Development of High Yielding Kentucky Bluegrass For Non-thermal Seed Production

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Justification

Field burning to enhance yield is being limited.

Current production practices are environmentally unsound and threatening to growers income.

Need

Development of high yielding, turf-type Kentucky bluegrass for sustainable seed production under non-burn management.

Phase I

Diversity evaluation of USDA-ARS Kentucky bluegrass collection

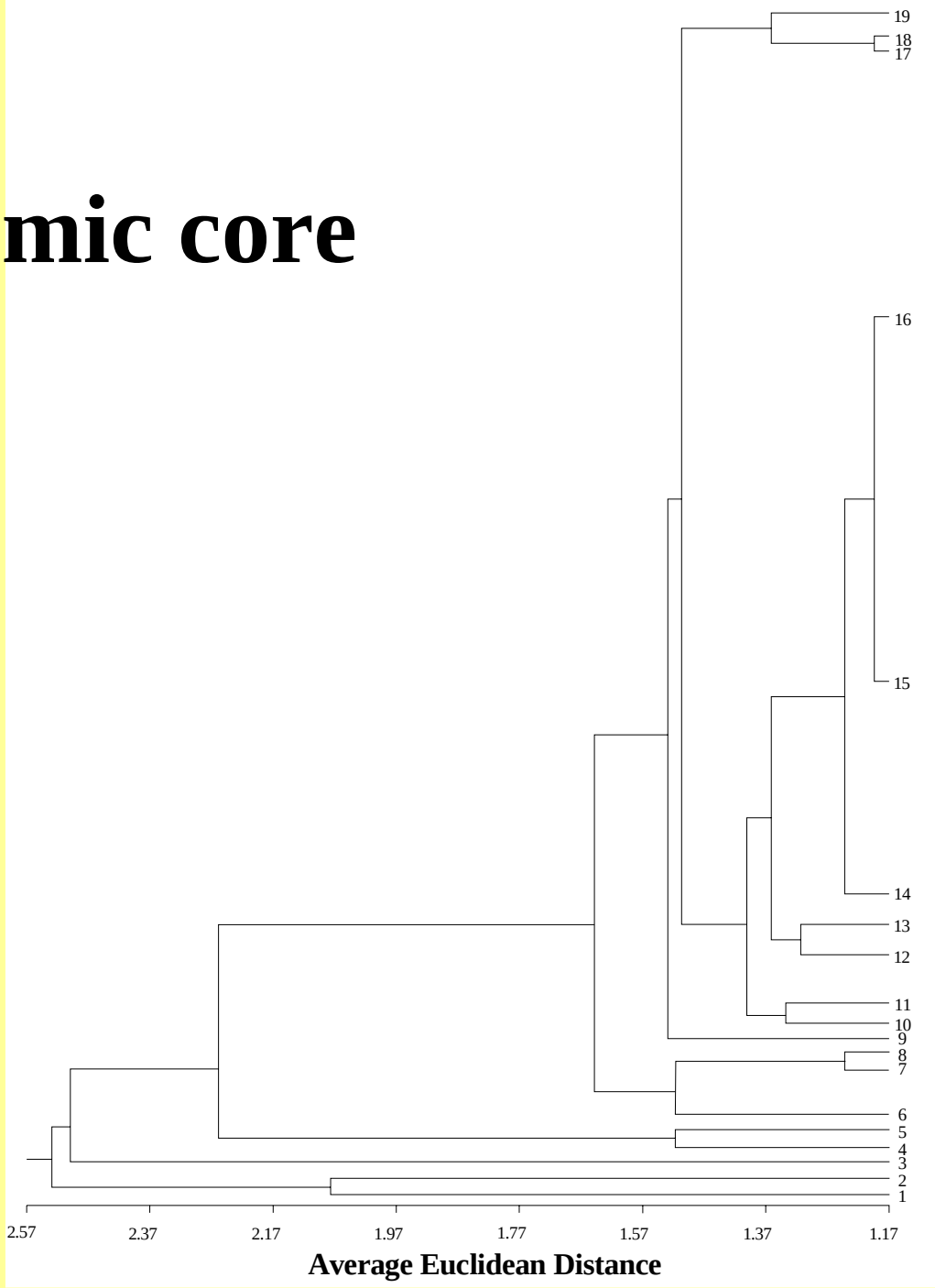
Kentucky bluegrass nursery (228 accessions and 17 commercial checks, replicated 1-m rows)

Diversity among PI accessions

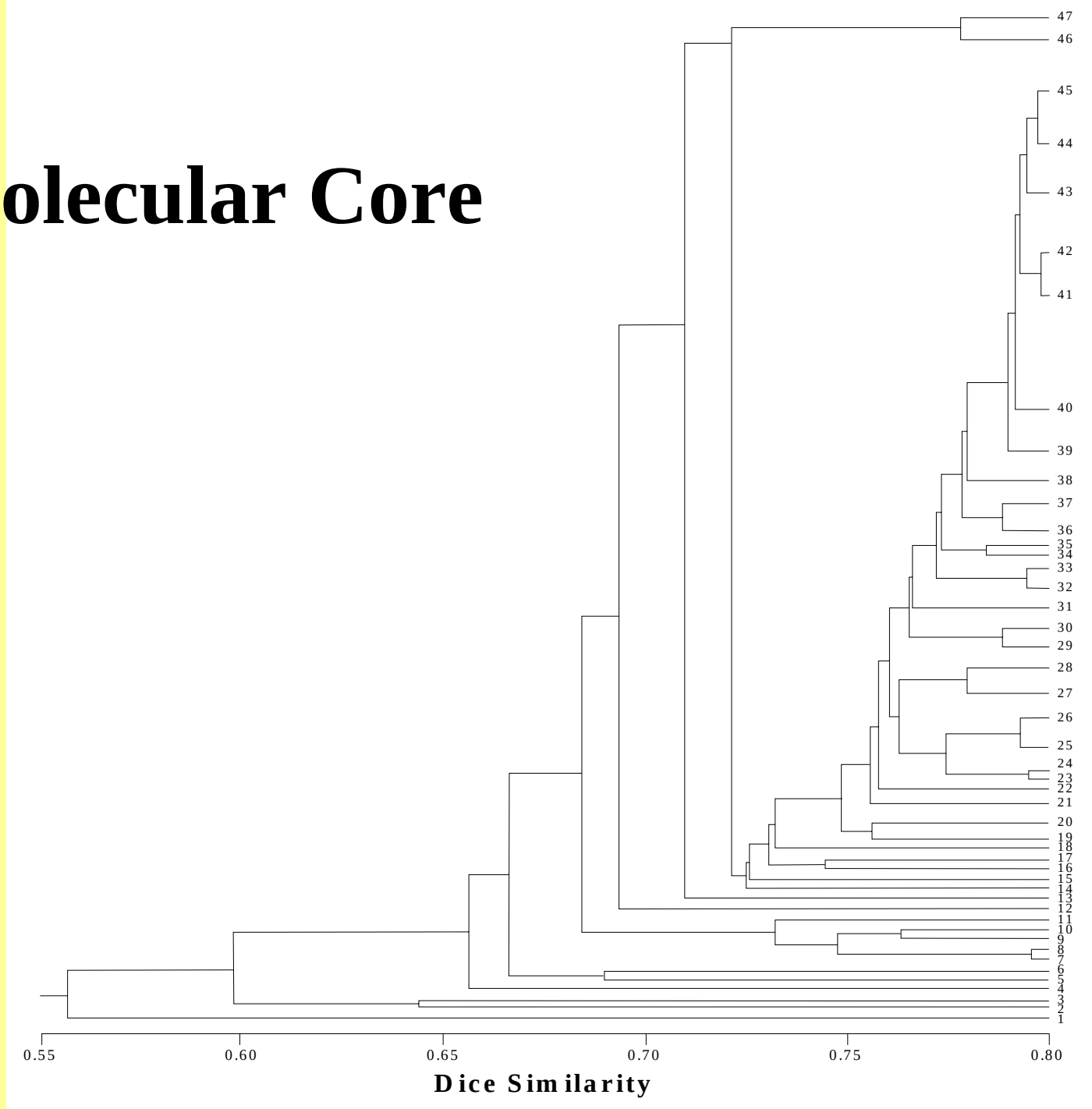
Agronomic Characterization for 17 Parameters

Emergence	Herb. damage	Biomass
Spring green-up	Powdery mildew	Canopy height
Leaf texture	Uniformity	Harvest height
Genetic color	Growth habit	Harvest date
Leaf habit	Heading date	Seed yield
Turf potential	Anthesis date	

Agronomic core



Molecular Core



Summary Phase I
Bluegrass Collection Evaluation

- Agronomic and molecular data could differentiate among accessions.
- Correlation between agronomic and molecular data was highly significant (r=-0.32**), although relatively weak.
- A Kentucky bluegrass core was developed for use in future research.

Phase II

Utilization of the Agronomic Core

- to select bluegrass accessions having high seed yield without burning and good turf quality

- to relate seed production to turf quality factors

Seed production plot treatments: Burned, Baled, and Full Residue across bluegrass Accessions and Controls

Seed production and developmental attributes

Heading date	Agressivity	Harvest index
Anthesis date	Panicle ht.	Wt. per seed
Harvest date	Biomass	Seed per panicle
Leaf habit	Yield	Panicles m^{-2}

Yield and yield components

	--------Residue treatment--------		
Attribute	Full	Baled	Burned
Biomass, g m^{-2}	**335.5a**	**425.6b**	**390.1ab**
Yield, g m^{-2}	**23.4a (37%)**	**46.4b (73%)**	**63.2c (100%)**
Harvest Index	**0.09a**	**0.13b**	**0.17c**
Wt.Seed, mg	**0.31a**	**0.31a**	**0.31a**
Seeds $panicle^{-1}$	**258.7a**	**197.6b**	**202.5b**
Panicles m^{-2}	**378.5a**	**780.6b**	**1095.5c**

Turf Attributes

Texture: Rated 1-9, with 9 the finest texture

Color: Rated 1-9, with 9 the darkest color

Spring green-up: 1 – 9 (1 = dormant and 9 = entirely non-dormant and green on 1 April)

Turf quality: Rated 1-9, with 9 the best, integrating factors such as turf color, leaf texture, and turf density

Turf quality (1-9 rating) and seed yield (g m^{-2})

Entry	Turf quality	Full yield	Baled yield	Burned yield
PI 230132	**5.2**	**55**	**119**	**163**
PI 368241	**5.0**	**56**	**127**	**137**
PI 539059	**5.3**	**50**	**85**	**89**
Kenblue	**5.3**	**33**	**64**	**79**
PI 349188	**5.9**	**36**	**62**	**74**
PI 371775	**6.0**	**24**	**46**	**51**
Midnight	**7.2**	**23**	**44**	**41**
PI 372742	**5.4**	**16**	**22**	**26**
PI 371768	**6.6**	**15**	**24**	**21**
PI 574523	**6.6**	**3**	**13**	**8**

Correlation between turf and yield factors

	Turf quality	Biomass	Yield	HI	Weight seed^{-1}	Seed panicle^{-1}	Panicles m^{-2}
Texture	**-033***	**0.32***	**0.37***	**-0.12ns**	**-0.20ns**	**0.30ns**	**0.25ns**
Color	**0.67****	**-0.56****	**-0.40***	**0.43****	**0.23ns**	**-0.56****	**-0.17ns**
Green-up	**-0.38***	**0.51****	**0.37***	**-0.47****	**-0.14ns**	**0.61****	**-0.19ns**
Turf qual.	**---**	**-0.53****	**-0.48****	**0.22ns**	**0.15ns**	**-0.55****	**-0.26ns**
Yield	**-0.48****	**0.84****	**---**	**0.12ns**	**0.05ns**	**0.76****	**0.66****

Summary Phase II
Core Utilization

- Accessions were identified that maintained seed production when baled and possessed good turf quality.
- Turf quality was negatively correlated with seed production.
- Panicles m^{-2} increased yield, but did not affect turf quality; thus, presenting a potential selection opportunity.

Phase III

Selection within Accessions for diversity in seed yield components

Nursery for individual plant agronomic and molecular characterization

10 entries (8 PI and 2 checks); 28 plants per entry; 3 replications

Agronomic variation within accessions

Variation for plant height within PI 349188

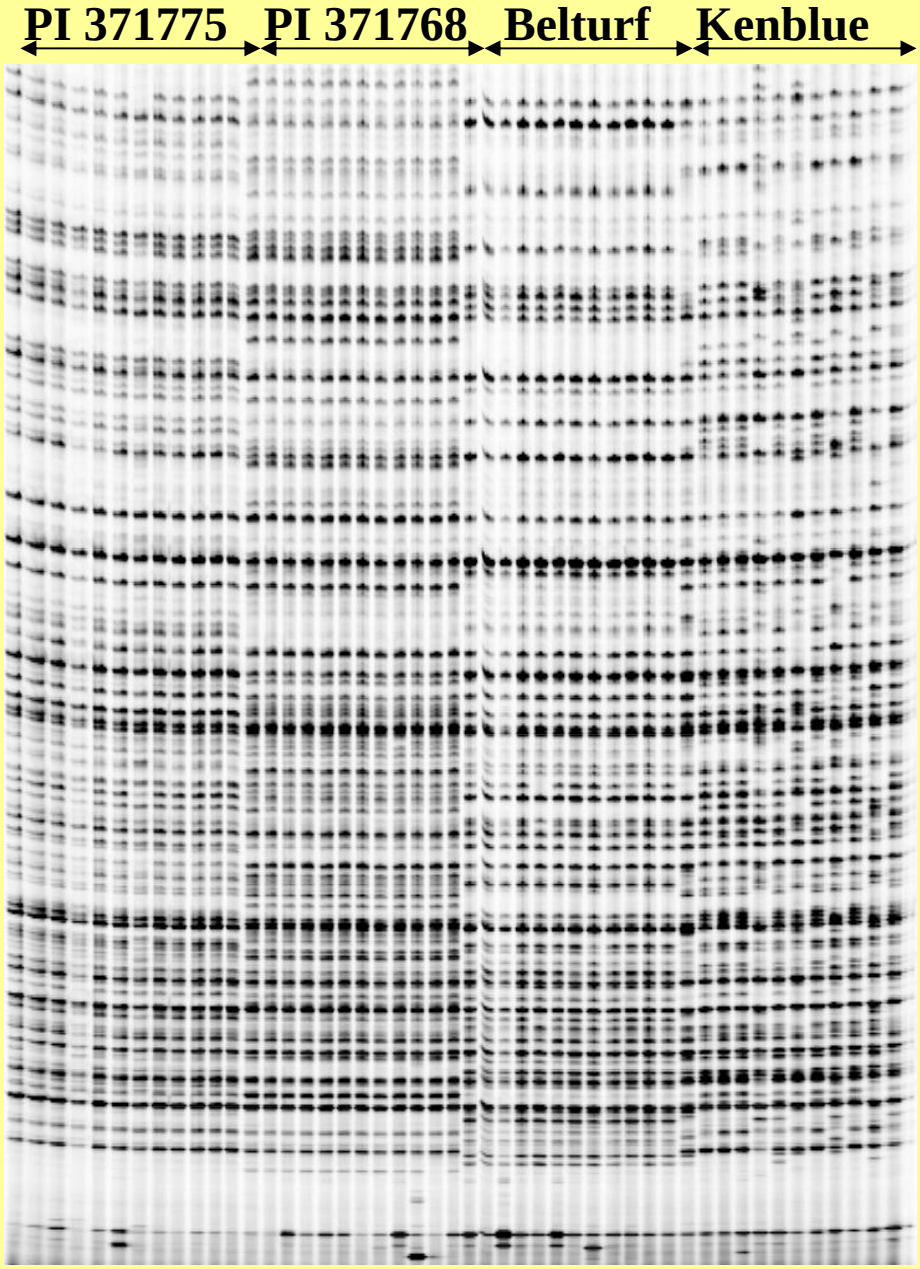
Variation for color within Midnight

The Molecular Guys

Ted Kisha extracting DNA

Federico Bertoli eating gelato

AFLP gel of *Poa pratensis*



Selection for yield components

- “Current Dogma” - there is limited variability within Kentucky bluegrass accessions due to their apomictic nature.

- Variation within accessions was quite prevalent, so the **potential exists for selection and enhancement**.

Harvested bluegrass space plants
2003 and 2004

Counted panicles

and

Threshed panicles

1680 plants:
10 entries
28 plants per entry
3 replications
2 years

Counted Seed
and recorded
Seed Weight

Based on the data: for each entry (accession), 100 seed were obtained from 5 selected plants:

A. plant with highest yield
B. plant with high seed weight
C. plant with high seed per panicle
D. plant with high panicles per unit area

Also:
F. 100 seed from the original population

TOTAL = 5,000 plants
(10 entries, 5 selections, 100 seed)

Seed germination and seedling growth

Grow out of bluegrass seedlings in flats

5,000 space plants established at Central Ferry, WA

Seed increase for on-farm seed production testing and university turfgrass trials in 2006

Results and Expected Outcomes

- USDA Kentucky bluegrass collection has been evaluated for diversity and a core collection was developed.
- Accessions with high seed yield without burning and good turf quality were identified.
- Variation within accessions has been identified.
- Seed increase is underway for future on-farm seed production and university turfgrass trials.
- Research is expected to lead to high yielding turf-type bluegrasses that do not require burning.