



Creeping Bentgrasses History and Performance

www.tee-2-green.com

www.turf-seed.com



Selecting the Right Grass





Evaluation of varieties for use on a golf course should never be based upon the price of the seed.

Grass must be selected based upon overall performance over a period of years.

- **Traffic and Green size**
- **Water Source**
- **Management – GC Superintendent**
- **Climatic conditions**
- **Soil types**



PST-9R3

PST-9R3

Alister

Alister

PST-0EB

Alister

Penn A-4

PST-9R3

PST-9R3

PST-9R3

PST-9R3

PST-9R3

PST-9R3

PST-9R3

Visual quality

Uniformity and Smoothness

Density and Texture

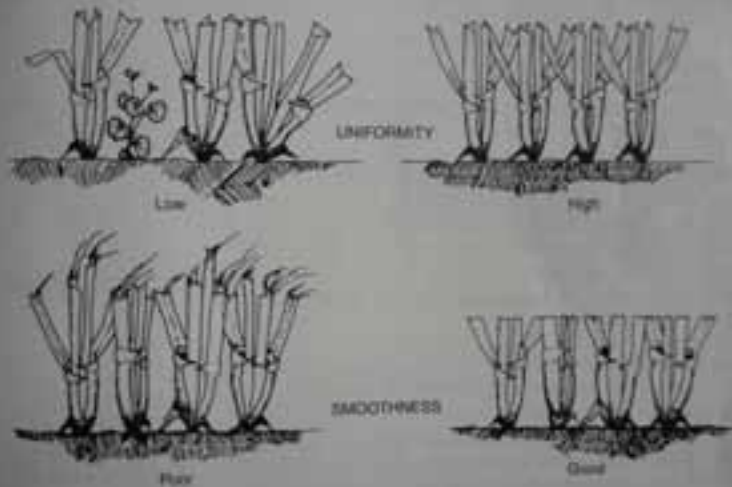
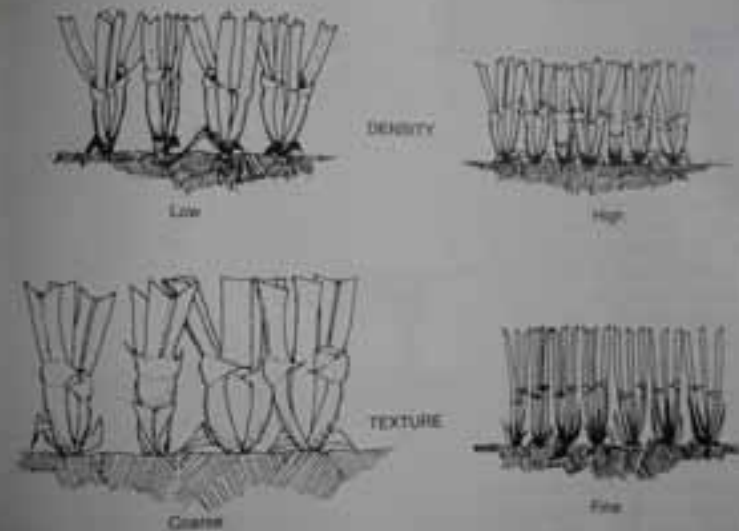


Figure 1.2. Visual characteristics of reef quality.

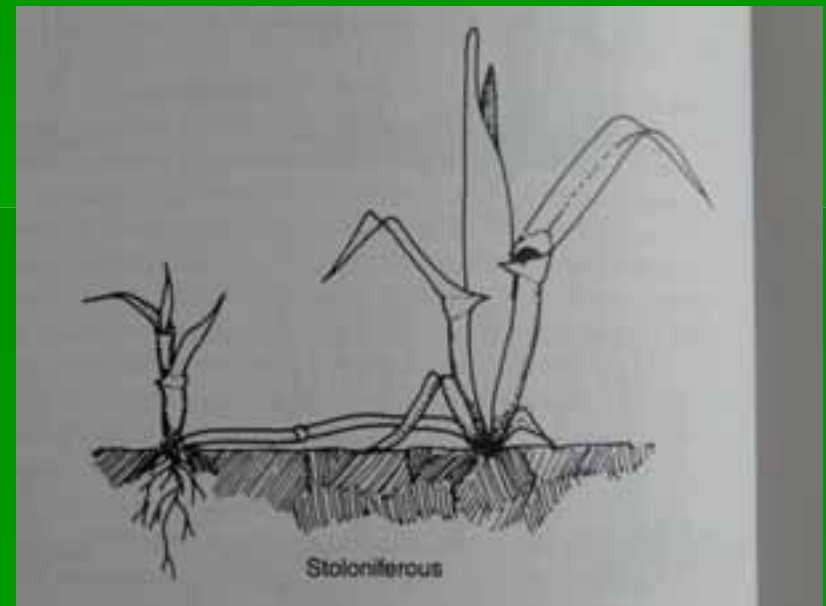
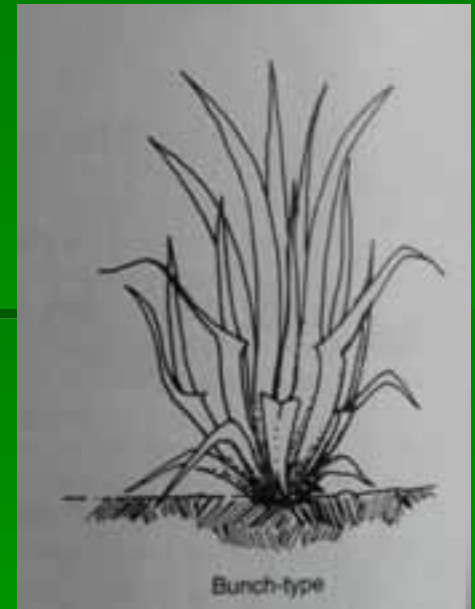
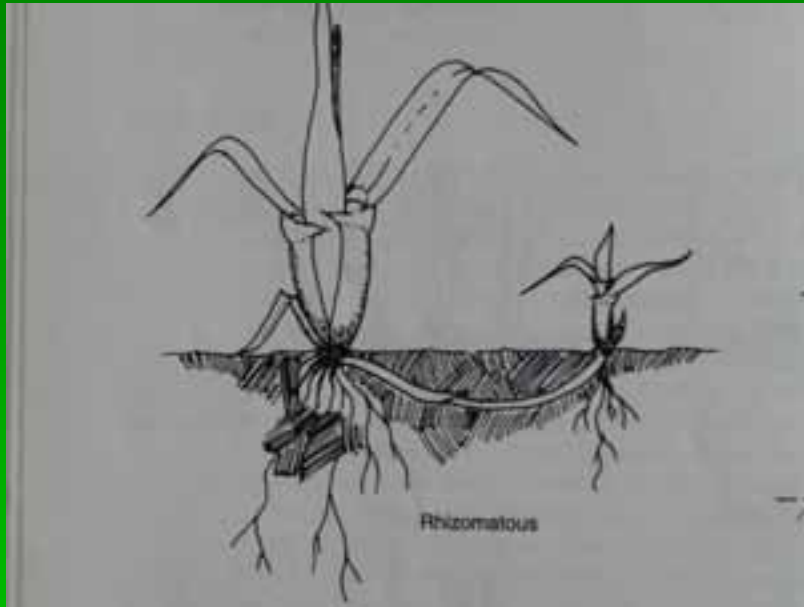




Colour



Growth habit

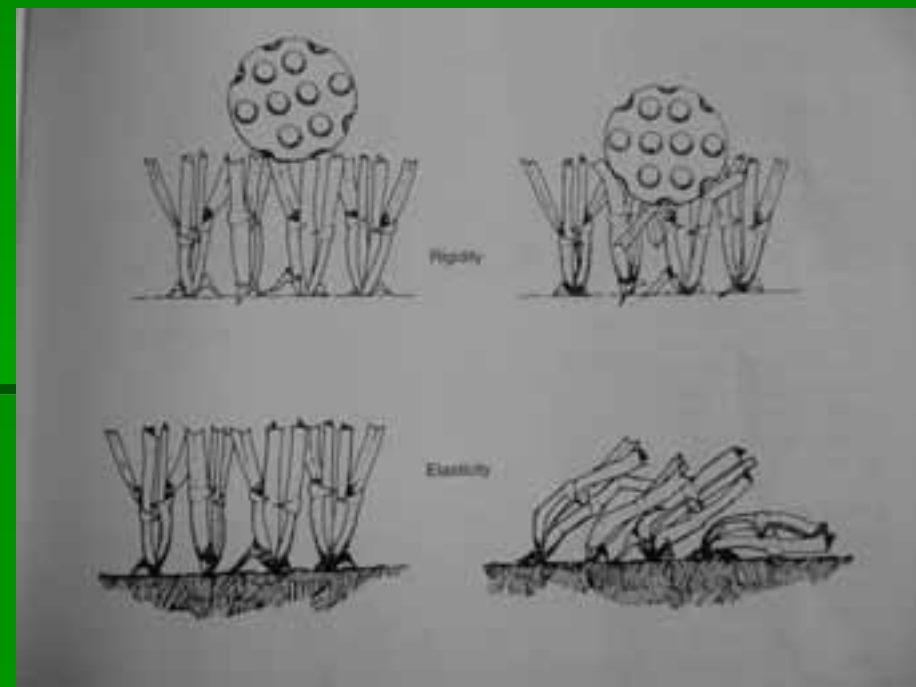
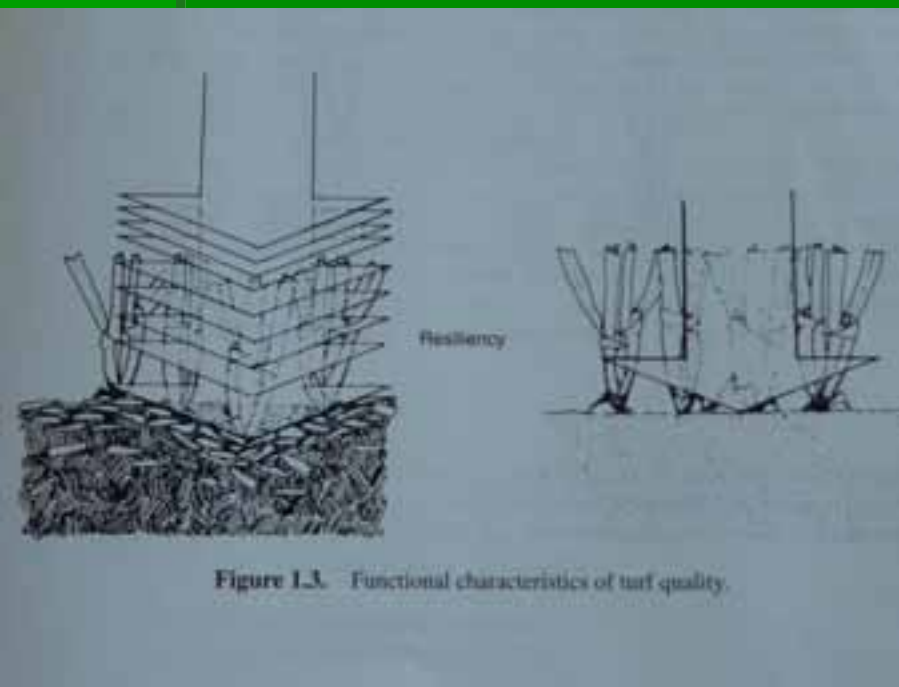




Functional quality

Resiliency

Rigidity and Elastizity









Rooting

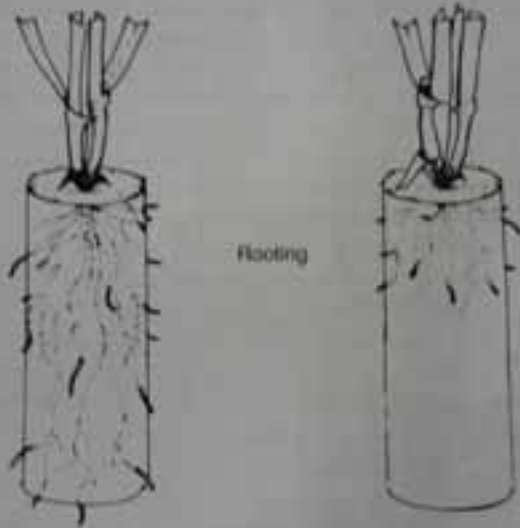
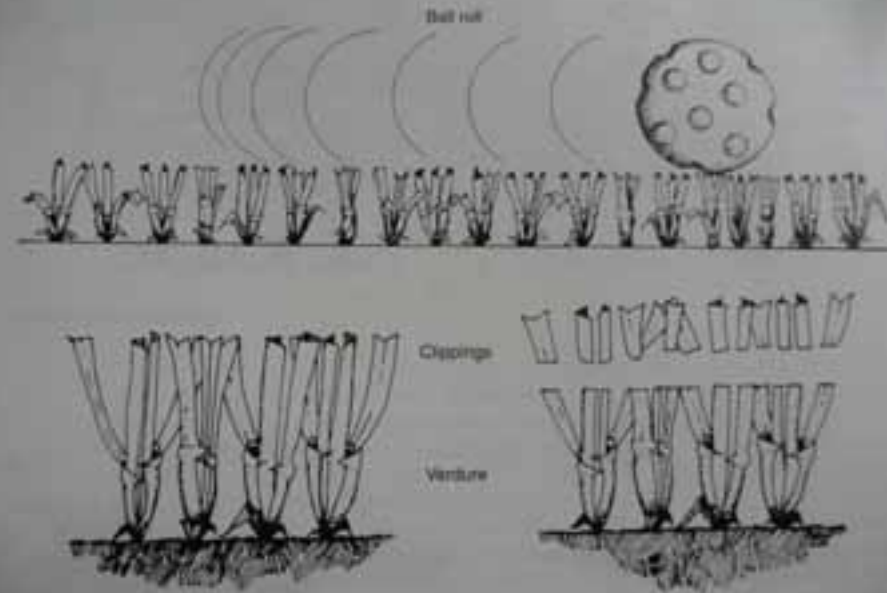


Figure 1.3. Continued

Ball roll and clippings





Bentgrasses to North America...

Bentgrass occurs in all of western Europe. It was introduced to North America on many old (1890-1930's) golf courses and other turf sites primarily from seed harvested from mixed stands of bentgrass species in Europe and sold as South German bentgrass. South German bentgrass usually consisted of approximately 75% Colonial bentgrass, 15% velvet bentgrass and 1% creeping bentgrass segregate into patches of predominately creeping bentgrass and to a lesser extent velvet bentgrass in cool-season climates.

New Golf Courses Constructed between 1920 – 1930's...

- Many seeded putting greens using South German Mixed Bentgrass
- Some seeded putting greens using the variety Seaside
- Some established putting greens vegetatively using stolons

Pennncross was the First Improved Seeded Bentgrass...

Dr. H.B. Musser released the cultivar Pennncross from the Pennsylvania State University in 1955.

Pennncross bentgrass is the first generation seed, produced by the random crossing of three vegetatively propagated clonal strains.

New Golf Courses Constructed between 1955 – 1970's...

Most courses seeded

Penncross

Some seeded

Seaside

A few courses used stolons vegetatively

New Golf Courses Constructed in the 1980's...

Some course seeded
greens to

Penncross

Many used the varieties

Penneagle or Pennlinks

Some used

Providence or SR 1020

New Golf Courses between 1990 and 2005...

Some seeded

Providence or SR 1020

Some seeded

L-93

Some seeded

A-1, A-4, G-2, G-6

Some seeded

Pennlinks or Penncross

Penncross is still the most sold variety

The sun never goes down on a Penncross Green







Pennncross is a F1 Hybrid

The seed is always produced by three
parental clones

Two are of european origin

One comes from a G.C.
near Philadelphia
(Dr. Musser)

Pennstate University Greenhouse

Oregon Tee-2-Green fields

Customer around the globe

The greens in Augusta were either seeded with Penncross or with Penneagle

Par three greens

Healthy, dense patches
(inspite the mechanical stress and heat)

Penneagle



G2

Penncross



A1, A4, G6

History of Putting Green Speed



In a 1947 USGA mowing survey report, approximately **25 %** of the responding golf courses reported mowing their greens at a $\frac{3}{16}$ inch (**4,6 mm**) height of cut, roughly **50%** mowed them at $\frac{1}{4}$ inch (**6,2 mm**), and the rest mowed them at $\frac{5}{16}$ (**8 mm**) or higher (Anonymous, 1947)

History of Putting Green Speed

After nearly 50 years of little change in mowing heights and green speeds, golf entered a phase of dramatic change on mowing heights and putting green speed.



Low mowing...Fast greens...

The Presidents Cup, RTJ Golf Club, near Washington, DC



History of Putting Green Speed

Today cutting heights of 3 mm to 2,7 mm are used to increase green speed.





1995

The new Pennpals

Penn A1, Penn A4, Penn G2, Penn G6

Dwarf dense types

Improvement in disease resistance

Improve heat tolerance

Deep and massive root system

Development of varieties for fairways

Bentgrass shoot density/dm², Augusta, GA

	1 st year	2 nd year	3 rd year
Penn A-1	1815	2145	3010
Penn G-2	2079	1963	2950
Penn A-4	1617	1917	3000
Penn G-6	1683	1838	2895
Crenshaw	1617	1419	1557
Penncross	1122	1270	1300

Pennlinks II

2000

Negative Perceptions

More fertilizer

More water

More aeration

More grooming

More topdressing

Require mowing at or under 3.2 mm

NO !!!

Fertility:

10 to 20 g/N per m² per year

Some use 25 g/N per m²

Irrigation:

Field capacity every 3 to 7 days

(Find hot spots with infrared thermometer)

20 to 50% less water

Yes



No

Aerifying

3 to 5 times per year, as with other
Varieties

Topdressing (key)

Weekly, Biweekly, once a month with
verticutting



USGA recommendation

20% of the area of an 8 to 10 year old green should be aerified each year!!!



Relation of spoon size and distance to the cultivated area

Spoon size Spoon distance and % of the cultivated area

	50,8 x 50,8 mm	50,8 x 101,6 mm	101,6 x 152,4 mm			
1/4 " = 6,35 mm	1,20%	0,60%	0,20%			
3/8 " = 9,3 mm	2,80%	1,40%	0,50%			
1/2 " = 12,7 mm	4,90%	2,50%	0,80%			
5/8 " = 15,88 mm	7,70%	3,80%	1,30%			
3/4 " = 19,5 mm	11%	5,50%	1,80%			
1 " = 25,4 mm	19,60%	9,80%	3,30%			

Rieke, Lyman (2002)

Benefits

Density

Traffic and wear tolerance

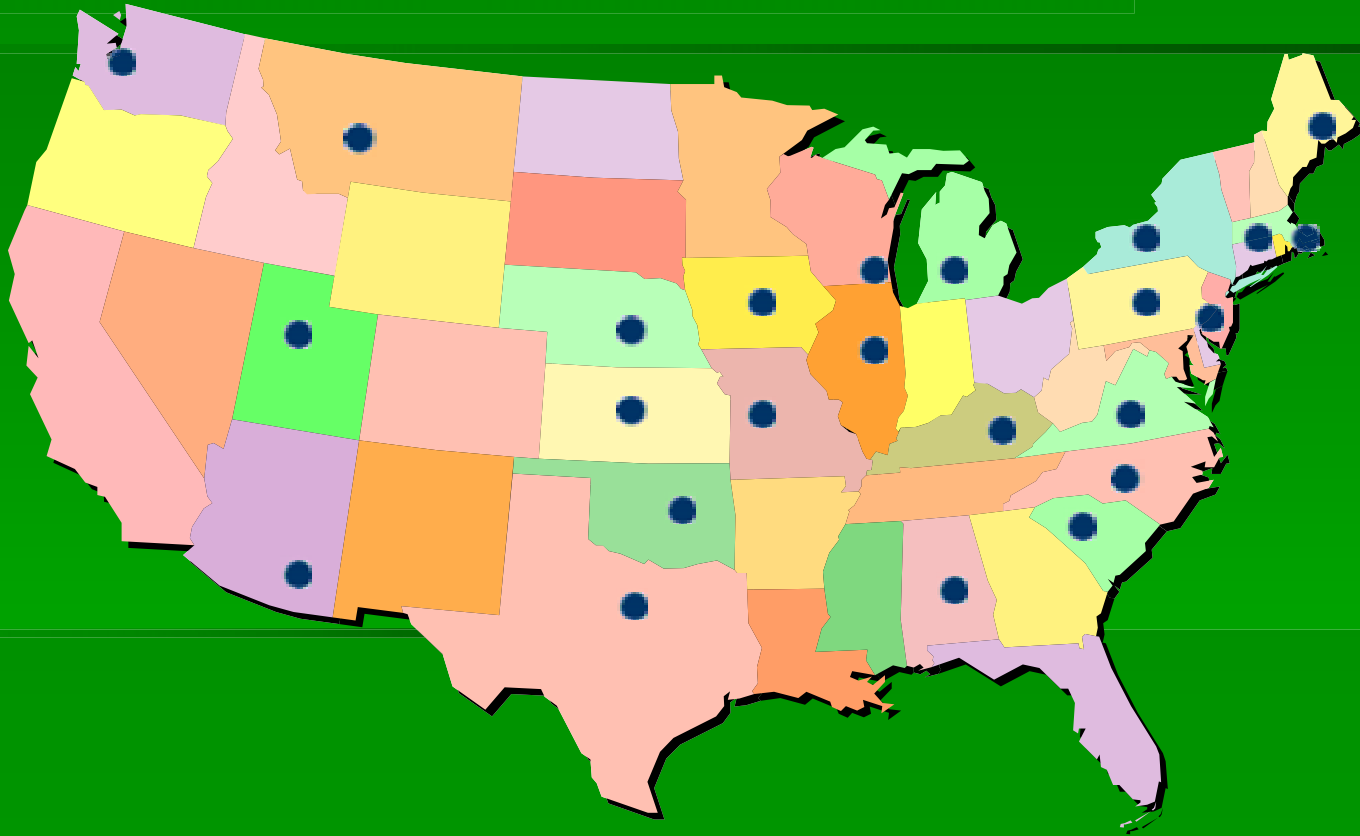
Drought tolerance

Disease resistance

Resistance to weed invasion

Putting Quality

OFFICIAL NTEP TRIAL LOCATIONS



**1998-2002 NATIONAL BENTGRASS PUTTING GREEN
TEST**

**MEAN TURFGRASS QUALITY RATINGS OF BENTGRASS CULTIVARS GROWN
ON A SAND GREEN**

NAME	MEAN	
PENN A-1	6.5	
PENN A-4	6.4	top statistical group
PENN G-1	6.4	
PENN A-2	6.4	
L-93	6.2	
PENN G-6	6.1	
BENGAL	6.1	
CENTURY	5.8	
SR 1119	5.8	
PROVIDENCE	5.7	
CRENSHAW	5.6	
VESPER	5.2	
PENNLINKS	5.1	
PENNCROSS	5.0	
LSD VALUE	0.2	

At 14 locations

MEAN TURFGRASS QUALITY RATINGS OF BENTGRASS CULTIVARS GROWN ON
A GREEN WITHOUT FUNGICIDES IN THE U.S.

NAME MEAN

PENN A-1 5.6

PENN A-2 5.5

L-93 5.5

PENN G-1 5.4

PENN A-4 5.4

PENN G-6 5.4

LSD 0,4

top statistical group

At 4 locations

**THATCH MEASUREMENTS OF BENTGRASS CULTIVARS
GROWN ON A GREEN
THATCH MEASUREMENTS IN MILLIMETERS**

NAME	MEAN
PENN A-4	13.9
VESPER	13.8
PENN A-1	13.6
SR 7200	13.2
PENN G-6	12.8
BENGAL	12.3
CRENSHAW	12.0
L-93	12.0
PENNLINKS	12.0
PROVIDENCE	11.9
PENNCROSS	11.6
LSD VALUE	1.9

At 2 locations

WINTER COLOR RATINGS

NAME MEAN

PENN A-2	5.9
PENN A-4	5.8
SR 7200	5.8
VESPER	5.8
L-93	5.7
BENGAL	5.6
CRENSHAW	5.6
PENN A-1	5.5
PROVIDENCE	5.5
PENNLINKS	5.4
PENN G-6	5.3
PENNCROSS	5.3
BACKSPIN	5.1

LSD VALUE 0.5

SPRING GREENUP RATINGS OF BENTGRASS CULTIVARS

NAME MEAN

SR 7200 6.1

PENN G-6 6.0

PENN A-4 6.0

PENN A-2 6.0

PENN G-1 6.0

PENN A-1 6.0

CRENSHAW 5.9

L-93 5.9

PROVIDENCE 5.8

SR 1119 5.7

PENNCROSS 5.6

PENNLINKS 5.5

LSD VALUE 0.3

PINK SNOW MOLD RATINGS 1/ 1999-2002 DATA

GRAY SNOW MOLD

NAME MEAN

NAME MI1

PICK CB 7.0
PENNCROSS 6.7
SR 1119 6.7

PENN A-1 6.3
ABT-CRB-1 6.0
IMPERIAL 6.0

CRENSHAW 6.4
BENGAL 6.3
SR 7200 6.2
PROVIDENCE 6.1
PENN A-2 6.1
L-93 6.0
PENNLINKS 6.0
PENN A-4 5.9
IMPERIAL 5.7
PENN G-6 5.3
Penn A – 1 5.2
VESPER 5.2

PENN A-2 6.0
PENN A-4 6.0
BENGAL 5.7
PENNCROSS 5.3
PENNLINKS 5.3
L-93 5.0
CRENSHAW 4.7
PENN G-6 4.7
PROVIDENCE 4.7
VESPER 3.7

LSD Value 2.9

LSD VALUE 2.0

at 1 location

At 3 locations

Onsite Ratings for turfgrass quality 1997 USGA/GCSAA NTEP onsite Bentgrass tests at 13 locations (1997 to 2002)

„Real life“ situations

Quality takes into account the aesthetic and functional aspects of the turf:

Color, density, uniformity, texture, disease or environmental stress

Top statistical group
Out of 13 locations

Penn A4

at 13 locations

Penn A1

at 9 locations

Penn G6

at 3 locations

L93

at 3 locations

The new ratings

MEAN TURFGRASS QUALITY RATINGS OF CREEPING BENTGRASS CULTIVARS GROWN ON A SAND GREEN AT TEN LOCATIONS

2002 - 2006 DATA

NAME	MEAN
TYEE	6.3
MEMORIAL	6.3
007	6.3
INDEPENDENCE	6.2
DECLARATION	6.2
PENN A-1	6.2
SHARK	6.1
BENGAL	6.1
AUTHORITY	6.1
MACKENZIE	6.0
BENCHMARK	6.0
ALPHA	6.0
T-1	6.0
KINGPIN	5.9
PENNLINKS II	5.6
PENNCROSS	5.2
LSD VALUE	0.3

At 10 locations

SUMMARY OF TURFGRASS QUALITY RATINGS FOR BENTGRASS CULTIVARS GROWN ON A GREEN */ 2006 DATA

NAME	MEAN	IN TOP 25%
007	6.3	33.3
13-M	6.3	28.6
ALPHA	6.0	14.3
AUTHORITY	6.2	23.8
BENCHMARK	6.1	23.8
BENGAL	6.1	4.8
CY-2	6.4	38.1
DECLARATION	6.4	52.4
GREENWICH	5.0	4.8
INDEPENDENCE	6.1	23.8
KINGPIN	6.2	33.3
MACKENZIE	6.3	33.3
MEMORIAL	6.4	47.6
PENN A-1	6.2	19.0
PENNCROSS	5.3	19.0
PENNLINKS II	5.7	19.0
SHARK	6.3	47.6
SR 7200	4.7	4.8
T-1	6.0	4.8
TYEE	6.3	42.9
LSD VALUE	0.2	

TABLE 31A. DOLLAR SPOT RATINGS OF BENTGRASS CULTIVARS
 GROWN ON A GREEN AT BLACKSBURG, VA
 2006 DATA

NAME MEAN

DECLARATION	8.8
SR 7200	8.8
MEMORIAL	8.7
BENCHMARK	8.3
VILLA	8.3
AUTHORITY	8.2
GREENWICH	8.1
KINGPIN	8.1
VESPER	8.1
007	8.0
PENN A-1	8.0
PENNLINKS II	7.9
PENNCROSS	7.4
ALPHA	7.2
MACKENZIE	7.1
SHARK	7.0
TYEE	6.8
T-1	6.7
BENGAL	6.1
INDEPENDENCE	5.2

LSD VALUE 1.1

The full cycle of the new NTEP ratings has not been finished yet

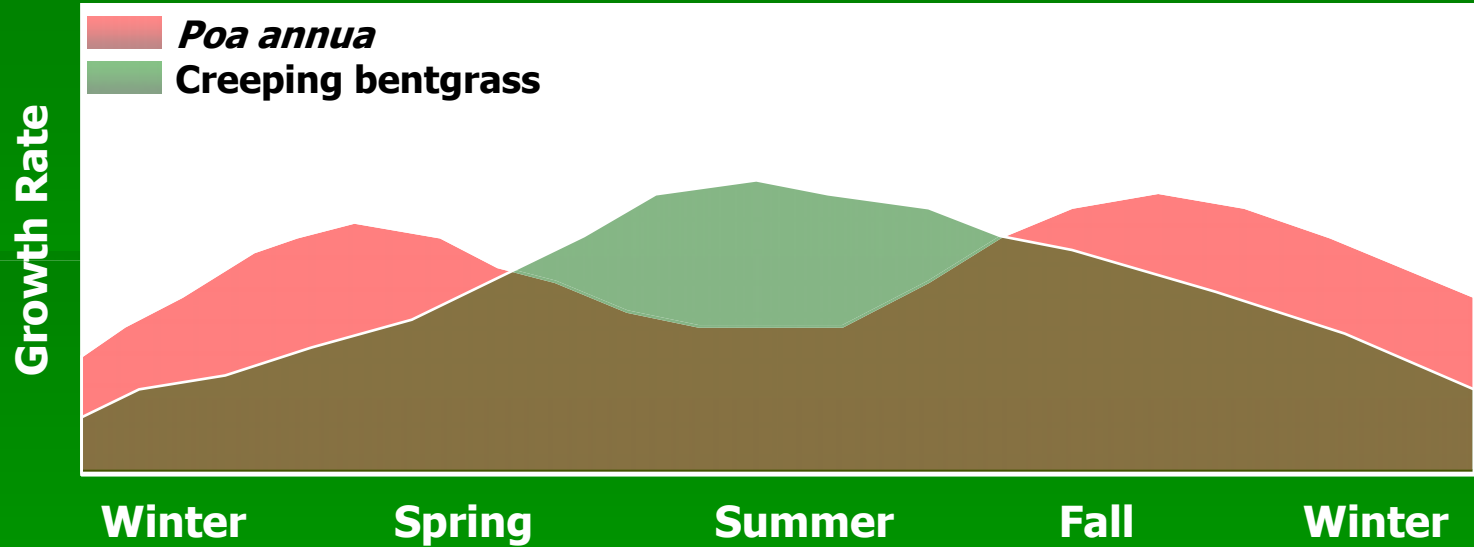
Very high traffic tolerance of Penn A's and G's (because of genetics)

More and more important, due to more golfers

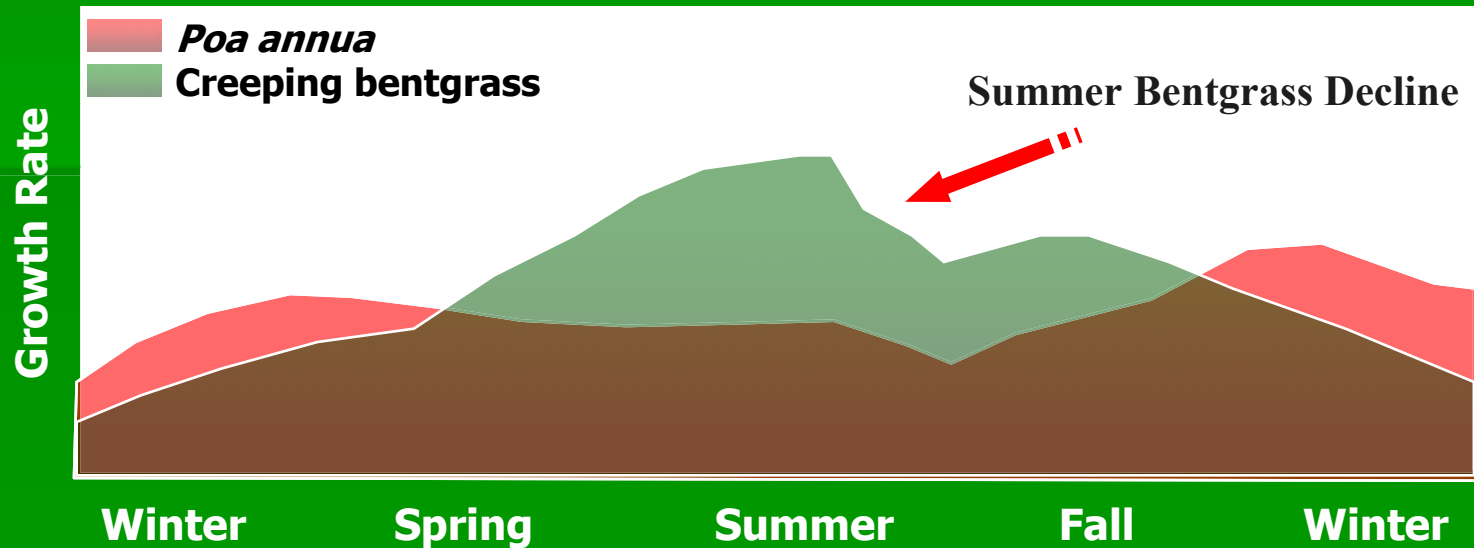
Or budget pressure



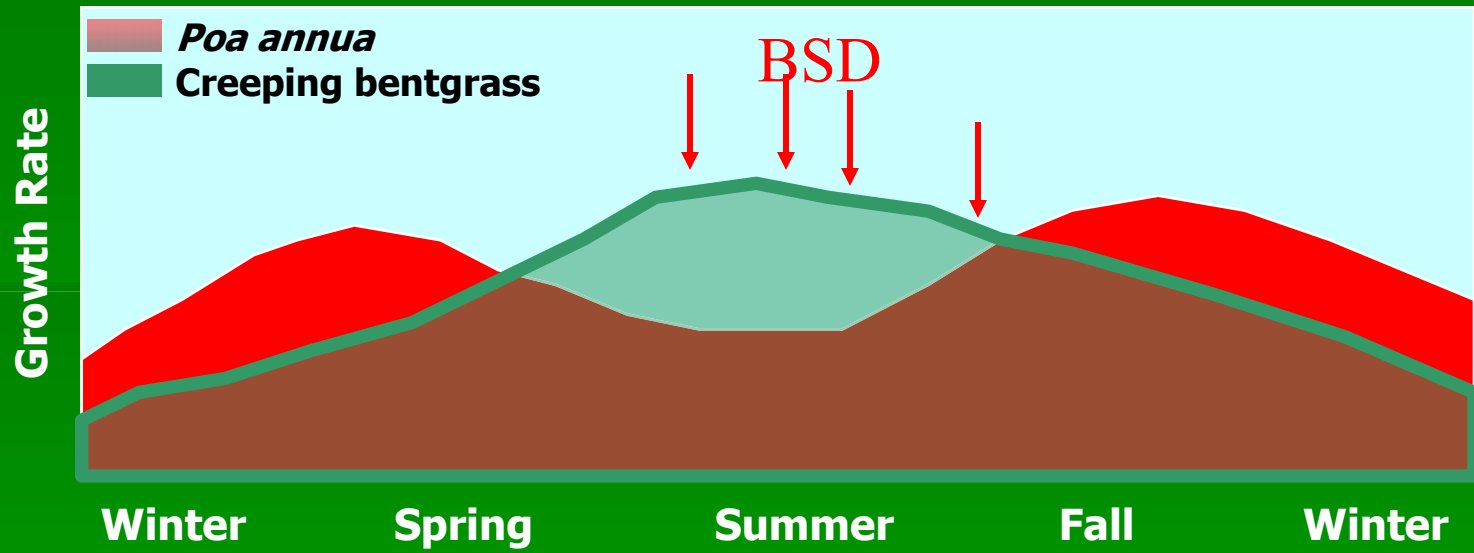
Penncross Creeping Bentgrass in Chicago source: Paul Vermeulen USGA 2002



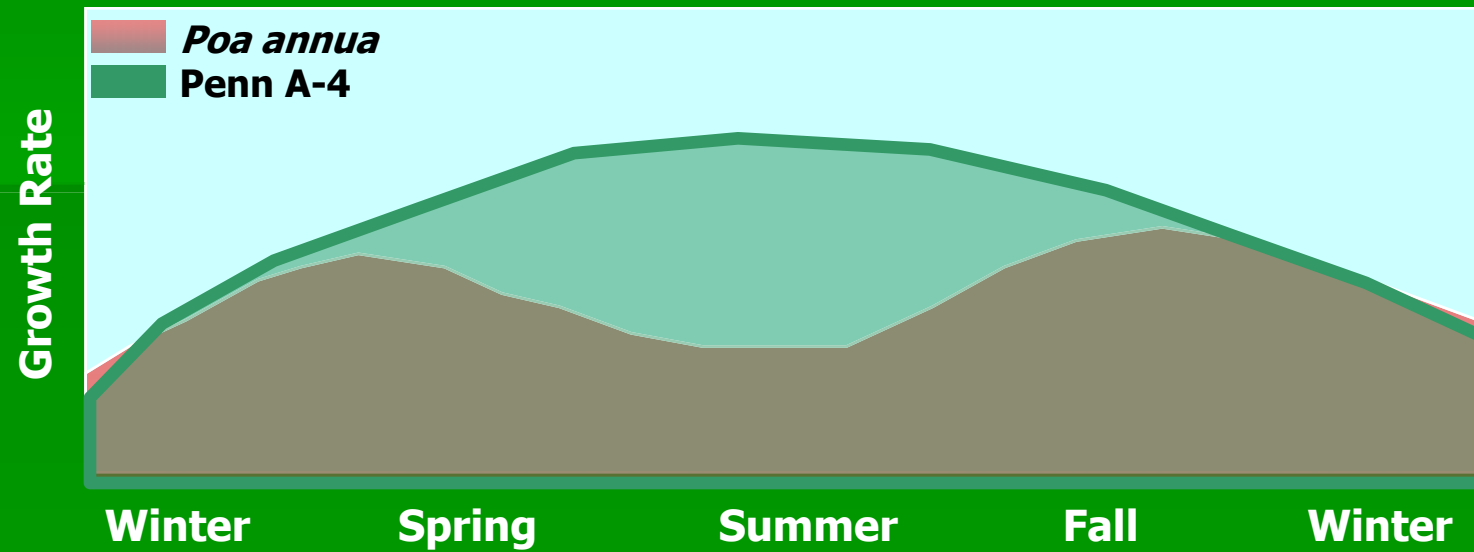
Penncross Creeping Bentgrass in St. Louis/Kansas City



Creeping Bentgrass (source: Paul Vermeulen USGA)



A-4 Creeping Bentgrass



L93, G-2, Providence

A-4



USGA/GCSAA Sponsored Sites 1997-02

Location	Variety 1	Variety 2	Variety 3	Variety 4
Dallas, TX	A-4	A-1, Imperial		G-1, L-93, SR 1119
New York, NY	A-4	G-1	A-1, Century, LCB-103	
Chicago, IL	A-1	G-6	G-1	A-4, L-93
Denver, CO	A-1	A-4, Century		L-93
St. Louis, MO	G-1	A-1, A-4		Century, Imperial
Seattle, WA	A-4	Century	G-1, L-93	

National Turfgrass Evaluation Program
(www.ntep.org)

Ball mark study by Andrea Bakalyar (Superintendent at the Wee Course in Knoxville Tennessee)

- Penncross
- Pennlinks
- Crenshaw
- L93
- SR 1020
- G2
- A1



No one bentgrass dramatically outperforms in this ballmark recovery test over 2 years (2000 and 2001)




Pick your bents for reason other than ball mark recovery

Overseeding, does it work? - YES



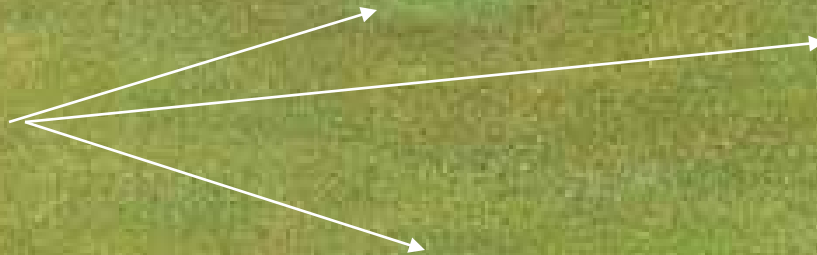
Rutgers test...*Poa annua* seedling turf



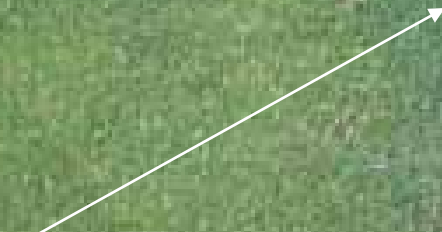
Rutgers interseeding trials using creeping bentgrass seeded into a *Poa annua* turf. Pennncross did not compete well with *Poa annua* while L-93 and the A and G varieties were able to establish into a mature *Poa annua* turf.

Up to 4 times / year – a cumulated rate of 4 to 6 g/m² of seed per year!

Penn G6



Penn G6



Encouraging *Poa annua*

- Low cutting heights - below 5/32" (4 mm) on greens; 3/8" (9 mm) on fairways.
- Poor drainage or over watering
- Excessive fertilization (especially during cooler months).
- Aerification during peak times of *Poa annua*
- Ball marks not repaired

Discouraging *Poa annua*

- Higher cutting height (as typically found on golf course roughs).
- Well drained soils and non-irrigated areas.
- Minimal fertilization
- Water bentgrass greens sparingly.

Once *Poa annua* populations increase beyond five percent...



...you may be only a few years away from a high % of *Poa annua*.

Why Clean of *Poa* invasion...

- Use of new variety i.e. greater plant density
- Hand picking
- Plugging
- Re-sodding collars if necessary
- Use of growth regulators (PGR's)

New Creeping Bentgrass Varieties...



Pine Hill GC, NJ

Hand picking and plugging *Poa*
when plants are found...

***Agrostis stolonifera* varieties**

- South German Bent mix
- Penncross (1955 Pennstate)

cutting heights of 6mm
cutting heights of 4 mm
Breakthrough

- Penneagle (1978 Pennstate)
- Pennlinks (1986 Pennstate University)
- Providence (1987 University of Rhode Island)
- Putter (1980 Washington State Univ.)
- SR 1020 (1987 Arizona University)
- Crenshaw (1990 Texas A&M University)
- Southshore (1991 Rutgers University)
- Cato (1993 Texas A&M University)
- L93 (1993 Rutgers Univ.)
- Pennpals A4, A1, G6, G1, G2 (1995)

cutting heights of 3mm
Breakthrough

- SR 1119 ()
- Seaside II
- Bengal (2000)
- Independence, Pennlinks II, Penneagle II , Memorial(2002)
- T1, Alpha, 007, Shark, Declaration, Tyee, Crystal Blue link, (2006)

Progression of creeping bentgrass shoot density

Future				150 ?
T 1 2004				119
Penn A 4 1995			87	
L 93 1995		77		
Penncross 1954	54			

Shoots per square inch

85 – 90 % of the new construction in
Ireland is seeded with one of the Penn
A's and G's

Not just for greens.





Fast divot recovery



Penncross divot



after 14 days



Tees: Pennncross Creeping bentgrass

Fast divots recovering
Good overall strength
Well known variety
Quality seed available

Extreme Rough:
Aurora Gold HF

Semi-Roughs:
Blue Semi-Cutt Ruff

Tees:
Penncross

Fairways:
PennWay
Special Blend

Greens:
Penn A-4+Penn G-6



Hills Golf Club , Sweden



Fairways: PennWay special blend

Maintenance keys

Low nutrients requirement

Low watering

High disease tolerance

Mowing 4-10 mm, plastic density

Very good divots recovery

High competition against weeds

No cheap acidifying fertilizers!!!

Penn G 6 Fairway, Golf Paradiso, Italy

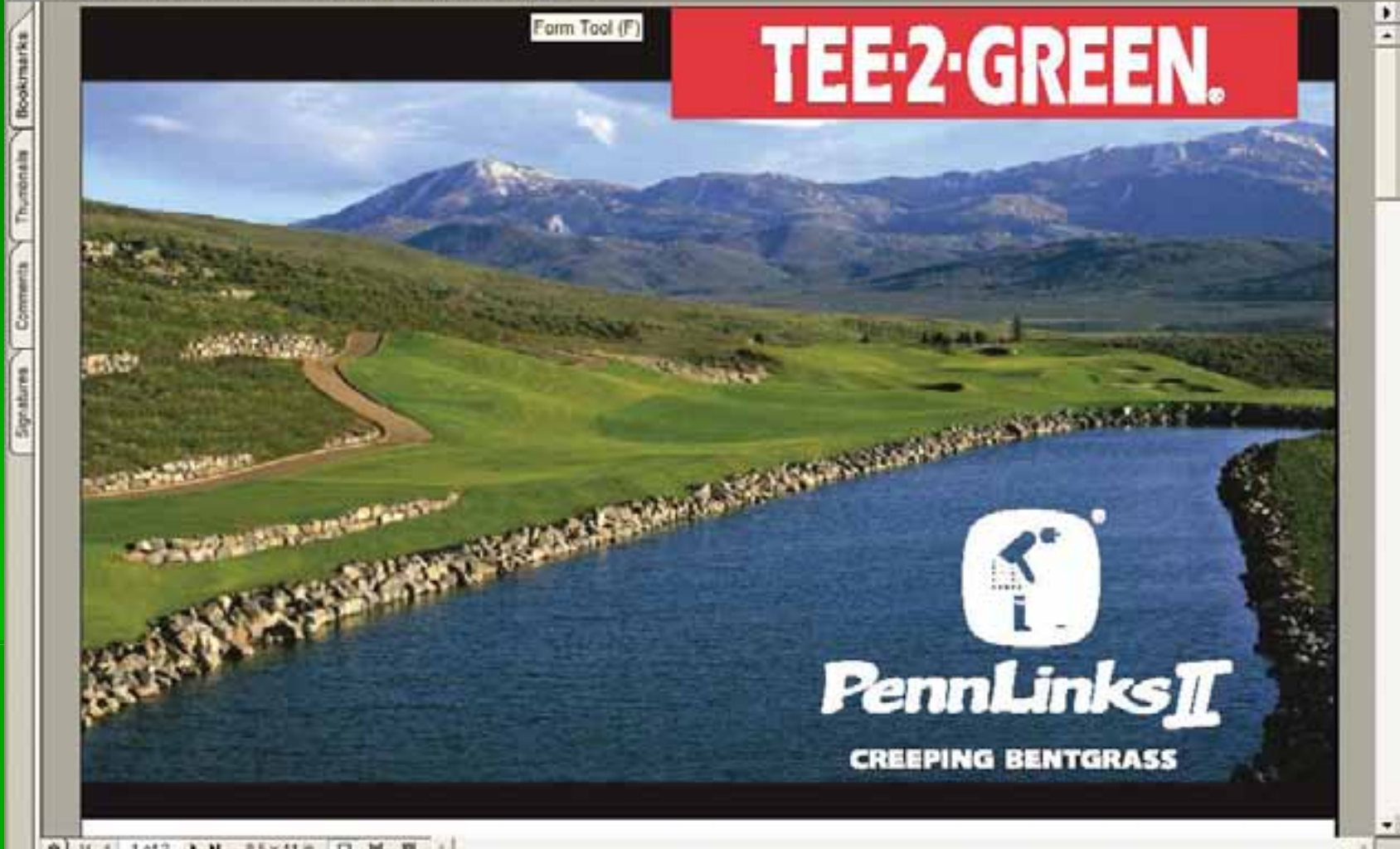














- **dollar spot resistant**
- **high-quality bentgrass**
- **grainless playing surface**
- **upright growth habit**
- **medium dark green color**
- **semi-aggressive growth habit**
- **good heat and drought tolerances**

Developed by Pure-Seed Testing, Inc., PennLinks II was bred for the most resistance to dollar spot as possible.

2004 mean dollar spot ratings for creeping bentgrass entries in fairway/tee turf trials seeded fall of 2003 at 7 locations.

Entry	IN	KS	MD	NJ	PA	VA	WI	Mean
Declaration	8.7 ¹	8.3	7.7	9.0	7.7	5.7	8.3	7.9
PennLinks II	8.7	7.3	7.0	8.0	5.3	5.7	6.0	6.9
Seaside	7.0	5.3	7.3	7.3	6.7	6.0	4.0	6.2
L-93	8.7	6.3	5.0	6.7	5.0	5.7	5.7	6.1
Penneagle II	8.0	5.3	4.3	5.3	4.7	5.3	5.7	5.5
Penncross	7.7	6.0	4.7	6.0	4.0	4.0	4.7	5.3
Bengal	5.7	6.7	3.0	4.7	4.0	7.0	5.7	5.2
T-1	7.0	6.7	2.3	5.0	4.0	6.0	5.7	5.2
Alpha	7.0	8.3	2.3	4.7	3.7	5.0	4.7	5.1
SR 1119	6.7	4.3	3.0	4.3	4.0	7.7	5.7	5.1
Independence	6.3	5.3	1.7	3.3	3.0	5.7	4.7	4.3
LSD (0.05)	1.4	2.7	2.0	1.3	1.3	2.8	1.5	0.7



Fungicides applied to fine turf...



- 70% of all fungicides are applied to control dollar spot and brown patch.
- Creeping bentgrass varieties that are less susceptible may save over 30% in fungicide usage.

TEE-2-GREEN.



PINEAGLE II

CREeping BENTGRASS

2004 mean brown patch ratings for creeping bentgrass entries in fairway/tee turf trials seeded **fall** of 2003 at 2 locations.

Entry	IL	NJ	Mean
Penneagle II	9.0 ¹	9.0	9.0
Declaration	9.0	9.0	9.0
T-1	9.0	9.0	9.0
Alpha	8.3	9.0	8.7
Bengal	9.0	7.7	8.3
SR 1119	8.7	7.7	8.2
PennLinks II	8.0	8.0	8.0
Independence	7.0	8.3	7.7
Penncross	7.7	6.0	6.8
L-93	6.0	5.7	5.8
Seaside	4.7	3.0	3.8
LSD (0.05)	1.4	1.4	1.0

19 = no disease



superior resistance to brown patch

- **medium fine**
- **semi-erect growth habit**
- **ideal in fairway**
- **early Spring green up**

Penneagle II is the result of tens of thousands plants being developed for increased diseases resistance. In clinical trials held in Hubbard, Oregon, Penneagle II was the best overall performer in resistance against brown patch, and third against dollar spot.

Old Head GC (Ireland) „Seaside II“ creeping bent Greens



- Seaside II tolerates up to 15000 ppm of salt



Agrostis capillaris

Alister is a superior quality colonial bentgrass,
with a distinguished full winter color in low light conditions.
Ideal in combination with fine fescues as Ombretta or
Seabreeze for overseeding on traditional fairways and greens
Good spring performance and excellent turf quality
Good dollar spot resistance

Use: , greens , tees, fairways
Mowing height 5-10 mm



Farandole

Festuca arundinacea



Close mowing!

Dark green, very low –growing

- **Good Fusarium, crown&stem rust resistance**

- **Excellent turf quality in arid climates**

Growth habit: bunch type

Seeding rate: 40-50 gr m²

Ideal in combination with Kentucky blue grass

Farandole



Farandole









Lolium perenne



- **Very dark green color**
- **Very uniform dense turf**
- **Upright low growth**
- **Very high salt tolerance**
- **High persistency**
- **Drought tolerance**
- **Monostand cultivar**



- **Medium dark green color**
- **Very uniform dense turf**
- **Upright low growth**
- **Cold tolerant**
- **Ideal for blends /overseeding**
- **Rapid establishment**
- **Endophyte content**
- **Germinates in 7000 ppm**

Semi-roughs: Blue Semi-Cutt Ruff



- 30% Brilliant Kentucky bluegrass
- 10% NorthStar Kentucky bluegrass
- 10% Midnight Kentucky bluegrass
- 25% Florentine Creeping red fescue
- 25% Tiffany Chewing red fescue





Extreme Roughs:



Aurora roughs extreme a 3 tagli superiori ad 80 mm



Aurora Gold incolta (da 2 anni senza tagli)



Extreme Roughs:

- Compact growth
- Very deep root system
- Drought tolerant
- Shadow tolerant
- Disease free
- Glyphosate tolerant
- Non invasive



**AURORA
GOLD**

