	-	-	Yes	-	-
8a	Tenacity + Xonerate	2.4	Yes	-	-	-	-	-	-	-	-	-	-	-
8b	Tenacity	5.0	-	-	-	-	Yes	-	-	-	-	Yes	-	-
9a	Tenacity + Xonerate	4.0	Yes	-	-	-	-	-	-	-	-	-	-	-
9b	Tenacity	3.0	-	-	-	-	Yes	Yes	Yes	Yes	-	-	-	-
10a	Tenacity + Xonerate	4.0	Yes	-	-	-	-	-	-	-	-	-	-	-
10b	Tenacity	2.4	Yes	-	-	-	-	-	-	-	-	-	-	-
10c	Tenacity	3.0	-	-	-	-	Yes	Yes	Yes	Yes	-	-	-	-
11	Prograss	174	-	-	Yes	-	-	-	-	-	-	Yes	Yes	-
12	KleenUp Pro	16.0	Yes	-	-	-	-	-	-	-	-	-	-	-
13a	KleenUp Pro	16.0	Yes	-	-	-	-	-	-	-	-	-	-	-
13b	Prograss	174	-	-	Yes	-	-	-	-	-	-	Yes	Yes	-
14a	KleenUp Pro	16.0	Yes	-	-	-	-	-	-	-	-	-	-	-
14b	Tenacity	4.0	-	-	-	-	Yes	-	-	-	-	-	-	-
14c	Tenacity	3.0	-	-	-	-	-	Yes	Yes	Yes	Yes	-	-	-

Results: Autumn 2015 Applications

Table 1. Perennial ryegrass populations during 2016 resulting from herbicide programs designed to suppress annual bluegrass in turf overseeded with perennial ryegrass applied in autumn 2015.

No.	Treatment (oz/Acre)	Perennial ryegrass population (2016)				
		25 Mar.	28 Apr.	26 May	29 June	28 July
		0 to 100% scale ¹				
13	KleenUp Pro (16.0) fb Prograss (174)3x	83.8	100.0	98.8	95.0	93.8
11	Prograss (174)3x	65.0	97.5	93.8	78.8	72.5
3	Tenacity (4.0) fb Tenacity (3.0)4x	55.0	63.8	63.8	51.3	56.3
14	KleenUp Pro (16.0) fb Tenacity (4.0) fb Tenacity (3.0)4x	56.3	62.5	83.3	68.3	48.8
2	Tenacity (5.0)3x	60.0	66.3	65.0	52.5	48.8
10	Tenacity (4.0)+Xonerate (2.4) fb Tenacity (3.0)4x	52.5	71.3	62.5	46.3	42.5
9	Tenacity (5.0)+Xonerate (1.2) fb Tenacity (3.0)4x	55.0	56.3	61.3	45.0	42.5
4	Tenacity (4.0) fb Tenacity (3.0)4x	40.0	37.5	35.0	38.8	40.0
6	Tenacity (4.0) fb Tenacity (3.0)4x	46.3	50.0	50.0	37.5	36.3
5	Tenacity (4.0) fb Tenacity (5.0)2x	46.3	46.3	46.3	31.3	35.0
8	Tenacity (4.0)+Xonerate (2.4) fb Tenacity(5.0)2x	51.3	72.5	58.8	42.5	32.5
7	Tenacity (4.0)+Xonerate (1.2) fb Tenacity (5.0)2x	46.3	50.0	45.0	31.3	30.0
1	CHECK	20.0	11.3	11.3	6.3	17.5
12	KleenUp Pro (16.0)	27.5	21.3	15.0	8.8	13.8
LSD (0.05)		14.8	21.7	17.9	13.8	13.7

¹ 100%-complete perennial ryegrass turf cover

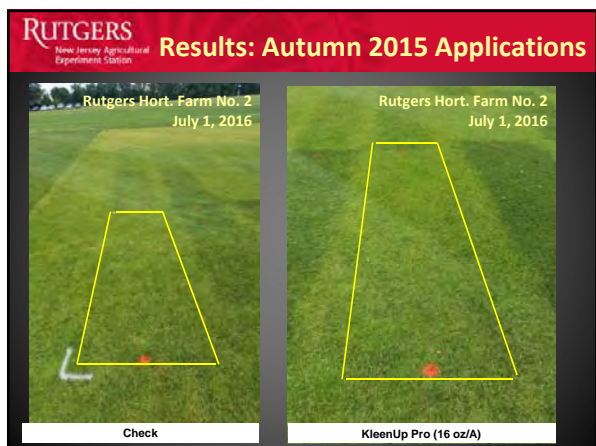
Materials and Methods

Perennial ryegrass establishment (0 to 100% scale; 100%=complete perennial ryegrass turf cover) following autumn 2015 herbicide programs was visually assessed during spring and summer 2016.

Herbicide injury (1 to 9 scale; 9=no injury) was assessed during autumn 2015 and 2016.

Statistical analysis
Data were subject to analysis of variance. Means were separated using Fisher's protected least significant difference (LSD) test at $p \leq 0.05$.





Rutgers Hort. Farm No. 2 July 1, 2016

Results: Autumn 2016 Applications

Table 2. Herbicide injury and turf quality during herbicide programs designed to suppress annual bluegrass in turf overseeded with perennial ryegrass during autumn 2016.

No.	Treatment (oz/Acre)	Nov. 4, 2016		Nov. 18, 2016	
		Injury	Quality	Injury	Quality
		1 to 9 scale ¹			
12	KleenUp Pro(16.0)	8.5	8.8	8.3	9.0
1	CHECK	9.0	8.5	8.5	9.0
11	Progress (174) 3x	8.8	6.3	9.0	8.0
13	KleenUp Pro (16.0) fb Progress (174)3x	8.3	6.5	9.0	7.5
8	Tenacity (4.0)+Xonerate (2.4) fb Tenacity (5.0) 2x	6.5	6.5	5.5	6.0
7	Tenacity (4.0)+Xonerate (1.2) fb Tenacity (5.0) 2x	6.3	6.0	5.5	5.5
2	Tenacity (5.0) 3x	6.8	6.3	5.0	5.0
5	Tenacity (4.0) fb Tenacity (5.0)2x	5.8	6.3	4.8	4.8
10	Tenacity (4.0)+Xonerate (2.4) fb Tenacity(3.0) 4x	2.8	3.3	2.0	2.0
9	Tenacity (4.0)+Xonerate (1.2) fb Tenacity(3.0) 4x	3.5	3.0	2.0	2.0
6	Tenacity (4.0) fb Tenacity (3.0) 4x	3.3	3.0	2.0	1.8
3	Tenacity (4.0) fb Tenacity (3.0) 4x	2.5	3.0	1.8	1.5
14	KleenUp Pro (16.0) fb Tenacity (4.0) fb Tenacity (3.0) 4x	2.8	3.0	1.0	1.0
4	Tenacity (4.0) fb Tenacity (3.0)4x	2.8	2.8	1.3	1.0
	LSD (0.05)	1.2	1.0	0.8	0.8

¹ 9 = least injury; best turf quality

