

**EIGHTH  
ANNUAL PROGRESS REPORT**  
concerning  
**BREEDING AND DEVELOPMENT  
OF BENTGRASS**



Submitted By:

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Texas Agricultural Experiment Station - Dallas  
Texas A&M University System

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**1992 RESEARCH REPORT  
BREEDING AND DEVELOPMENT OF BENTGRASS**

**M. C. Engelke, and R. Murphy and K. B. Marcum**

**EXECUTIVE SUMMARY**

Principle Investigator: Dr. M. C. Engelke  
Co-Investigators: Dr. K. B. Marcum  
Technical Support: Mr. Roland Murphy

Research Period: 1 November 1991 through 1 November 1992.

Syn3-88 and Syn4-88 (CATO) have been seeded to over 40 golf courses during the past 12 months, including eight golf courses where nine or more greens have been established. The documentation for release will be submitted to the administrative channels by mid-December. Seed production on Syn3-88 exceeded 900 pounds per acre in 1992 (2nd crop year), and production of Syn4-88 (CATO) exceeded 400 pounds per acre (1st year). Syn1-88 seeded to a 5 acre seed increase filed in early August with the initial crop harvest anticipated in August 1993. Syn1-88 is being evaluated extensively in California and West Texas for salinity tolerance under field conditions. All the elite bentgrasses including several commercial cultivars are presently being assessed for salinity tolerance in Greenhouse studies at TAES-Dallas. Syn1-88 was seeded to the #3 green at Tralee Golf Course in Northern Ireland (in cooperation with the Palmer design group) to assess its persistence under sea spray.

Five new experimental varieties of creeping bentgrass are being increased and will be transplanted in Oregon during 1992/93 for seed production trials and entry into the 1993 NTEP bentgrass trials. These new varieties were developed specifically for improvements in heat tolerance- tissue and root, and/or deep root growth characters, disease resistance and turf quality persistence and competitive ability. These will be identified as SYN1-92 through SYN5-92. We anticipate entering approximately eight entries into the 1993 trials to include Syn1-88, Syn3-88 and Syn4-88 (CATO).

Single cross, and polycross populations, and numerous half-sib families are currently being subjected to disease pressure (Colbaugh), salinity tolerance, heat tolerance and root growth characters to determine the method of heredity and optimum approach to genetic manipulation.

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The three bentgrasses, formally identified as Syn3-88 and Syn4-88 (CATO) will be resubmitted to the Plant Improvement Review committee during the next 2 months. Additional information has been generated in support of the proposal and will be provided to the committee for consideration. Completed Release Proposal for both Syn3-88 and CATO Creeping Bentgrasses are included in the Appendix. Since considerable duplication in data files existed between these two documents the files were condensed to reduce unnecessary duplications.

The Syn3-88 production field (10 acres) is in excellent condition. Approximately 2000 pounds of seed stock has been placed in permanent storage in Oregon, including approximately 55 pounds of breeder seed. The 1992 production of Syn3-88 will be available for commercial distribution in the fall of 1993, with an estimated yield of 10,000 pounds. The 1993 seed harvested is anticipated to yield an additional 10,000 pounds of seed. Once the variety is released, and the Licensing Process completed, approximately 20,000 pounds of seed should be available for distribution.

A new 5-acre Syn4-88 seed stock field was replanted in the fall of 1991 due to contamination by Highland bentgrass in the previous field. The 1990 field was severely rouged with subsequent seed being used for demonstration plantings and further testing. The 1991 seed production field yielded approximately 600 pounds per acre in the first year of production. However, due to severe Kentucky Bluegrass contamination in 1992, this field was eliminated after seed harvest in August 1992.

Consequently, there is presently no seed production of CATO. However, following extensive cleaning, approximately 1100 pounds of CATO has been tagged as qualifying for Foundation Status by Oregon State University, and placed cold storage at SNO-TEMP in Tangent, Oregon. Additionally, approximately 1000 pounds of seed was available for distribution and testing.

As indicated in the November 1991 report, CATO (Syn4-88) has been established on nine greens of the Bentwater Country Club in Montgomery, Texas (North west of Houston) under the management of Mr. Anges McMillian. The greens were planted in late October 1991. The course was designed by Mr. Scott Miller. I have had the opportunity to visit the site on several occasions. The site represents the most southern and most humid site for evaluation to date. Several of the greens are small and tucked into the trees which will likely result in poor air circulation and potential for stress. Likewise, several of the greens are well placed with adequate ventilation and light exposure. The site will truly be a test of the strength of CATO. The decision was made in November 1992 to construct the second nine holes of Bentwater Country Club and based on the past years performance, CATO will be the grass of choice. As limited seed stocks are available, sufficient seed has been "stored" specifically for use at Bentwater in the fall of 1993. Additionally, Peach Orchard - Grandbury, Tx and Sherrill Park - Richardson have nine or more greens planted to CATO Creeping Bentgrass and reporting

good success with the grass.

Syn3-88 has been the grass of choice for replanting of nine or more greens on several golf courses throughout the lower mid-west including: Sherrill Park - Richardson, Tx, Lakes Spivey Golf Club - Jonesboro, GA, Chapel Hills Golf Club - Douglasville, GA, Bogey Hills Country Club - St. Charles, MO, Bellerive Country Club - St. Louis, Mo, Kirkwood Plantation - Holly Springs, MS, and North Lakes Golf Club - Memphis, TN.

Several noted golf courses have used a mechanical blend of both Syn3 and Syn4, which was identified as Syn12 for total reconstruction. The courses include: Preston Trails Country Club - Dallas, Brookhollow Country Club - Dallas and Riveria Country Club in Los Angeles, CA.

Sufficient breeder seed of Syn1-88 was available for a spring planting in 1992. A 5-acre increase field was established in April 1992 with the first crop becoming available in August 1993.

Totally, the experimental bentgrasses have been provided to over 80 locations of nursery testing and superintendent familiarization. Syn1-88, Syn3-88 and CATO have been sent to 5 locations in the western United States to evaluate their performance under high salinity conditions. Syn1-88 is a direct reselection of Seaside bentgrass with considerable improvement in the quality, texture and rooting characters over Seaside. Salinity of these and several other bentgrasses will simultaneously be evaluated in greenhouse trials at TAES-Dallas in cooperation with Dr. K. B. Marcum.

Seed of Syn3-88 and CATO was distributed to select golf courses in Hawaii in cooperation with the Western Director for evaluation beginning in the late spring of 1992. As supplies last, additional seed will be sent to other locations as request are received.

Several hundred progeny are presently being evaluated for disease resistance and heritability of resistance in cooperation with Dr. Phil Colbaugh. Crosses made during 1990 included four parental lines previously identified as resistant to Pythium, which were crossed with two highly susceptible parents. Additional polycross populations have been evaluated as reported in Colbaugh's report.

Assessment of genotype performance continues in the greenhouse, field and laboratory, with screening of germplasm. Approximately 75 superior plants were shipped to Dr. Virginia Lehman in the early spring however vernalization was not sufficient to acquire seed. The clones were field planted in September 1992 and will provide primary breeding stocks for 1993. In the summer of 1992, an additional nine (9) polycross populations were constructed based on field and laboratory testing of germplasms established in 1990. Invaluable cooperation continues from Pickseed West, with Dr. Jerry Pepin and Mr. Doug King, as well as Dr. Virginia Lehman. Seed harvested from these polycrosses will be evaluated at TAES-Dallas in space plant nurseries, and under greenhouse selection procedures targeted toward salinity, root growth characters, root heat tolerance, leaf water content and tissue tolerance to high temperatures.

Manuscripts published or submitted for publication include:

Lehman, V. G. and M. C. Engelke, 1991. Heritability estimates of Creeping Bentgrass root systems using flexible tubes. Crop Sci. 31:1680-1684

White, R. H., M. C. Engelke, S. J. Morton, and B. A. Ruemmele. 1992. Competitive Turgor Maintenance in Tall Fescue. Crop Sci. 32:251-256.

White, R. H., M. C. Engelke, S. J. Morton, J. M. Johnson-Cicalese, and B. A. Ruemmele. 1992. Acremonium endophyte Effects on Tall Fescue drought tolerance. Crop Sci. 32:1392-1396.

Lehman, V. G., and M. C. Engelke. 1993. Heritability of creeping bentgrass shoot water content under soil dehydration and elevated temperatures. TA#30155. Accepted for publication Crop Sci 33: Sept-Oct.

Lehman, V. G., M. C. Engelke, and R. H. White. 1993. Leaf water potential and relative water content variation in Creeping Bentgrass clones. Submitted for publication Crop Sci . TAES TA#31068

## **APPENDIX**

Release Documents for Syn3-88 Creeping Bentgrass

Release Documents for CATO Creeping Bentgrass

**SYN 3-88**

# **CREEPING BENTGRASS**

## **RELEASE PROPOSAL**



Texas A&M University  
Research and Extension Center  
17360 Coit Road  
Dallas, TX 75025-6499

### *Authors*

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## SYN3-88 Creeping Bentgrass

**SYN3-88** Creeping Bentgrass is a cool-season grass for golf putting greens and fairway surfaces, and other areas where high quality, closely mowed turf is desirable. **Syn3-88** was developed and tested as Syn3-88 by the Texas Agricultural Experiment Station, Texas A&M University System in Dallas, Texas under grants from the United States Golf Association, and Bentgrass Research, Inc. **Syn3-88's** area of adaptation and utility includes wherever Bentgrasses have been previously used, in addition to having strong adaptation to the Transition regions and Southern United States where bentgrasses have been marginally used in the past. Briefly, its merits and limitations are as follows:

### MERITS

- Six-clone Synthetic Variety
  - Broad genetic base
  - Uniformity of plant type,
  - Less tendency for segregation
- Persistent root system during summer stress periods
- Improved tolerance to summer heat and drought stress
- Erect growth habit
- Fine Texture
- Dark green color
- High density during summer stress period
- Tolerant to *Pythium* blight
- Tolerant to Brown Patch (*Rhizoctonia solani*)

### LIMITATIONS

- High density results in thatching tendency
- Susceptible to Dollar Spot (*Sclerotinia spp.*)



Date 31 January 1993

1. CROP Benigrass Type of Release Varietal  
 2. Proposed name or identification: [REDACTED]  
 3. Designation or name in development stages: Syn3-88 or TAMU Syn88-3

4. **Primary features or advantages:** Syn3-88 is a six clone synthetic, selected for its superior quality, density of turf and general performance specifically for bentgrass putting greens in southern regions of the Transition zone and where creeping bentgrass is commonly used for turfgrasses. The variety, under development since 1984, has demonstrated superior performance in trials on golf courses and research plots across the United States in density of stand, genetic color, general competitive ability and more aggressive growth and persistence during summer months than Pennncross, or Pennlinks creeping bentgrasses which are the principle proprietary creeping bentgrass varieties presently in use in the same area. Syn3-88 has been tested in replicated trials in Costa Mesa, CA; West Palm Beach, FL; Atlanta, GA; Augusta, GA; Chattanooga, TN and Dallas, TX. Over 195 observations comparing numerous cultivars of creeping bentgrass for various agronomic and turf quality characters have been recorded since 1988. Syn3-88 was in the top statistical grouping (superior performance) 92.3 % of the time as compared to Pennncross (68.2%), Pennlinks (73.3%) and SR1020 (84.1%) all having an equal number of observations (Table 25). Syn3-88 is reported to be tolerant to *Rhizoctonia* blight and *Pythium* blight. Syn3-88 is susceptible to Dollar Spot (*Sclerotinia homeocarpa*). (Appendix - Colbaugh - Texas). Syn3-88 maintains summer density and persistence better than Pennncross (APPENDIX - Carrow - Georgia). Seed yield of Syn3-88 approached 940 pounds per acre compared to Pennncross averaging 450 pounds. Syn3-88 is presently being evaluated on 9 or more putting greens on 12 golf courses throughout the mid-west and southern United States (Table 26) and in additional trials and test plots on 87 golf courses throughout the region where bentgrass is normally grown.

5. Plant Variety Protection - suggested action: Application for Plant Variety Protection included. Plant material under evaluation in space plant nurseries in Oregon with the initial PVPA data submitted in the spring 1993, and the final data to be submitted in the fall 1993. The variety must be

6. Seed -- amount available and date: ~2000 pounds of Foundation seed stock April 1993, and ~ 10,000 pounds of Registered - Certified Tagged seed available for commercial sales April 1993.

7. Provisions to maintain breeder seed: Approximately 50 pounds of breeder seed in cold storage (SNO-TEMP) Tangent Oregon. Should be sufficient seed supply along with the Foundation grade seed stocks to maintain the variety.

8. Proposed seed distribution: Transfer Foundation Seed and Registered grade seed stocks to a single Licensee for production, and world marketing and distribution.

9. **Suggested Fees (for Breeder or Genetic Stock):** \$30,000\* License fee (or equivalent) plus sale of Foundation (\$10.00 per pound) and Certified seed stocks (\$6.00 per pound)  
 All cost associated with the production of Foundation seed stocks (~\$5.00 per pound) were paid for by the USGA Bentgrass research grant for which cost recovery is requested to the project. The production cost on the 10,000 pounds of seed and the anticipated 1993 crop of 10,000 + pounds must still be paid (~\$5.00 per pound).

**10. Supportive documents attached:**

RELEASE PROPOSAL XXXX with appendix A - C  
CROP SCIENCE REGISTRATION XXXX  
AUTHORSHIP STATEMENT XXXX

PVP DOCUMENTS XXXX

- a. ORIGIN & BREEDING HISTORY XXXX  
b. NOVELTY STATEMENT XXXX  
c. OTHER INFORMATION XXXX  
d. OBJECTIVE DESCRIPTION XXXX  
e. OWNERSHIP STATEMENT XXXX

11. Release Proposal - prepared with or reviewed by: Drs. V. G. Lehman, P. F. Colbaugh, James A. Reinert, and W. E. Knoop.

Submitted by:

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Associate Professor  
Turfgrass Breeding, Genetics and Management

James A. Reinert  
Resident Director  
Texas A&M REC - Dallas

## RELEASE PROPOSAL SYN3-88 CREEPING BENTGRASS<sup>1</sup>

M. C. Engelke, V. G. Lehman, W. R. Kneebone, P. F. Colbaugh, J. A. Reinert and W. E. Knoop<sup>2</sup>

'Syn3-88' creeping bentgrass (*Agrostis palustris* Huds.) was developed for release in 1993 by the Texas Agricultural Experiment Station. Syn3-88 will be suitable for use as a cool-season turfgrass for golf course putting surfaces and fairways throughout the usual areas of adaptation of creeping bentgrass, with improved adaptation to the Southern transition zone. Syn3-88 is a six clone synthetic variety selected from an original 92 clone germplasm nursery.

Following extensive agronomic selection and evaluation at TAES-Dallas, a 50 clone elite germplasm nursery was established in Oregon in the fall of 1985 to evaluate seed production potential. Six parental clones, from these 50 genotypes, were selected based on floral niching and plant type in Tangent, Oregon during the 1986 and 1987 growing seasons. The parental clones were physically isolated in January 1988 in Oregon with the first seed harvest in August 1988 (Pre-breeder Seed). The parental clones, originating from Arizona and Texas, were designated as TAES-2737, TAES-2739, TAES-2740, TAES-2741, TAES-2743, and TAES-2895 (Table 1). A limited seed supply was germinated, with approximately 2000 seedlings established as transplants in a 0.13 ha. breeder field in Oregon in January 1989. Additional roguing for uniformity of plant type and flowering date of the breeder field during 1989 and 1990 resulted in the breeder stock of Syn3-88 (Generation 1). Generation 1 (breeder seed) provided planting stock for production of Experimental Seed Stocks which have been inspected, tested, tagged and qualified as seed stocks of Foundation Class (Generation 2), which in turn will be used to produce Registered or Certified Class of seed (Generation 3). Either Registered or Certified seed can be used for the market class. Production from foundation fields is limited to 3 years, after which the field may be downgraded to certified for an additional 3 years of production. Certified production will be limited to no more than 7 years from date of planting to ensure genetic purity and integrity. Production fields of Syn3-88 may be typified by having up to 20 percent of its inflorescences exhibiting an open panicle following pollination.

The six parental clones of Syn3-88 were evaluated under greenhouse conditions for morphological characters in 1985 (Table 1). The parents had high density, an aggressive spread rating, and fine leaf type, with variable ligule lengths in comparison to the other 86

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<sup>1</sup> Syn3-88 was developed by the Texas Agricultural Experiment Station with partial funding from the United States Golf Association and Bentgrass Research, Inc.

<sup>2</sup> Associate Professor, Turfgrass Breeding & Genetics (TAES); Turfgrass Breeder, Loftis Great Western Seed Co., Albany, OR (former Research Associate, TAES-Dallas); Professor Emeritus, University of Arizona; Associate Professor - Plant Pathology (TAES); Professor - Entomology and Resident Director (TAES); and Professor and Turf Extension Specialist (TAEX); Texas A&M Research and Extension Center, Dallas, Texas.

clones evaluated. Under field conditions, the parents were middle to higher in quality ratings (1985 through 1988) as compared to the other 86 clones of bentgrass (Tables 2 and 3). Three of the six clones were lower than 'Penncross' in thatch accumulation as measured by thickness and weight of a 20 mm wide x 76 mm long slice of the thatch layer when evaluated in 1987 under greens management (Table 4). All six parents produced adequate seed germination and yield when grown in Tangent, OR in a polycross nursery containing 50 clones (Table 5). The parental clones were evaluated to determine date of heading (Table 6), with all clones initiating heading within 21 days of each other. Four of the six clones rated high in seedhead numbers when evaluated in Tangent, OR in 1987, with five of the six clones having an aggressive spread rating (Table 7).

Plants, measuring 25-30 cm in diameter with a 15 - 20 cm soil base were dug and transplanted into an isolated crossing block. The crossing block was composed of two replications of each clone randomly placed to enhance cross pollination. Seed was harvested by maternal clone and later bulked in equal quantities from each clone to create the variety designated 'Syn3-88'.

Turf plots were established at Augusta, GA and Dallas, TX under putting green management conditions in the fall of 1988 to compare Syn1-88, Syn3-88 and Syn4-88 with nine commercial varieties. Seeding rate was 49 g are<sup>-1</sup>. Syn3-88 was intermediate for stand establishment, but not significantly different from Penncross at Dallas in 1988 (Table 8). Quality was rated 1-9 with 9 = best in the turf evaluations.

The accumulated performance of each entry is reflected in a parameter identified as Turf Performance Index (TPI). Turf Performance Index is defined here as the frequency of the number of times the entry performed in the highest (best) statistical grouping regardless of the character measured. Beginning with the trials in Dallas, and at Augusta National Golf Course (1988) to the present, several replicated turf trials across the country have provided collectively 195 separate turf quality evaluations and assessments of various agronomic attributes for Syn3-88 and several other experimental and commercial cultivars of creeping bentgrass (Tables 9 - 25). Observations were taken by TAES research personnel, scientists from other Universities and commercial companies, golf course superintendents, Golf Professionals and interested turf industry personnel. Tables 9 - 14 summarize quality, rooting and tillering data collected on the creeping bentgrass variety trials established at TAES-Dallas in October 1988, and evaluated from 1988 to fall 1992. This constitutes 101 separate observations per entry for which Syn3-88 ranked in the highest statistical grouping 91.1% of the time (92 out of 101 evaluations). By comparison, Penncross ranked in the highest statistical grouping (70) for 69.3%, Pennlinks (75) for 74.2% and SR1020 (84) for 83.2%.

Similar trials were established at Augusta National Golf Course, Augusta, GA in the fall of 1988 in cooperation with the golf superintendent and under the monthly supervision of Dr. Gil Landry, Turf Extension Specialist, University of GA. The trials were terminated prematurely by a new superintendent in the fall of 1991. Data table 18 summarizes performance data from Augusta during the test period. Of the 18 quality observations taken ,

Syn3-88 was top of the class 17 times (94.4%) with Pennncross only 7 times (38.9%). The seasonal performance of Syn3-88 at Augusta was consistently superior to Pennncross, Pennlinks, and Seaside which are standard commercial cultivars..

The National Turf Evaluation Program (NTEP) established replicated turf trials across the country in 1989,. Unfortunately due to an insufficient quantity of seed, Syn3-88 was included only in select trials, specifically in Florida at Banyan Golf Club, West Palm Beach and at TAES-Dallas. Quality and performance data for the NTEP trials at Dallas are summarized in Tables 15-17, and the Florida data is summarized in Table 19. In Florida, Syn3-88 was in the highest quality rating group and was not as susceptible to either Dollar spot (*Sclerotinia* spp.) and *Pythium* spp. disease as many other varieties. Disease pressure at the West Palm Beach, Florida test site may be considered extreme due to high ambient temperatures and relative humidity.

Additional trials have been established at the Atlanta Athletic Club, Atlanta, GA (Fall 1991) with the cooperation of Dr. Gil Landry, with data summarized to date in Table 20; and in two separate trials at the Honors Course near Chattanooga, TN with the cooperation of David Stone, golf Superintendent . Tennessee data is summarized in Tables 21 thru 23; and at Mesa Verda Country Club, Costa Mesa, CA with the cooperation of Reed Yenny , golf Superintendent and USGA Agronomist Paul Vermeulen (Fall 1992) with data summarized to date in Table 24.

In summary, Syn3-88 has been tested in replicated trials in Costa Mesa, CA; West Palm Beach, FL; Atlanta, GA; Augusta, GA; Chattanooga, TN and Dallas, TX . Over 195 observations comparing numerous cultivars of creeping bentgrass for various agronomic and turf quality characters have been recorded since 1988 (Table 25). Syn3-88 was in the top statistical grouping (superior performance) 92.3 % of the time as compared to the industry standards of Pennncross (68.2%), Pennlinks (73.3) as well as SR1020 (84.1). Syn3-88 is reported to be tolerant to *Rhizoctonia* blight and *Pythium* blight (Appendix - Colbaugh - Texas). Syn3-88 is susceptible to Dollar Spot (*Sclerotinia homeocarpa*) (Appendix - Colbaugh - Texas). Syn3-88 maintains summer density and persistence better than Pennncross (Appendix - Carrow - Georgia). Seed yield of Syn3-88 approached 940 pounds per acre compared to Pennncross averaging 450 pounds.

Syn3-88 is genetically different from the other commercially available varieties, as illustrated by the performance data in this document. Breeder's seed, Foundation Class seed and approximately 10,000 pounds of Registered/Certified class seed is available as of January 1993. A 12 acre production field was established in Oregon in 1991 which produced the Foundation Class Seed with 50 pounds breeder seed being maintained in cold storage for future use.

Table 1. Greenhouse morphological characterization of parental clones<sup>1,2</sup> of Syn3-88, taken in the greenhouse 30 July 1985.

Accession TAES#	Origin	Density <sup>3</sup>	Growth <sup>4</sup> Type	Spread <sup>5</sup>	Spread <sup>6</sup> Type	Leaf <sup>7</sup> Width	Ligule <sup>8</sup> Length
2737	Ariz	2	U	2	S	1.5	1.4
2739	Ariz	2	P	2	S	1.4	0.8
2740	Ariz	3	P	3	S	1.3	0.9
2741	Ariz	2	P	3	S	1.2	1.2
2743	Ariz						
2895	Texas	1	U	1	S	1.0	1.2

<sup>1</sup>Parental clone data extracted from analysis including 92 clones of original germplasm nursery with means separations from 'a' to 'z'.

<sup>2</sup>Non-replicated trial, but multiple measures per tray.

<sup>3</sup>Density rated 1-3, 3=best.

<sup>4</sup>Growth type where P=prostrate, U=upright, I=intermediate.

<sup>5</sup>Spread rated 1-3, 3=most.

<sup>6</sup>Type of spread, T=Tillers, S=Stolons.

<sup>7</sup>Leaf width, mean of 3 leaf widths.

<sup>8</sup>Ligule, mean of 3 ligule lengths.

Table 2. Mean quality of parental clones<sup>1</sup> of Syn3-88 under putting green conditions at TAES-Dallas, TX 1985 - 1986.

Day of Year, 1986							
TAES#	Jan08-85	Jan17-86	Mar09-86	Apr20-86	Ma25-86	Ju23-86	Mean
	Quality 1-9, 9= best						
2737	5.0 a*	7.5 a	6.0 a	6.5 a	6.0	5.5	6.4
2739	2.0	6.5 a	3.0	5.0	5.0	6.0	5.7
2740	6.0 a	8.5 a	8.0 a	8.0 a	7.0	9.0 a	8.0 a
2741	5.5 a	6.0 a	5.5 a	6.5 a	7.0	9.0 a	6.9
2743							
2895	7.0 a	4.5	6.5 a	8.0 a	6.5	6.5	6.5
Range	2.0-8.5	1.0-8.5	3.0-8.5	2.5-8.5	2.0-9.0	1.0-9.0	2.4-9.0
Pennncross	.	.	.	5.5	7.0	8.0	.

<sup>1</sup>Parental clone data extracted from analysis including all 92 clones with mean separations from 'a' to 'z'.

\*Means followed by an 'a' were in the highest statistical grouping using the Waller/Duncan k ratio t test (k ratio = 100). ns = nonsignificant.

Table 3. Mean quality parental clones of Syn3-88 under putting green conditions at TAES-Dallas, TX 1987 - 1988.

TAES#	Day of Year, 1987				1987	1988
	Mar23	May30	Jul14	Sept26	Mean	Mean
	Quality 1-9, 9 = best					
2737	5.0 a*	7.0 a	7.0 a	1.0	4.6 a	5.5
2739	2.0	4.0	7.0 a	1.0	4.0 a	7.0
2740	6.0 a	6.0 a	9.0 a	5.5 a	6.4 a	7.0 a
2741	5.5 a	5.0 a	9.0 a	1.0	4.2 a	4.0
2743	5.5 a	5.5 a	5.5 a	4.0 a	5.0 a	7.0 a
2895	7.0 a	4.0	9.0 a	1.5	4.0 a	8.0 a
Range	2.0-8.5	1.5-8.0	1.0-9.0	1.0-7.5	1.6-7.2	1.5-8.0
Penncross	3.5	6.5 a	6.0 a	3.5 a	5.3 a	5.0

\*Means followed by an "a" letter are not significantly different using the Waller/Duncan k ratio t test (k=100).

Table 4. Mean thatch layer (examined by extracting a soil slice) and depth of thatch and weight (17 June 1987) of parental clones of Syn3-88.

TAES#	Thatch, Slice	Thatch, Weight
	--mm--	--mg--
2737	8.0	15.8 a*
2739	7.5	15.3 a
2740	7.5	15.3 a
2741	8.0	14.5
2743		
2895	6.8	14.8
Range	5.3-10.0	13.3-16.5
Penncross	7.8	15.0 a

\*Means followed by an 'a' were in the highest statistical grouping at the k=100 level using the Waller/Duncan k ratio t test.

Table 5. Germination and seed yield of parental clones of Syn3-88 grown in Tangent, OR, 1986.

TAES#	Germination <sup>+</sup>	Seed yield <sup>++</sup>
	--%--	--g--
2737	91	2.10
2739	71	1.00
2740	72	1.20
2741	68	1.55
2743	76	1.75
2895	68	2.80
Range	50.0-91.0	0.0-6.8

\*Three petri plates of 100 seeds counted after 7 days of hydration.  
One application of Subdue for *Pythium* sp. control.

\*\*Mean seed yield per plant with three plants per treatment.

Table 6. Heading date of parental clones of Syn3-88, in Tangent, Or in 1987 by replication.

	Replication		
	I	II	III
2737	6/18	6/25	6/16
2739	.	6/25	6/6
2740	6/4	6/6	6/5
2741	6/10	6/7	6/3
2743	6/16	6/13	6/12
2895	6/8	6/8	6/6

Table 7. Mean seed head and spread rating and growth habit of parental clones of Syn3-88 at Tangent, OR in 1987.

TAES#	Seedhead	Spread	Growth habit
		-----Rating 1-9, 9=best -----	
2737	4.3	7.7 a	3.0
2739	5.7	8.0 a	6.3 a
2740	8.3 a	6.3 a	3.3
2741	9.0 a	6.3 a	2.0
2743	8.3 a	7.0 a	2.7
2895	7.3 a	4.3	2.7
Range	0.0-9.0	1.7-9.0	1.0-8.3

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan k ratio t test (k ratio=100). ns = nonsignificant.



Tables 8 - 25 are common to both Syn3-88 and CATO releases. All tables be included in the CATO documents.

Table 26 Distribution and testing of Syn3-88 Experimental Creeping Bentgrass developed at Texas A&M Univ-REC with support from Bentgrass Research Inc. and the U.S.Golf Association.. Extensive field testing initiated in 1991 when sufficient seed stocks were available for distribution and testing.

# LOCATION

<u>State</u>	<u>City</u>	<u>Golf Course</u>	<u>Superintendent</u>	<u>Site</u>	<u>Quantity</u>	<u>Date of Est.</u>
A. Includes multiple greens, often the entire course as indicated by the number of greens underside.						
CO	Denver	Denver Country Club	Fritz Law	Fairway	300#	4-92
GA	Douglasville	Chapel Hills Golf Club	Jimmy Greenway	Greens 18	225#	8-92
GA	Jonesboro	Lakes Spievy Golf Club	Joe Hamilton	Greens 9+	175#	9-91, 8-92
MO	St. Louis	Bellerive C C	Tom Van DeWalle	Greens (OS) 18	100#	9-92
MO	St. Charles	Bogie Hills CC	Robert Glasglow	Greens 18	225#	9-92
MS	Holly Springs	Kirkwood Plantation	Harris Gholson (O)	Greens 18	150#	10-92
TN	Memphis	North Lakes G C.	Jim Harris	Greens 9+	75#	10-92
TX	Brownwood	Feather Bay Golf Club	D. W. Mitchell (O)	Greens 9+	150#	4-92
TX	Dallas	Preston Trails CC	Alan Houdeck	Greens 18	180#	9-92
(Syn3+Syn4)						
TX	Dallas	Las Colinas Sports Club	Tom Diamond	Greens (OS) 18	85#	10-92
TX	Dallas	Brook Hollow CC	Bill Shrum	Greens 18	150#	2-93
(Syn3+Syn4)						
TX	Grandbury	Pecan Orchard Golf Course	Roland Harper (O)	Greens 9+	75#	8-91
TX	Richardson	Sherrill Park Golf Course	Rusty Johnson	Greens 9+	160#	9-92
AZ	Carefree,		Marc Snyder	Nursery	10#	1-92
AZ	Tucson,	University Arizona	Dave Kopeck	Test Plot	5#	9-91
CA	Cerritos,	Mesa Verda CC	Reed Yanning	Rep Tests	2#	4-92
CA	Lake Forest,	USGA Green Section	Paul Vemeulen	Test Plots	5#	12-92
CO	Denver,	Denver Country Club	Fritz Law	Test Plots	1#	9-91
DE	Wilmington,	Wilmington C C	Paul Latshaw	Test Plot	1#	4-92
FL	Hope Sound,	USGA Green Section	John Foy	Test Plots	10#	9-91
FL	Jupiter,	Loxahachie Golf Club	Phil Shumaker	Green (OS) 1	10#	11-92
FL	Jupiter,	Loxahachie Golf Club	Phil Shumaker	Rep Tests	1#	9-91
GA	Atlanta,	Dunwoody C C	Bill Womack	Test Plot	1#	3-92
GA	Atlanta,	Atlanta Athletic Club	Dr. Gil Landry (C)	Rep Tests	10#	9-31
GA	Augusta,	Augusta National	Marsh Benson	Green 1	10#	9-91
GA	Griffin,	Univ of GA-Griffin	Dr. Lee Burpee	Test Plots	1#	3-92
HI		Mimemato Golf Club	Sean Hullian	Nursery	5#	4-92
HI		Quality Turfgrass Sod Farm	Tom Staton	Test Green	5#	9-91
HI		Makalei Golf Club	Steve Swanhart	Nursery	5#	4-92
HI		Manuakea Golf Club	Bob Itamoto	Nursery	5#	4-92
HI	Honolulu,	Oahu CC	John Gillis	Nursery	5#	5-92
HI	Honolulu,	Oahu Country Club	John Gillis	Test Plot	5#	9-92
HI	Princeville,	Princeville Golf Course	Damian Baptiste	Nursery	5#	7-92
IL	Edwardsville,	Sunset Hills	Duke Ajemian	Test Plot	15#	9-91
KS	Coffeyville,	Coffeyville CC	Steve Lopeman	Test Plot	5#	9-91
KS	Olathe,	Shadow Glen G. C.	Steve Gregory	Nursery	5#	9-91
KS	Wichia,	Wichia CC	Brent Conrad	Nursery	5#	9-91
MD	Timonium,	Baltimore CC	Doug Peterson	Test Plot	2#	8-92
MO	Kansas City,	Blue Hills CC	Dave Fearis	Nursery	5#	9-91
MO	St. Louis,	Algonquin Golf Club	Don Zonzie	Nursery	5#	10-92
MS	West Point,	Old Wavely G C	Bill Colorado	Nursery	5#	9-91
NB	Lincoln,	Firethorn CC	Bill Youngscape	Test Plots	5#	9-91
NC	Pinehurst,	CC of North Carolina	George Thompson	Test Plot	5#	10-92

Table 26. (Cont.) Test site generally consisted of a single green or nursery, or in some cases replicated test sites were established which may or may not generate support information for statistical performance.

<u>State</u>	<u>City</u>	<u>Golf Course</u>	<u>Superintendent</u>	<u>Site</u>	<u>Quantity</u>	<u>Date of Est.</u>
NC	Raleigh,	North Carolina State Univ	Dr. Richard White	Rep Tests	1#	5-92
OK	Ardmore	Ardmore CC	Bill Byrd	Green (OS)	10#	10-91
OK	Ardmore	Lakeview Golf Club	David Long	Nursery	5#	5-92
OK	Broken Arrow,	Indian Springs CC	Brad Davis	Test Plot	5#	9-91
OK	Edmond,	Edmond CC	Tom Boyd	Nursery (10)	10#	9-91
OK	Lindsay,	Lindsay Municipal G. C.	Jim Golden	Test Plot	5#	9-91
OK	Oklahoma City,	Oklahoma City C C	Craig Elms	Nursery	5#	9-92
OK	Oklahoma City,	Trosper Park Golf Club	Pat Rigsby	Green 1	9#	9-91
OK	Tulsa,	LaFortune Golf C.	Mike Delaloye	Test Plot	5#	9-91
OK	Tulsa,	Meadowbrook CC	Gary Hallett	Nursery	5#	9-91
OR	Bend,	7th Mountain G. Vill	Walter Mattison	Nursery	5#	5-92
OR	Sun River,	Sun River Resort Golf C	John Ramey	Nursery	5#	5-92
TN	Gallatin,	Gallatin Country Club	L. C. Merryman	Nursery	25#	9-92
TX	Austin,	Barton Creek Golf Club	Tim Long	Nursery	15#	5-92
TX	Bay City,	Sod Farm	Steve Brown	Nursery	2#	1-92
TX	Carrollton,	Indian Creek CC	Steve Ballard	Nursery	5#	9-92
TX	College Station,	Texas A&M Univ	Wallace Menn	Rep Tests	1#	9-91
TX	Corpus Christi,	Padre Isle C C	Carl Suding	Test Plot	2#	10-91
TX	Dallas,	Lakewood CC	Mike Plumber	Nursery	5#	9-91
TX	Dallas,	Preston Trails CC	Alan Houdeck	Nursery	10#	9-91
TX	Dallas,	Northwood CC	Mike Allen	Nursery	15#	9-91, 10-92
TX	Dallas,	Dallas Athletic Club	Burt Neddels	Nursery	5#	9-91
TX	Dallas,	Brook Hollow CC	Bill Shrum	Nursery	15#	9-91
TX	Dallas,	Las Colinas Sports Club	Tom Diamond	Nursery	10#	9-91
TX	Denton,	Oakmont CC	Doug Moore	Nursery	5#	10-91
TX	Fort Worth,	Shady Oaks Country Club	Pat Jones	Greens OS 3	20#	9-91
TX	Fort Worth,	Colonial CC	Tom Werner	Nursery (10)	10#	9-91, 11-92
TX	Garland,	FireWheel G. C.	Blake Burrows	Green (OS)	5#	9-91
TX	Jacksboro,	Jacksboro C C	Henry Ricahrds	Nursery	10#	8-92
TX	Kerrville,	Riverhill CC	Grant Collins	Nursery	10#	1-92
TX	McKinney,	Stone Bridge CC	David Reidman	Nursery	5#	9-92
TX	Ooltewah,	The Honors Course	David Stone	Rep Tests	7#	10-91, 10-92
TX	Snyder,	West Test College	Don Buckland	Test Plots	5#	10-91
VA	Richmond,	CC of Virginia	Alan Hess	Nursery (30)	30#	9-91
WA	Redmond,	Sahalee Country C lub	Tom Wolff	Test Plots	1#	5-92
WI	Madison,	University of Wisconsin	Tom Salaiz	Rep Tests	1#	4-92
WY	Jacksonhole,	Jacksonhole CC	Brian Heywood	Test Plot	2#	8-92

Limited testing was initiated with my permission in Foreign countries in 1991 in cooperation with interested domestic seed companies - Specifically Pick Seed West under the direction of Dr. Jerry Pepin.

#### FOREIGN

AUST	Melbourne,	Turfgrass Technology	John Neylan	Nursery	10#	8-91,11-92
JAP	Tokyo,	Tomen America	Tak Yamada	Test Plots	5#	12-92

# INDEX OF TABLES

Table 1. Greenhouse morphological characteristization	4
Table 2. Mean quality of parental clones1 of Syn3-88	4
Table 3. Mean quality parental clones of Syn3-88	5
Table 4. Mean thatch layer (examined by extracting	5
Table 5. Germination and seed yield of parental clones	6
Table 6. Heading date of parental clones of Syn3-88	6
Table 7. Mean seed head and spread rating and growth	7
Table 8a. Percent stand and quality ratings of Syn1-88, Syn3-	8
Table 8b. Leaf blade width of Syn1-88, Syn3-88 and Syn4-88	8
Table 8b. Leaf blade width of Syn1-88, Syn3-88 and Syn4-88 an	8
Table 9a. Quality ratings of Syn1-88, Syn3-88, Syn4-88	9
Table 9a. Quality ratings of Syn1-88, Syn3-88, Syn4-88 and n	9
Table 9b (cont.) Quality ratings of Syn1-88, Syn3-88, Syn4-88	9
Table 10a. Turf quality ratings of Syn1-88, Syn3-88, Syn4-88	10
Table 10b. (Cont.) Turf quality ratings of Syn1-88, Syn3-88,	10
Table 10c. (Cont.) Turf quality ratings of Syn1-88, Syn3-88,	11
Table 10d. Accumulative Turf Performance Index (TPI) rating	11
Table 11a. Quality ratings of Syn1-88, Syn3-88, Syn4-88	12
Table 11b (Cont.) Quality ratings of Syn1-88, Syn3-88, Syn4-	12
Table 11c (Cont.) Quality ratings of Syn1-88, Syn3-88, Syn4	13
Table 11d. (Cont.) Turf Quality notes on Creeping Bentgrass	13
Table 11e. Accumulative Turf Performance Index Scores for Creep	14
Table 12. Mean quality ratings of Syn1-88, Syn3-88, Syn4-88	15
Table 13a. Tiller counts on Creeping Bentgrass Variety Trials	16
Table 13b. (Cont.) Tiller counts on Creeping Bentgrass Variet	16
Table 13c. (Cont.) Tiller counts on Creeping Bentgrass Variet	17
Table 13d. (Cont.) Accumulative Turf Performance Index	17
Table 14a. Root depths counts on Creeping Bentgrass Variety T	18
Table 14b (Cont.) Root depths counts on Creeping Bentgrass	18
Table 15. NTEP Creeping Bentgrass variety evaluation trials	19
Table 16a. Tiller counts on National Turf Evaluation Program (	20
Table 16b (Cont.) Tiller counts on National Turf Evaluation P	21
Table 17a. NTEP Root depth measurements on Creeping Bentgrass	22
Table 17b (Cont.) NTEP Root depth measurements on Creeping Be	23
Table 18a. Mean quality ratings of Syn4-88 and seven cultivar	24
Table 18b (Cont.) Mean quality ratings of Syn4-88 and seven c	24
Table 18c. (Cont.) Mean quality ratings of Syn4-88 and seven	25
Table 18d. Accumulative Turf Performance Index Ratings	25
Table 19. Quality and disease evaluation of Syn3-88,	26
Table 20a. Turfgrass vigor ratings of seleted Creeping Bentgr	27
Table 20b. (Cont.) Turfgrass quality performance ratings of s	27
Table 20c. (Cont.) Turfgrass Performance ratings of seleted Cr	28
Table 21. Winter color and percent coverage for selected cult	29
Table 22. Turfgrass quality ratings for selected Creeping	30
Table 23. Turfgrass quality ratings for selected Creeping	31
Table 24. Turfgrass quality ratings for selected Creeping	32
Table 25. Summary of Accumulative Turf Performance Index Rating	33
Table 26. Distribution and testing of Syn3-88 Experimental.	34

**SYN 3-88**

**CREEPING BENTGRASS**

**CROP SCIENCE  
REGISTRATION**



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## REGISTRATION OF SYN3-88 CREEPING BENTGRASS

Syn3-88 (Reg. no. \_\_\_\_\_) is a dark green creeping bentgrass (Agrostis palustris Huds.) with good summer performance and quality in the Southern U.S. released by the Texas Agricultural Experiment Station, Texas A&M University System in June 1993. \_\_\_\_\_ was identified as Syn3-88 during development and evaluation.

Syn3-88 is a six-clone synthetic cultivar with the parental clones selected from plants which survived environmental stresses under golf course conditions. Five parental clones originated from germplasm obtained from the University of Arizona and the sixth clone originated from collection in Texas. Syn3-88 shares three parents in common with the cultivar 'SR1020'. Ninety-two vegetative clones of bentgrass were planted on a putting green surface in Dallas, TX in 1985 in replicated trials. Vegetative propagules of the fifty clones which had the highest quality and persistence through the summer of 1985 were planted in a replicated seed production nursery in the fall at Tangent, OR. The parental clones were physically isolated in Tangent, OR in January 1988, with first seed harvested in August 1988. Selection of clones for inclusion was based on medium to high turf quality performance, including density, texture, color, and persistence in Dallas, and floral nicking, seedhead number, plant spread, plant morphology, and seed yield in Oregon.

First planted in turf trials at Dallas, TX and Augusta, GA in 1988, Syn3-88 had significantly more tillers and a similar leaf texture compared to 'Penncross'. Syn3 exhibits a more erect leaf orientation than Penncross. In the summer of 1988, Syn3-88 had significantly higher quality ratings than Penncross and 'Pennlinks' in Dallas, TX, and higher quality ratings than Penncross and Pennlinks in the summer of 1989 in Augusta, GA. Planted in the NTEP trials in Florida, Syn3-88 had significantly better disease resistance in 1990 to a combined disease complex of pythium blight (Pythium sp.) and dollar spot caused by Lanzia and Moellerodiscus spp. than the other 22 entries. Syn3-88 has been tested in replicated trials in Costa Mesa, CA; Atlanta, GA; Augusta, GA; West Palm Beach, FL; Chattanooga, TN and Dallas, TX. Over 195 observations comparing numerous cultivars of creeping bentgrass for various agronomic and turf quality characters have been recorded since 1988. Syn3-88 was in the top statistical grouping (superior performance) 92.3 % of the time as compared to Penncross (68.2%), Pennlinks (73.3%) and SR1020 (84.1%). Syn3-88 is reported to be tolerant to *Rhizoctonia* blight and *Pythium* blight (Colbaugh et al., 1993). Syn3-88 is susceptible to dollar spot (*Sclerotinia homeocarpa*). (Colbaugh et al., 1993). Syn3-88 maintains summer density and persistence better than Penncross. (Carrow, 1992)

Syn3-88 is a fine-textured, upright, creeping bentgrass with a dark green color. Up to 20% of the inflorescences may not completely close after pollination.

Syn3-88 is recommended for use in areas where-ever creeping bentgrass is well-adapted on golf-course putting greens, fairways, tees, and other areas where a high-quality, closely mown turf is desirable. Syn3-88 is also recommended for use in the Southern and transition regions of the U.S. where bentgrass is adapted.

Syn3-88 Creeping Bentgrass

Syn3-88 yields of approximately 450 pounds per acre in the year of establishment, and approximately 900 pounds per acre from the second harvest year. Breeder seed of Syn3-88 will be maintained by Foundation Seed Services, Texas A&M University, College Station, TX 77843-2474. Presently approximately 2000 pounds of Foundation Seed Stock and 50# of breeder seed are stored at SNO-TEMP in Tangent, Oregon. Three generations of seed increase from breeder seed will be permitted, to include one each of foundation, registered, and certified. United States Plant Variety Protection has been applied for.

#### Literature Citations:

Carrow, Robert N. Fertility Effects on Creeping Bentgrass, Pest, Water and Root Relationships. 1992. Executive Summary - USGA Annual Report

Colbaugh, P. F. and M. C. Engelke. 1992. Pythium blight on NTEP Bentgrasses-1991. Biological and Cultural Test for Control of Plant Diseases. Vol:7. 1992. APS press (in press).

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Research for the development of this cultivar was supported in part by grants from the United States Golf Association, and Bentgrass Research, Inc.. Contribution Texas Agricultural Experiment Station Technical Article \_\_\_\_\_. Registration by CSSA. Accepted \_\_\_\_\_.

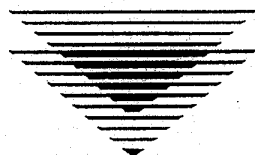
\*Corresponding author.

**SYN 3-88**

**CREEPING BENTGRASS**

**APPLICATION FOR**

**PLANT VARIETY PROTECTION**



Texas A&M University  
Research and Extension Center  
17360 Coit Road  
Dallas, TX 75025-6499

*Documents*

<i>Exhibit A.</i>	ORIGIN & BREEDING HISTORY
<i>Exhibit B.</i>	NOVELTY STATEMENT
<i>Exhibit C.</i>	OTHER PERTINENT INFORMATION
<i>Exhibit D.</i>	OBJECTIVE DESCRIPTION
<i>Exhibit E.</i>	OWNERSHIP STATEMENT



Exhibit A. (PVP)

ORIGIN AND BREEDING HISTORY OF SYN3-88 CREEPING BENTGRASS

Syn3-88 is a six-clone synthetic variety of creeping bentgrass. In spring 1985, 92 clones of creeping bentgrasses were vegetatively established and maintained on a modified sand base putting green. The replicated trial was subjected to close mowing, traffic and cultural practices typical to the Southern United States. These field trials were maintained and evaluated through 1988, with primary assessment on turf performance characters including visual quality, density, texture, color, growth habit, and persistence. Based on the first years data (1985) at Dallas, Texas, 50 of the most elite clones were established in a germplasm nursery in Tangent, Oregon to evaluate seed production potential. Six parental clones from these 50 genotypes were selected for polycross isolation following extensive evaluation for turf quality characters in Texas, as well as similarity for floral niching and plant type in Oregon during the 1986 and 1987 growing seasons. The parental clones were physically isolated in January 1988 in Oregon with the first seed harvest in August 1988. The parental clones designated as TAES-2737, TAES-2739, TAES-2740, TAES-2741, TAES-2743, and TAES-2895. Clones TAES-2732, TAES-2739, TAES-2740, TAES-2741 and TAES-2743 were obtained from Dr. Robert Kneebone in 1984 and were previously identified as clone A39, A74, A72, A77, and A85. Clone TAES-2895 was collected from 30 year old greens at Brookhollow Country Club in Dallas in 1985. Seed was harvested in August 1988 by maternal parent and bulked to form the pre-breeder seed. Experimental turf research plots were established in Georgia and Texas in fall of 1988 using the breeder seed. Experimental turf research plots were established in Georgia and Texas in fall of 1988 using the pre-breeder seed.

Approximately 2000 seedlings developed from the breeder seed were established as transplants in a 0.13 ha field in Oregon in January 1989. Additional rouging for uniformity of plant type, flowering date, and seed yield was conducted during 1989 and 1990, resulting in the breeder stock of Syn3-88 (Generation 1). Seed harvested and established from this generation was used to establish a 12 acre Experimental Seed Production Field which was entered into the Oregon State University Seed Certification as an experimental variety. Approximately 5400 pounds of seed was produced in 1991 of which 2000 pounds of seed has been purity and germ tested and tagged as Foundation Seed Stock and placed in cold storage at SNO-TEMP in Tangent, Oregon. The remaining seed has been used for distribution and testing as indicated in Table 25 of the main document. The variety yielded approximately 900 pounds per acre in 1992 providing approximately 10,000 pounds of seed which is available for immediate marketing and distribution. The production field is eligible for entry into the varietal certification program in 1993. This production field will be available for harvest in 1993.

Due to extensive selection, Syn3-88 has shown few variants, with acceptable uniformity and quality from one generation to the next.

Exhibit B. (PVP)

#### NOVELTY STATEMENT OF SYN3-88 CREEPING BENTGRASS

Syn3-88 can be clearly distinguished from all other cultivars of creeping bentgrass by the combination of spaced-plant and turf characteristics summarized Exhibit C and Table 1-25 - Syn3-88 Release Proposal.

Syn3-88 most closely resembles Pennncross. Syn3-88 may be distinguished from Pennncross by the following characteristics:

1. Syn3-88 has a shorter flag leaf length than Pennncross (Exhibit C).
2. Syn3-8 has significantly better turf performance in California, Georgia, Tennessee and Texas than Pennncross (Tables 9-25 - Syn3-88 Release Proposal).
3. Syn3-88 has significantly darker green color than Pennncross, SR1020, and Cobra in Atlanta, GA trials (Table 20c - Syn3-88 Release Proposal).
4. Syn3-88 has significantly different seed characteristics from Pennncross, including a percentage of obovate seed shape and length of basal hairs (Exhibit D).

Syn3-88 Creeping Bentgrass

Table 1. Morphological measurements determined in 1991 for bentgrasses measured near Tangent, Oregon.

Cultivar	Flag Leaf length		Plant Height		Anthesis Date
	-cm-	std*	-cm-	std*	
Astoria	8.4	3.0	47.3	15.0	30 June
Cobra	5.1	1.6	30.6	6.2	5 July
Exeter	7.7	2.1	44.9	14.2	3 July
Highland	8.9	3.8	48.4	12.7	29 June
Kingstown	5.9	2.5	38.5	10.7	3 July
National	4.2	1.1	27.8	5.4	7 July
Penncross	4.4	1.2	29.1	4.0	9 July
Penneagle	3.9	1.1	30.9	2.8	5 July
Pennlinks	4.6	1.3	29.3	8.4	8 July
Seaside	8.4	2.2	38.5	7.9	7 July
Southshore	4.0	1.1	26.3	5.6	7 July
Syn4-88	3.9	0.9	22.0	6.2	5 July
Syn3-88	4.0	1.3	29.3	11.1	5 July

\*std=Standard deviation

Table 2. Morphological measurements determined in 1992 for bentgrasses measured near Tangent, Oregon.

	Plant height --cm--	Flag leaf length ---mm-----	Panicle lengths -----mm---
Astoria	61.1a*	78.0b*	14.0b*
Cobra	52.9b	45.5de	8.3de
Exeter	62.3a	85.1b	14.3b
Highland	62.5a	97.8a	17.2a
Kingstown	50.2bc	41.5def	9.9c
National	44.5de	37.4efg	7.1fg
Penncross	48.4cd	35.2fg	7.5ef
Penneagle	44.2de	32.0gh	6.7fg
Pennlinks	44.4de	29.7gh	6.1gh
Seaside	62.5a	55.2c	10.0c
Southshore	44.2de	30.2gh	6.5fg
Syn4-88	44.6de	23.6h	5.2h
Syn3-88	43.9e	29.9gh	6.8fg

\*Means followed by the same letter are not significantly different using Waller/Duncan k ratio (k=100).

U.S. Department of Agriculture  
Agricultural Marketing Service  
Science Division  
Beltsville, Maryland 20705

OBJECTIVE DESCRIPTION OF VARIETY  
BENTGRASS (Agrostis spp.)

Name of Applicant(s) <u>MC Engelke &amp; VG Lehman</u>	Variety Name or Temporary Designation
Address (Street and No. or R.F.D. No, City, & ZIP Code) <u>17360 Coit Road</u> <u>Dallas, TX 75252-6499</u>	FOR OFFICIAL USE ONLY PVPO Number

Place numbers in the boxes (e.g. ) for the characters that best describe typical plants of this variety. The symbol  $\Delta$  indicates decimal.

COMPARISON VARIETIES FOR USE BELOW

1= Astoria 2= Exeter 3= Highland 4= Seaside 5= Penncross 6= Kingstown  
7= Astra 8= Other Penneagle 9= Cobra

1. SPECIES:

- ☒ 1= Colonial (browntop) A. tenuis 2= Creeping A. stolonifera (A. palustris)  
3= Velvet A. canina ssp. canina 4= Brown bent A. canina ssp. montana  
5= Red top A. gigantea

2. ADAPTATION: (0= Not Tested, 1= Not Adapted, 2= Adapted)

☒ Northeast ☒ Southeast ☒ North Central ☒ Pacific N. W.  
☒ Other (Specify) Japan

3. MATURITY (At first anthesis): Use comparison varieties

Days earlier than  , Maturity same as  ,  Days later than

4. HEIGHT (Average of longest 10 shoots from soil surface to top of head):

<input type="text" value="3"/> <input type="text" value="7"/> Cm Height (at maturity)	<input type="text" value="0"/> <input type="text" value="4"/> Cm Shorter than <input type="text" value="9"/>	} Comparison Variety
	Height same as <input type="text" value="8"/>	
<input type="text" value=""/> <input type="text" value=""/> Cm Taller than <input type="text" value=""/>		

5. GROWTH HABIT:

% Prostrate  % Decumbent  % Geniculate  % Erect

Bentgrass - 2 -

6. VEGETATIVE REPRODUCTION:

☐ Rhizomes 1= Absent 2= Present

☒ Stolons 1= Absent 2= Present

☐ % Rhizomes ☐ ☐ ☐ % Stolons

7. LEAF BLADE:

☒ Color: 1= Yellowish Green (Cohansey)  
3= Green (Exeter)  
5= Bluish Green (Highland)

2= Light Green (Washington)  
4= Dark Green (Kingstown, Tracenta)  
6= Other (Specify) \_\_\_\_\_

☒ Texture: (fineness)

1= Very fine (Kingstown)  
3= Medium fine (Astoria)  
5= Medium coarse (Virginia)

2= Fine (Exeter)  
4= Medium (Seaside)  
6= Coarse (Vermont)

☐ ☐ ☐ Stomatal density upper leaf surface (Number/mm<sup>2</sup>)

Lower Surface: ☐ ☐ ☐ % Smooth ☐ ☐ ☐ % Rough

Upper Surface: ☐ ☐ ☐ % Smooth ☐ ☐ ☐ % Rough

Margins: ☐ ☐ ☐ % Smooth ☐ ☐ ☐ % Rough

☐ Mm Width (Average of 10)

☐ Mm Narrower than ☐

Width same as ☐

☐ Mm Wider than ☐

Comparison

Variety

☐ Mm Width (Flag leaves)

☐ ☐ ☐ Cm Length (Flag leaves)

8. LEAF SHEATH:

☐ Anthocyanin: 1= Absent 2= Present

☐ ☐ ☐ % Red sheaths

9. LIGULE (Lower and middle leaves):

Shape at Apex: ☐ ☐ ☐ % Acute ☐ ☐ ☐ % Rounded ☐ ☐ ☐ % Truncate

☐ ☐ ☐ % Other (Specify) \_\_\_\_\_

Pubescence:

☐ ☐ ☐ % Glabrous ☐ ☐ ☐ % Pubescent

Margins:

☐ ☐ ☐ % Entire ☐ ☐ ☐ % Toothed

☐ ☐ ☐ % Other (Specify) \_\_\_\_\_

☐ ☐ ☐ Mm Length

## 10. LEMMA:

Shape: ☐4☐9 % Lanceolate ☐☐☐ % Ovate ☐0☐3 % Obovate☐4☐8 % Elliptic ☐☐☐ % Oblong ☐☐☐ % Other (Specify) \_\_\_\_\_

3779

☐☐ Mm Width

1 5279

☐☐ Mm Length (exclusive of awn)Color: ☐1☐3 % Buff ☐8☐7 % Silvery ☐☐☐ % Other (Specify) \_\_\_\_\_Surface: ☐9☐5 % Glossy ☐0☐5 % DullTexture: ☐1☐0☐0 % Smooth ☐☐☐ % PunctatePubescence: ☐1☐0☐0 % Glabrous ☐☐☐ % Sparse ☐☐☐ % CopiousBasal Hairs: ☐3☐6 % Absent ☐6☐4 % Few ☐☐☐ % Many☐6☐3 % Short ☐3☐7 % Long☐☐☐5 % Appressed ☐9☐5 % Ascending ☐☐☐ % SpreadingAwns: ☐9☐9 % Absent ☐0☐0☐1 % Few ☐☐☐ % Many☐☐☐ % Awn-pointed ☐☐☐ % Short ☐☐☐ % Long☐1☐0☐0 % Straight ☐☐☐ % Geniculate

Awn Insertion on Lemma:

☐☐☐ % Basal☐☐☐ % Middle ☐1☐0☐0 % Distal

## 11. PANICLE:

Type (in anthesis): ☐☐☐ % Open ☐☐☐ % CompactAnthocyanin: ☐7☐2 % Absent ☐2☐8 % PresentBranches in Anthesis: ☐☐☐ % Appressed ☐☐☐ % Ascending ☐☐☐ % SpreadingBranches in Fruit: ☐2☐8 % Appressed ☐7☐1 % Ascending ☐☐☐ % SpreadingBranch Surface: ☐☐☐ % Smooth ☐☐☐ % Scabrous

## 12. SEED:

0814

☐☐ Grams per 1000 seed

## 13. SPRING GREEN UP:

☐ 1- Early (Exeter) 2- Medium (Astoria) 3- Late (Kingstown)

Bentgrass - 4 -

14. ENVIRONMENTAL RESISTANCE: (0= Not tested, 1= Susceptible 2= Resistant)

☒ Cold ☒ Heat ☒ Drought ☐ Shade ☐ Other (Specify) \_\_\_\_\_

15. DISEASE RESISTANCE: (0= Not tested 1= Susceptible 2= Resistant):

- |   |   |
|---|---|
| <input type="checkbox"/> Red Leaf Spot - <u>Drechslera erythrospila</u>                             | <input type="checkbox"/> Helminthosporium Leaf Spot<br>( <u>Bipolaris sorokiniana</u> ) |
| <input type="checkbox"/> Melting Out - <u>Drechslera poae</u><br>( <u>Helminthosporium vagans</u> ) | <input checked="" type="checkbox"/> Dollar Spot - ( <u>Sclerotinia homoeocarpa</u> )    |
| <input checked="" type="checkbox"/> Pythium Blight - ( <u>P. aphanidermatum</u> )                   | <input checked="" type="checkbox"/> Pythium Blight ( <u>P. ultimum</u> )                |
| <input type="checkbox"/> Fusarium Blight ( <u>F. roseum</u> )                                       | <input type="checkbox"/> Fusarium Blight ( <u>F. tricinctum</u> )                       |
| <input type="checkbox"/> Fusarium Patch (Pink Snow Mold)<br>( <u>F. nivale</u> )                    | <input type="checkbox"/> Powdery Mildew ( <u>Erysiphe graminis</u> )                    |
| <input type="checkbox"/> Ophiobolus Patch ( <u>O. graminis</u> )                                    | <input type="checkbox"/> Stripe Smut ( <u>Ustilago striiformis</u> )                    |
| <input type="checkbox"/> Copper Spot ( <u>Gloeocercospora sorghi</u> )                              | <input type="checkbox"/> Typhula Blight (Snow Scald)<br>( <u>T. incarnata</u> )         |
| <input type="checkbox"/> Red Thread ( <u>Corticium fuciforme</u> )                                  | <input checked="" type="checkbox"/> Brown Patch ( <u>Rhizoctonia solani</u> )           |
| <input type="checkbox"/> Stem Rust ( <u>Puccinia graminis</u> )                                     | <input type="checkbox"/> Crown Rust ( <u>P. coronata</u> )                              |
| <input type="checkbox"/> Leaf Rust ( <u>P. poae-nemorale</u> )                                      | <input type="checkbox"/> Other _____  |

16. INSECT RESISTANCE (0= Not tested, 1= Susceptible, 2= Resistant):

- |  |   |
|--|---|
| <input type="checkbox"/> European Chafer<br>( <u>Amphimallon solstitialis</u> )            | <input type="checkbox"/> Garden Chafer<br>( <u>Phyllopertha horticola</u> ) |
| <input type="checkbox"/> Chinch Bug ( <u>Blissus insularis</u> )                           | <input checked="" type="checkbox"/> Webworm ( <u>Crambus</u> spp.)          |
| <input checked="" type="checkbox"/> Armyworm (Cutworm)<br>( <u>Pseudaletia unipuncta</u> ) | <input type="checkbox"/> Other _____  |

17. GIVE VARIETY(S) THAT MOST CLOSELY RESEMBLE THE SUBMITTED VARIETY: For the following characteristics indicate degree of resemblance (D.R.) with one of the following numbers: 1= Submitted variety is less than, lighter, or inferior to similar variety, 2= Same as, 3= More than, darker or superior, etc.

Character	Similar Variety	D.R.	Character	Similar Variety	D.R.
Growth Habit	SR1020	2	Leaf Color	SR1020	3 (Table
Aw Length			Panicle Type	Pennlinks	2
Seed Weight	Penncross	2	Turf Fineness		
Cold Resistance			Heat Resistance		
Drought Resistance			Shade Resistance		
Brown Patch					
Basil Hairs	Penncross	1			

18. COMMENTS:



Exhibit E. Statement of the Basis of Applicant's Ownership

Ownership of Syn3-88 by the Texas Agricultural Experiment Station (TAES) is based on the fact that unique selections were made at TAES facilities at Dallas, Texas. TAES personnel performed all selection and testing activities. Initial Breeder Seed production was accomplished in Tangent, Oregon under contract with the TAES turfgrass Breeders.

Syn3-88 Creeping Bentgrass

# CATO

## CREEPING BENTGRASS

### RELEASE PROPOSAL



Texas A&M University  
Research and Extension Center  
17360 Coit Road  
Dallas, TX 75025-6499

#### *Authors*

M.C. Engelke  
V.G. Lehman  
C. Mays  
P.F. Colbaugh  
J.A. Reinert  
W.E. Knoop

Associate Professor, Turfgrass Breeder, TAES-Dallas  
Turfgrass Breeder, Lebanon, OR  
Brookhollow Country Club, Dallas, TX  
Associate Professor, Plant Pathology, TAES-Dallas  
Professor, Entomology, TAES-Dallas  
Professor, Turf Extension Specialist, TAES-Dallas

CROP BentgrassType of Release Varietal

2. Proposed name or identification: CATO  
3. Designation or name in development stages: Syn4-88 or TAMU Syn88-4

4. Primary features or advantages: Cato is a six clone synthetic, selected for its superior quality, density of turf and general performance for bentgrass greens in southern regions of the transition zone as well as through out the regions of the country where creeping bentgrasses are used for turfgrasses. The variety, under development since 1984, has demonstrated superior performance in trials on golf courses and research plots across the United States in persistence and density of stand, genetic color, general competitive ability and more aggressive growth and persistence during summer months than Pennncross, or Pennlinks creeping bentgrasses which are the principle proprietary creeping bentgrass varieties presently in use in the same area. Cato has been tested in replicated trials in Costa Mesa, CA; West Palm Beach, FL; Atlanta, GA; Augusta, GA; Chattanooga, TN and Dallas, TX. Over 195 observations comparing numerous cultivars of creeping bentgrass for various agronomic and turf quality characters have been recorded since 1988. Cato was in the top statistical grouping (superior performance) 85.1% of the time as compared to Pennncross (68.2%), Pennlinks (73.3%) and SR1020 (84.1%) all having an equal number of observations (Table 25). Cato is reported to be moderately susceptible (Appendix - Colbaugh - Texas) to susceptible to *Rhizoctonia* blight (Appendix - Burpee - Georgia) and moderately tolerant to *Pythium* blight and to Dollar Spot (*Sclerotinia homeocarpa*). (Appendix - Colbaugh - Texas). Cato maintains summer density and persistence better than Pennncross (APPENDIX - Carrow - Georgia). Seed yield of Cato is approximately 600 pounds per acre for first year production, compared to Pennncross averaging 450 pounds in mature fields. Cato is presently being evaluated on 9 or more putting greens on 5 golf courses throughout the mid-west and Southern United States (Table 26).

5. Plant Variety Protection - suggested action: Application for Plant Variety Protection included. Plant material under evaluation in space plant nurseries in Oregon with the initial PVPA data submitted in the spring 1993, and the final data in the fall 1993.

6. Seed -- amount available and date: 1100 pounds of Experimental Seed Stock in April 1993. Full compliance with Oregon Certification of qualify as Foundation Seed Stocks. No additional seed stocks are available.

7. Provisions to maintain breeder seed: Approximately 50 pound of Breeder seed in cold storage (SNO-TEMP), Tangent, OR. Should be sufficient seed supply along with the Foundation grade seed stocks to maintain the variety.

8. Proposed seed distribution: Transfer Seed Stocks to single Licensee for marketing, production and distribution.

9. Suggested Fees (for Breeder or Genetic Stock): \$30,000\* License fee (or equivalent) plus sale of Foundation (\$10.00 per pound) and Certified seed stocks (\$6.00 per pound). All cost associated with the production of Foundation seed stocks (~\$5.00 per pound) were paid for by the USGA Bentgrass research grant for which cost recovery is requested to the project.

10. Supportive documents attached:

RELEASE PROPOSAL XXXX with appendix A - D  
CROP SCIENCE REGISTRATION XXXX  
AUTHORSHIP STATEMENT XXXX

PVP DOCUMENTS XXXX

- a. ORIGIN & BREEDING HISTORY XXXX
- b. NOVELTY STATEMENT XXXX
- c. OTHER INFORMATION XXXX
- d. OBJECTIVE DESCRIPTION XXXX
- e. OWNERSHIP STATEMENT XXXX

11. Release Proposal - prepared with or reviewed by: Drs. V. G. Lehman, P. F. Colbaugh, James A. Reinert, and W. E. Knoop.

Submitted by:

M. C. Engelke,  
Associate Professor  
Turfgrass Breeding, Genetics and Management

James A. Reinert  
Resident Director  
Texas A&M REC - Dallas

## CATO Creeping Bentgrass

**CATO** Creeping Bentgrass is a cool-season grass for golf putting greens and fairway surfaces, and other areas where high quality, closely mowed turf is desirable. Cato was developed and tested as Syn4-88 by the Texas Agricultural Experiment Station, Texas A&M University System in Dallas, Texas under grants from the United States Golf Association, and Bentgrass Research, Inc. Cato's area of adaptation and utility includes wherever Bentgrasses have been previously used, in addition to having strong adaptation to the Transition regions and Southern United States where bentgrasses have been marginally used in the past. Briefly, its merits and limitations are as follows:

### MERITS

- Six-clone Synthetic Variety
  - Broad genetic base
  - Uniformity of plant type,
  - Less tendency for segregation
- Persistent root system during summer stress periods
- Improved tolerance to summer heat and drought stress
- Erect growth habit
- Fine Texture
- Improved dark green color
- Tolerance to Dollar Spot (*Sclerotinia spp.*)
- High density during summer stress period
- Moderately tolerant to *Pythium* blight
- Excellent rate of recovery from Brown Patch

### LIMITATIONS

- Moderately susceptible to Brown Patch (*Rhizoctonia solani*).
- Intermediate germination rate

## RELEASE PROPOSAL 'CATO' CREEPING BENTGRASS<sup>3</sup>

M. C. Engelke, V. G. Lehman, C. Mays, P. F. Colbaugh, J. A. Reinert, and W. E. Knoop<sup>4</sup>

'Cato' creeping bentgrass (*Agrostis palustris* Huds.) was developed and released by the Texas Agricultural Experiment Station in April 1993. Cato was tested under the experimental designation of Syn4-88. Cato will be suitable for use as a cool-season turfgrass for putting surfaces and fairways throughout the usual area of adaptation of creeping bentgrass, with improved adaptation to the Southern Transition zone. Cato is a six-clone synthetic variety selected from an original 92 clone germplasm nursery.

The name 'Cato' was selected to recognize the late Paul Cato, Past President, Tournament Chairman, Greens Chairman, etc. of Colonial Country Club, Fort Worth and the founding father of Bentgrass Research, Inc (BRI) which was chartered in 1982 as a non-profit fund raising organization. BRI's research objectives include the development of bentgrasses which are better adapted to natural environmental conditions of the southern U.S. Mr. Cato passed away in August 1991 at the age of 51. Cato was selected by members of BRI as the name for one of the first bentgrasses developed with their support.

In spring 1985, 92 clones of creeping bentgrasses were vegetatively established and maintained on a modified sand base putting green. The replicated trial was subjected to close mowing, traffic and cultural practices typical to the Southern United States. These field trials were maintained and evaluated through 1988, with primary assessment on turf performance characters including visual quality, density, texture, color, growth habit, and persistence. Based on the first years data (1985) at Dallas, Texas, 50 of the most elite clones were established in a germplasm nursery in Tangent, Oregon to evaluate seed production potential. Six parental clones from these 50 genotypes were selected for polycross isolation following extensive evaluation for turf quality characters in Texas, as well as similarity for floral niching and plant type in Oregon during the 1986 and 1987 growing seasons. The parental clones were physically isolated in January 1988 in Oregon with the first seed harvest in August 1988. The parental clones designated at TAES-1198, TAES-1247, TAES-1252, TAES-2758, TAES-2761, and TAES-2897. Clones TAES-1247, TAES-1252, TAES-2758 and TAES-2761 were collected from old 'Seaside' greens at Brookhollow Country Club in Dallas in 1985. Clones 1198 and 2897 were collected in Michigan. Seed was harvested in August 1988 by maternal parent with an equal quantity of seed from each parent being bulked to form the pre-breeder seed. Experimental turf research plots were established in Georgia and Texas in fall of 1988 using the pre-breeder seed.

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<sup>3</sup>Cato was developed by the Texas Agricultural Experiment Station with partial funding from the United States Golf Association and Bentgrass Research, Inc.

Associate Professor, Turfgrass Breeding & Genetics (TAES); Turfgrass Breeder, Lofts Great Western Seed Co., Albany, OR (former Research Associate, TAES-Dallas); greens keeper, Brookhollow Country Club, Dallas, Texas, Associate Professor - Plant Pathology (TAES); Professor - Entomology and Resident Director (TAES); and Professor and Turf Extension Specialist (TAEX); Texas A&M Research and Extension Center, Dallas, Texas.

Approximately 2000 seedlings were established as transplants in a 0.13 ha breeder field in Oregon in January 1989. Additional roguing of the breeder field, for uniformity of plant type, flowering date, and seed yield was conducted during 1989 and 1990 resulting in the breeder stock of Cato (Generation 1).

Generation 1 (breeder seed) provided planting stock for production of Experimental seed Stocks where have been inspected, tested, tagged and qualified as seed stocks of Foundation Class (Generation 2), which in turn will be used to produce Registered or Certified Class (Generation 3). Either Registered or Certified seed can be used for the market class. Production from Foundation fields is limited to 3 years, after which the field may be downgraded to certified for an additional 3 years of production. Certified production is limited to no more than 7 years from date of planting to ensure genetic purity and integrity.

The six parental clones of Syn4-88 were evaluated under greenhouse conditions for morphological characters in 1985 (Table 1). The parents had high density with an aggressive spread rating, fine leaf type, with variable ligule lengths in comparison to the other 86 clones evaluated. Under field conditions, the parents were middle or higher in quality ratings across dates of evaluation as compared to the other 86 clones of bentgrass (Tables 2 and 3). Three of the parents were higher than 'Pennncross' in thatch accumulation when evaluated in 1987 under green conditions (Table 4). Four of the parental clones produced adequate levels of seed germination and seed yield when grown in Tangent, OR in a polycross nursery containing 50 clones (Table 5). The parental clones of Cato were evaluated to determine date of heading (Table 6), with all clones initiating heading within 17 days of each other. Five of the parents of Cato rated high in seedhead numbers when evaluated in Tangent, OR, 1987, with three of the clones having an aggressive spread rating (Table 7).

Plants measuring 25-30 cm in diameter with a 15 - 20 cm soil base were dug and transplanted into an isolated crossing block in January 1988. The crossing block was composed of two replications of each clone randomly placed to enhance cross pollination. Seed was harvested by maternal clone and later bulked in equal quantities from each clone to create the variety designated and tested as Syn4-88 and named 'Cato'.

Turf plots were established at Augusta, GA and Dallas, TX under putting green management in the fall of 1988 to compare Syn1-88, Syn3-88 and Syn4-88 with nine commercial cultivars. Seeding rate was 49 g are<sup>-1</sup>. Syn4-88 was in the lowest grouping of varieties relative to stand establishment in Dallas in 1988 (Table 8). Subsequent plantings have shown little differentiation in germination rate between Cato and other commercially available cultivars. Quality was rated from 1 to 9 with 9=best in the turf evaluations.

The accumulated performance of each entry is reflected in a parameter identified as Turf Performance Index (TPI). Turf Performance Index is defined as the frequency or the number of times the entry performed in the highest (best) statistical grouping regardless of the character measured. Beginning with the trials in Dallas, and at Augusta National Golf Course

(1988) to the present, several replicated turf trials across the country have provided collectively 195 separate turf quality evaluations and assessments of various agronomic attributes for Cato and several other experimental and commercial cultivars of creeping bentgrass (Tables 9 - 25). Observations were taken by TAES research personnel, scientists from other Universities and commercial companies, Golf Course Superintendents, Golf Professionals and interested turf industry personnel. Tables 9 - 14 summarize quality, rooting and tillering data collected on the creeping bentgrass variety trials established at TAES-Dallas in October 1988, and evaluated from 1988 to fall 1992. This constitutes 101 separate observations per entry for which Cato ranked in the highest statistical grouping 89.1% of the time (90 out of 101 evaluations). By comparison, Pennncross ranked in the highest statistical grouping (70) for 69.3%, Pennlinks (75) for 74.2% and SR1020 (84) for 83.2%.

Similar trials were established at Augusta National Golf Course, Augusta, GA in the fall of 1988 in cooperation with the golf superintendent and under the monthly supervision of Dr. Gil Landry, Turf Extension Specialist, University of GA. The trials were terminated prematurely by a new superintendent in the fall of 1991. Table 18 summarizes performance data from Augusta during the test period. Of the 18 quality observations taken, Cato was top of the class 11 times (61.1%) with Pennncross only 7 times (38.9%). The seasonal performance of Syn4-88 at Augusta was consistently superior to Pennncross, Pennlinks, which are standard commercial cultivars..

The National Turf Evaluation Program (NTEP) established replicated turf trials across the country in 1989,. Unfortunately due to an insufficient quantity of seed, Cato was included only in select trials, specifically in Florida at Banyan Golf Club, West Palm Beach and at TAES-Dallas. Quality and performance data for the NTEP trials at Dallas are summarized in Tables 15-17, and the Florida data is summarized in Table 19. In Florida, Cato was in the highest quality rating group and was not as susceptible to either Dollar spot (Sclerotinia spp.) and Pythium spp. disease as many other varieties. Disease pressure at the West Palm Beach, Florida test site may be considered extreme due to high ambient temperatures and relative humidity.

Additional trials have been established at the Atlanta Athletic Club, Atlanta, GA (Fall 1991) with the cooperation of Dr. Gil Landry, with data summarized to date in Table 20; and in two separate trials at the Honors Course near Chattanooga, TN with the cooperation of David Stone, Golf Course Superintendent. Tennessee data is summarized in Tables 21 thru 23; and at Mesa Verda Country Club, Costa Mesa, CA with the cooperation of Reed Yenny, Golf Course Superintendent and USGA Agronomist Paul Vermeulen (Fall 1992) with data summarized to date in Table 24.

In summary, Cato has been tested in replicated trials in Costa Mesa, CA; West Palm Beach, FL; Atlanta, GA; Augusta, GA; Chattanooga, TN and Dallas, TX. Over 195 observations comparing numerous cultivars of creeping bentgrass for various agronomic and turf quality characters have been recorded since 1988 (Table 25). Cato's Turf Performance

Index was 85.1 % as compared to the industry standards of Penncross at 68.2%, Pennlinks 73.3% and SR1020 84.1%. Cato is reported to range from moderately susceptible (Appendix - Burpee - Georgia) to susceptible to *Rhizoctonia* blight, moderately susceptible to *Pythium* blight, and tolerant to Dollar Spot (*Sclerotinia homeocarpa*) (Appendix - Colbaugh - Texas). Cato maintains summer density and persistence better than Penncross (Appendix - Carrow - Georgia). Seed yield of Cato approached 600 pounds per acre for first year production compared to Penncross averaging 450 pounds in mature fields..

Cato is genetically different from the other commercially available varieties, as illustrated by the performance data in this document. Breeder's seed, and Foundation Class seed stocks (1100 pounds) is available as of January 1993. There is no present field production of Cato.



Table 1. Greenhouse morphological characterization of parental clones<sup>1,2</sup> of Syn4-88, taken in the greenhouse 30 July 1985.

Accession TAES#	Origin	Density <sup>3</sup>	Growth <sup>4</sup>	Spread <sup>5</sup>	Spread <sup>6</sup>	Leaf <sup>7</sup>	Ligule <sup>8</sup>
			Type		Type	Width	Length
1198	MI	2	U	3	T	1.4	1.1
1247	TX	2	I	3	S	1.3	1.3
1252	TX	2	I	3	S	1.2	1.0
2758	TX	2	U	2	T	1.1	1.0
2761	TX	3	I	3	S	1.2	1.1
2897	MI	3	P	3	S/T	1.2	1.1

<sup>1</sup>Parental clone data extracted from analysis including 92 clones of original germplasm nursery with means separations from 'a' to 'z'.

<sup>2</sup>Non-replicated trial, but multiple measures per tray.

<sup>3</sup>Density rated 1-3, 3=best.

<sup>4</sup>Growth type where P=prostrate, U=upright, I=intermediate.

<sup>5</sup>Spread rated 1-3, 3=most.

<sup>6</sup>Type of spread, T=Tillers, S=Stolons.

<sup>7</sup>Leaf width, mean of 3 leaf widths.

<sup>8</sup>Ligule, mean of 3 ligule lengths.

Table 2. Mean quality under putting green conditions at TAES-Dallas of Syn4-88 parental clones, 1985-1986.<sup>1</sup>

Day of Year, 1986							
TAES#	Jan08-85	Jan17-86	Mar09-86	Apr20-86	Ma25-86	Ju23-86	Mean
Quality 1-9, 9= best							
1198	3.0 fg	5.5 b-g	7.0 a-d	6.5 a-e	7.5 a-d	5.0 f-l	6.3 m-u
1247	8.0 ab	5.5 b-g	8.5 a	8.5 a	9.0 a	8.5 ab	8.0 ab
1252	6.0 a-f	5.5 b-g	7.0 a-d	7.0 a-d	8.0 a-d	7.0 b-e	7.1 a-j
2758	5.0 a-g	7.5 abc	6.5 a-e	6.5 a-e	8.0 abc	6.4 h-u	.
2761	2.5 fg	6.5 a-e	6.0 a-e	6.5 a-e	5.5 e-h	7.0 b-d	5.6 r-z
2897	4.5 b-g	7.5 abc	8.0 ab	8.5 a	7.5 a-d	7.5 a-d	6.6 e-q
Range	2.0-8.5	1.0-8.5	8.5-3.0	2.5-8.5	2.0-9.0	1.0-9.0	2.4-9.0
Pennncross	.	.	5.5	7.0	8.0	.	.

<sup>1</sup>Parental clone data extracted from analysis including all 92 clones with mean separations from 'a' to 'z'.

\*Means followed by an 'a' were in the highest statistical grouping using the Waller/Duncan k ratio t test (k ratio = 100). ns = nonsignificant.

Table 3. Mean quality under putting green conditions at TAES- Dallas of Syn4-88 parental clones, 1987-1988.<sup>1</sup>

Accession	DATE	
	1987	1988
TAES#	Mean	Mean
	----- Quality (1-9, 9=best) ----	
1198	5.3 ab <sup>2</sup>	6.0 b-f
1247	7.0 a	7.5 abc
1252	6.3 ab	7.5 abc
2758	4.3 ab	7.5 abc
2761	5.0 ab	7.0 a-d
2897	5.2 ab	7.0 a-d
Range	1.6-7.2	1.5-8.0
Penncross	5.3 ab	5.0 d-h

<sup>1</sup>Means followed by an "a" letter are not significantly different using the Waller/Duncan k ratio t test (k=100).

Table 4. Mean depth and weight of thatch layer of parental clones of Syn4-88 taken 17 June 1987 from a 20 mm by 77 mm soil slice at TAES-Dallas.<sup>1</sup>

TAES#	Thatch, Slice	Thatch, Weight
	--mm--	--mg--
1198	7.8	14.8
1247	9.0 a <sup>2</sup>	15.5 a
1252	8.0	14.3
2758	10.0 a	16.0 a
2761	9.5 a	16.0 a
2897	.	.
Range	5.3-10.0	13.3-16.5
Penncross	7.8	15.0 a

<sup>1</sup>Means followed by an 'a' were in the highest statistical grouping at the k=100 level using the Waller/Duncan k ratio t test.

Table 5. Germination and seed yield of the parental clones of Syn4-88, grown in Tangent, OR, 1986.<sup>1</sup>

Accession TAES#	Germination <sup>2</sup> --Percent--	Seed yield <sup>3</sup> --g/plant--
1198	85	0.54
1247	80	3.60
1252	71	2.40
2758	65	4.40
2761	57	3.89
2897		.
Range	50-91	0.0-6.83

\*Three petri plates of 100 seeds counted after 7 days of hydration.  
One application of Subdue for *Pythium* sp. control.

\*\*Mean seed yield per plant with three plants per treatment.

Table 6. Mean heading date of parental clones of Syn4-88, by replication in Tangent, OR, in 1987.

Accession TAES#	Replication		
	I	II	III
	----- month - day -----		
1198	6-12	6-15	6-14
1247	6-9	5-28	6-3
1252	6-6	6-5	5-29
2758	6-4	6-1	5-28
2761	6-6	6-3	6-4
2897	6-12	6-14	6-12

Table 7. Mean seedhead, spread and growth habit (9=erect) rating of parental clones of Syn4-88 at Tangent, OR, in 1987.

Accession	Seedhead	Spread	Growth Habit
TAES#	----- Rating 1-9, 9=best -----		
1198	5.0	6.3 a	6.0 a
1247	7.3 a	5.7	2.3
1252	7.7 a	5.0	2.3
2758	9.0 a	6.3 a	2.3
2761	6.7 a	4.3	2.3
2897	8.0 a	7.7 a	4.0
Range	0.0-9.0	1.7-9.0	1.0-8.3

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan k ratio t test (k ratio=100). ns = nonsignificant.

Table 8a. Percent stand and quality ratings of Syn1-88, Syn3-88, Syn4-88 and nine cultivars of creeping bentgrass. Seed of each was planted at a rate of 1 lb./1000 sq. ft. on 31 Oct. 1988 in a randomized complete block design with four replications.

Cultivar	Date				
	9 Nov.	5 Dec.	19 Dec.	26 Dec.	3 Jan.
	--% STAND--				
Syn1-88	13.8 a*	22.5	18.8	28.8 a	62.5
Syn3-88	13.5	10.0	14.3	18.8	48.8
Syn4-88	2.3	2.0	5.5	12.5	26.3
National	23.7 a	33.8 a	28.8 a	35.0 a	80.0 a
Provident	11.0	6.5	13.8	21.3	46.3
Putter	8.8	9.3	13.8	22.5	55.0
Pennncross	8.0	16.3	19.3	27.5 a	57.5
Cobra	5.3	5.5	10.5	16.3	45.0
SR1020	4.3	8.0	12.5	13.8	40.0
PSU-126	3.3	5.3	8.8	13.8	30.0
Southshore	3.0	3.5	11.0	12.5	35.0
Seaside	1.0	10.0	14.5	26.3	57.5

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan k ratio t test (k ratio=100). ns = nonsignificant.

Table 8b. Leaf blade width of Syn1-88, Syn3-88, Syn4-88 and nine cultivars of creeping bentgrass established at TAES-Dallas, TX in Oct. 1988 with measurements Oct. 1989 and Mar. 1990.

Cultivar	Leaf Blade Width	
	-----Date-----	
	Oct. 1989	March 1990
	--mm--	
Syn1-88	0.87 <sup>ns</sup>	1.03 a
Syn3-88	0.79	0.96 a
Syn4-88	0.85	0.90
Cobra	0.89	0.91 a
National	0.90	0.96 a
Pennncross	0.85	0.98 a
Pennlinks	0.87	1.02 a
Provident	0.90	0.93 a
Putter	0.87	0.91 a
Seaside	0.91	1.03 a
Southshore	0.85	1.01 a
SR1020	0.81	0.90

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan k ratio t test (k ratio=100). ns = nonsignificant.

Table 9a. Quality ratings of Syn1-88, Syn3-88, Syn4-88 and nine cultivars of creeping bentgrass by independent evaluators, from the variety trials at TAES-Dallas, TX established in 1989.

Cultivar	Evaluator								
	SG	RH	RH	SO	RW	DH	SM	WT	MM
	Date								
	3-1	3-29	3-30	4-3	4-4	4-7	5-31	6-20	6-20
	Quality 1-9, 9 = best								
Syn1-88	7.3 a	5.3 a	5.3	5.6 a	6.5 a	6.0	3.8	7.2 a	6.0
Syn3-88	4.5	6.5 a	7.5 a	5.6 a	7.0 a	7.8 a	8.0 a	7.7 a	7.8 a
Syn4-88	3.8	6.0 a	6.8 a	5.3 a	7.5 a	7.3 a	7.0 a	7.7 a	8.0 a
Cobra	4.3	5.0	5.3	5.0	5.3	6.8 a	6.3	7.7 a	6.8
National	5.0	3.3	4.0	5.0 a	4.3	6.0	4.5	7.4 a	4.9
Pennncross	6.8 a	5.8 a	6.3 a	5.9 a	6.0 a	6.8 a	5.0	7.3 a	6.4
Pennlinks	3.5	5.0	5.5	4.8 a	5.0	6.5 a	6.3	7.1 a	7.4 a
Provident	4.5	6.0 a	6.8 a	5.3 a	6.3 a	7.0 a	7.3 a	7.2 a	7.1 a
Putter	2.3	4.3	5.0	4.3	1.0	4.8	2.0	7.3 a	7.8 a
Seaside	3.5	3.5	4.0	4.6 a	3.8	6.5 a	2.8	7.0	4.5
Southshore	4.0	5.0	6.5 a	5.4 a	5.8	6.3	4.5	7.3 a	6.3
SR1020	6.0 a	5.5 a	6.3	5.8 a	5.8	7.5 a	7.8 a	7.5 a	7.3 a

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan multiple comparison procedures (k ratio=100). ns = nonsignificant.

Table 9b (cont.) Quality ratings of Syn1-88, Syn3-88, Syn4-88 and nine cultivars of creeping bentgrass by independent evaluators, from the variety trials at TAES-Dallas, TX, were established in 1989.

Cultivar	Evaluator									
	PM	DN	TD	BC	KS	DD	SS	JB	WB	MS
	Date									
	7 -12	7-12	8-27	9-8	9-8	9-8	9-8	10-4	10-4	10-4
	Quality 1-9, 9 = best									
Syn1-88	5.1	5.5	4.3 a	8.3 a	8.3 a	8.0 a	8.3 a	7.8 a	6.8 a	7.8 a
Syn3-88	6.8 a*	8.0 a	3.3	8.0 a	8.0 a	8.0 a	7.5 a	3.8	3.0	5.3
Syn4-88	7.0 a	7.8 a	3.0	8.5 a	8.5 ab	8.0 a	7.3 a	5.3	4.8	6.8 a
Cobra	4.9	5.5	3.8 a	8.3 a	8.3 a	7.3 a	7.3 a	5.3	4.3 a	5.5
National	5.1	4.8	4.8 a	8.0 a	8.0 a	8.0 a	8.5 a	7.3 a	6.5 a	7.3 a
Pennncross	4.9	5.5	4.3 a	8.0 a	8.0 a	7.0 a	7.3 a	5.5	4.5 a	6.0 a
Pennlinks	6.0 a	6.8	3.8 a	8.0 a	8.0 a	7.5 a	7.0 a	5.8	4.3 a	6.3 a
Provident	5.6	6.5	3.5	8.3 a	8.3 a	7.0 a	7.5 a	4.5	2.8	5.8 a
Putter	4.3	6.8	3.3	8.5 a	8.5 a	8.0 a	8.3 a	5.5	4.0 a	6.8 a
Seaside	3.0	4.3	5.0 a	7.3	7.3	7.0 a	7.8 a	6.0 a	5.3 a	7.0 a
Southshore	5.8	5.5	4.3 a	7.3	7.3	7.3 a	7.3 a	5.5	3.8 a	5.8 a
SR1020	6.3 a	7.0	2.8	8.5 a	8.5 a	7.8 a	7.5 a	4.0	1.8	4.5

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan k ratio t test k ratio=100). ns = nonsignificant.

TPI=Turf Performance Index = number of occurrences a genotype was in top quality group for each date.

Table 10a. Turf quality ratings of Syn1-88, Syn3-88, Syn4-88 and eight cultivars of creeping bentgrass by multiple observers on June 5, 1990, from the Variety trials at TAES-Dallas, TX, were established in 1988.

Cultivar	bar	eng	gas	jar	kac	Evaluators		plc	ptr	rhw	snw	mek	TPI <sup>1</sup>
						mor	mtn						
						Quality 1-9, 9 = best							
Syn1-88	6.5 a*	6.5 a	5.0 a	7.5 ns	6.0 ns	5.5	7.3 ns	5.0 a	6.3 a	4.5	6.8 a	6.0 a	10
Syn3-88	6.8 a	7.0 a	6.0 a	7.0	6.8	6.0 a	7.0	5.3 a	6.8 a	7.0 a	7.5 a	6.5 a	12
Syn4-88	7.0 a	6.8 a	6.0 a	8.3	7.3	5.8 a	7.5	7.0 a	6.5 a	6.5 a	7.8 a	7.8 a	12
Cobra	6.5 a	6.3 a	5.0 a	7.0	6.5	5.5	6.8	6.3 a	6.3 a	5.3	7.3 a	6.0 a	9
National	5.0	5.3	5.2 a	6.5	6.2	5.2	6.8	4.3	5.3	4.0	5.7	5.5	4
Pennncross	6.5 a	6.3 a	5.0 a	7.8	6.0	5.0	6.5	5.3 a	6.5 a	4.8	6.3	5.5	8
Pennlinks	6.0 a	6.3 a	5.0 a	6.8	5.5	5.8 a	7.3	4.5	6.0 a	6.3 a	7.0 a	5.5	10
Provident	6.8 a	7.3 a	6.3 a	7.0	5.8	6.0 a	6.5	6.0 a	5.8 a	6.5 a	7.5 a	6.8 a	12
Putter	7.0 a	6.5 a	5.5 a	8.4	6.3	6.3 a	7.3	6.8 a	6.5 a	6.8 a	7.0 a	7.0 a	12
Seaside	4.5	6.2 a	4.5	6.8	5.8	5.5	6.5	3.7	5.5	4.5	5.7	4.8	4
SR1020	7.3 a	7.3 a	5.3 a	7.4	7.3	6.5 a	7.8	7.0 a	7.3 a	7.5 a	8.0 a	7.0 a	12

Table 10b. (Cont.) Turf quality ratings of Syn1-88, Syn3-88, Syn4-88 and eight cultivars of creeping bentgrass by multiple observers on Sep. 26, 1990.

Cultivar	bar	oli	crd	Evaluators		ots	tmh	TPI
				cm	jsa			
Quality 1-9, 9 = best								
Syn1-88	5.5 a*	5.0 a	5.3 a	7.0 a	4.8 a	4.0 a	4.5 a	7
Syn3-88	6.0 a	6.0 a	7.3 a	7.3 a	6.0 a	5.3 a	5.3 a	7
Syn4-88	4.8 a	4.8 a	5.0 a	6.5 a	5.0 a	3.5	4.0 a	6
Cobra	5.3 a	5.3 a	6.0 a	6.8 a	5.3 a	4.0 a	4.5 a	7
National	4.3 a	4.5 a	6.0 a	6.0	2.8	4.3 a	4.3 a	5
Pennncross	4.3 a	3.8	4.5	5.8	4.2 a	3.8 a	4.2 a	4
Pennlinks	4.8 a	4.8 a	4.5	6.8 a	4.3 a	3.5	4.3 a	5
Provident	4.8 a	5.3 a	5.0 a	6.3	5.0 a	3.8 a	4.0 a	6
Putter	3.8	4.3 a	5.0 a	6.3	3.8 a	3.8 a	4.5 a	5
Seaside	4.0 a	5.0 a	5.5 a	6.5 a	4.2 a	3.8 a	5.3 a	7
SR1020	3.5	4.3 a	4.5	6.0	3.3	3.5	3.0 a	2

Table 10c. (Cont.) Turf quality ratings of Syn1-88, Syn3-88, Syn4-88 and eight cultivars of creeping bentgrass by multiple observers on Nov. 16, 1990.

Cultivar	bar	eng	Evaluators		stp	wer	TPI
			gbm	jar			
			Quality 1-9, 9 = best				
Syn1-88	2.8 a*	5.0 a	3.8 a	5.8 a	5.0 a	6.0 a	6
Syn3-88	4.3 a	6.8 a	5.3 a	7.0 a	6.0 a	5.8 a	6
Syn4-88	3.5 a	6.3 a	4.8 a	5.9 a	4.3 a	5.8 a	6
Cobra	3.5 a	5.5 a	4.8 a	6.5 a	5.3 a	6.0 a	6
National	4.0 a	6.2 a	4.0 a	6.3 a	5.3 a	5.3 a	6
Penncross	3.0 a	5.0 a	3.8 a	5.9 a	5.0 a	5.5 a	6
Pennlinks	2.5 a	5.3 a	3.8 a	5.0 a	4.0 a	4.8 a	6
Provident	3.3 a	5.0 a	3.5 a	5.8 a	3.5 a	5.5 a	6
Putter	2.8 a	4.8 a	3.5 a	4.5 a	4.0 a	5.0 a	6
Seaside	3.3 a	5.5 a	4.2 a	6.4 a	4.7 a	5.3 a	6
SR1020	3.0 a	5.5 a	3.5 a	5.4 a	4.3 a	5.3 a	6

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan multiple comparison procedures (k ratio=100). ns = nonsignificant.

TPI = Turf Performance Index is the number of occurrences a genotype was in the top statistical group.

Table 10d. Accumulative Turf Performance Index (TPI) rating from multiple evaluators during 1990 for the Variety Trials at TAES-Dallas, TX.

	Date of Observation			Total
	Jun05	Sep26	Nov16	
(Max # observations)	12	7	6	25(max)
Syn1-88	10	7	6	23
Syn3-88	12	7	6	25
Syn4-88	12	6	6	24
Cobra	9	7	6	22
National	4	5	6	15
Penncross	8	4	6	18
Pennlinks	10	5	6	21
Provident	12	6	6	24
Putter	12	5	6	23
Seaside	4	7	6	17
SR1020	12	2	6	20

TPI = Turf Performance Index is the number of occurrences a genotype was in the top statistical group.



Table 11a. Quality ratings of Syn1-88, Syn3-88, Syn4-88 and nine cultivars of creeping bentgrass, TAES-Dallas, TX, for 1989 TAES-researchers.

1989 Observations													
Cultivar	Jan28	Jan29	Mar30	Apr27	Jun11	Jun28	Jul21	Aug22	Sep26	Oct23	Nov25	Dec03	TPI
Quality 1-9, 9 = best													
Syn1-88	6.8 a	7.8 a	5.3	3.5	3.5	5.5	4.3	5.9 a	7.1 a	5.4 a	4.8 a	6.0ns	7
Syn3-88	7.3 a	7.3 a	7.5 a	7.5 a	7.5 a	8.0 a	6.8 a	6.8 a	6.1 a	6.7 a	6.8 a	5.5	12
Syn4-88	4.2	6.8 a	5.3	7.0 a	7.0 a	8.5 a	6.3 a	6.3 a	4.5	6.8 a	6.8 a	7.0	9
Cobra	4.5	6.3 a	5.3	5.3	5.3	6.0	5.0	4.9 a	5.6 a	4.3	4.8 a	5.8	5
National	4.8	6.0 a	3.5	3.0	3.0	3.5	3.0	4.8 a	5.9 a	4.0	3.5	4.8	4
Pennncross	6.8 a	6.8 a	5.3	4.5	4.5	4.8	4.0	3.3	4.5	4.3	5.0 a	5.3	4
Pennlinks	5.0	5.8 a	5.3	5.5	5.5	6.8	5.0	4.5	5.9 a	6.3 a	5.0 a	5.5	5
Provident	6.0 a	7.3 a	5.5	6.0	6.0	7.8 a	5.5	5.8 a	5.4 a	5.0	5.8 a	6.0	7
Putter	3.5	4.5	3.8	3.5	3.5	4.5	5.3	5.4 a	5.3 a	6.1 a	5.8 a	6.5	5
Seaside	4.5	6.3 a	3.3	2.0	2.0	3.3	2.5	3.1	4.1	2.8	2.8	3.8	2
Southshore	4.5	6.0 a	5.3	4.5	4.5	4.3	4.0	2.8	3.5	3.8	4.5 a	4.0	3
SR1020	5.0	6.3 a	5.8 a	7.0 a	7.0 a	8.3 a	6.3 a	5.0 a	4.8	5.5 a	5.3 a	4.0	10

Table 11b (Cont.) Quality ratings of Syn1-88, Syn3-88, Syn4-88 and nine cultivars of creeping bentgrass, TAES-Dallas, TX, for 1990, by TAES researchers.

1990 Observations						
Cultivar	Jan27	Feb13	Mar16	Apr04	May01	TPI
Quality 1-9, 9 = best						
Syn1-88	7.0 a	6.8 a	6.1 a	4.0	4.4	3
Syn3-88	6.3 a	6.8 a	6.5 a	5.8 a	6.3 a	5
Syn4-88	6.8 a	6.5 a	5.1 a	5.5 a	6.4 a	5
Cobra	5.0	5.8 a	4.8 a	5.8 a	4.5	3
National	5.5	4.3	3.5	3.6	3.9	0
Pennncross	5.3	6.3 a	5.5 a	4.9 a	5.6 a	4
Pennlinks	6.3 a	5.8 a	5.6 a	5.6 a	5.8 a	5
Provident	6.3 a	6.8 a	7.0 a	6.5 a	7.1a	5
Putter	7.5 a	7.0 a	6.1 a	5.4 a	6.9 a	5
Seaside	3.3	3.8	4.3	3.6	4.0	0
Southshore	5.0	6.3 a	5.4 a	4.4	4.6	2
SR1020	6.0 a	6.8 a	5.0 a	5.9 a	6.1 a	5

Table 11c (Cont.) Quality ratings of Syn1-88, Syn3-88, Syn4-88 and nine cultivars of creeping bentgrass, TAES-Dallas, TX, for 1991, by TAES researchers.

Cultivar	Jun04	Sep26	1991 Observations		Dec31	TPI
			Oct18	Nov24		
			Quality 1-9, 9 = best			
Syn1-88	7.3ns	4.3ns	5.3 a	5.0 a	5.0 a	5
Syn3-88	5.8	5.5	6.0 a	6.0 a	5.5 a	5
Syn4-88	6.0	6.8	4.5 a	5.5 a	5.3 a	5
Cobra	6.5	5.5	5.0 a	4.7 a	5.2	4
National	6.0	5.7	5.0 a	4.2	4.2	3
Penncross	5.2	6.2	3.7	4.2	4.5	2
Pennlinks	4.2	4.2	4.0	4.7 a	4.0	3
Provident	5.2	6.2	5.2 a	5.2 a	5.0 a	5
Putter	6.2	6.5	4.2 a	5.0 a	5.0 a	5
Seaside	5.5	5.5	5.3 a	5.0 a	4.2	4
Southshore	5.2	4.5	4.0	4.0	3.7	2
SR1020	5.5	6.5	6.0 a	5.2 a	5.2 a	5

Table 11d. (Cont.) Turf Quality notes on Creeping Bentgrass Variety Trials - TAES-Dallas, TX, for 1992 by TAES researchers. Established Oct. 1988.

Cultivar	Jan31	Feb28	Aprl	1992 Observations		Jul01	Aug01	Sep01	TPI
				May1	Jun6				
				Quality 1-9,9 = best					
Syn1-88	5.3	6.3	6.0	5.8	4.5	4.5 <sup>ns</sup>	5.8 <sup>ns</sup>	5.0	3
Syn3-88	5.0	6.3	7.3 a	7.3 a	6.8 a	4.5	6.8	7.0	7
Syn4-88	6.0	6.8 a	7.0 a	7.0 a	6.0 a	5.5	5.5	5.0	7
Cobra	6.0	6.7 a	6.7 a	6.0	5.5 a	5.0	6.0	5.7	6
National	5.5	6.5 a	5.7	5.7	5.2 a	4.5	5.7	5.0	3
Penncross	5.0	6.2	6.5 a	5.7	5.7 a	4.2	5.5	5.5	3
Pennlinks	5.2	6.0	6.2	5.7	5.7 a	5.0	5.5	4.7	2
Providence	6.0	7.0	7.0 a	6.5 a	5.0	5.7	5.7	5.2	6
Putter	5.5	6.5 a	6.5 a	6.7 a	5.2 a	5.2	6.5	5.0	7
Seaside	5.0	6.0	6.5 a	6.2 a	5.5 a	4.7	6.0	5.2	6
Southshore	5.0	6.0	6.0	5.2a	4.7	4.7	5.5	4.7	4
SR1020	6.2	6.7 a	7.0 a	7.0 a	5.5 a	5.0	5.7	4.7	7

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan multiple comparison procedures (k ratio=100). ns = nonsignificant.

TPI = Turf Performance Index is number of occurrences a genotype was in top quality group for each date.

Table 11e. Accumulative Turf Performance Index Scores for Creeping Bentgrass Variety Trials - TAES - Dallas, TX.  
Established Nov. 1989.

Cultivar	1989	1990	1991	1992	Total
Syn1-88	7	3	5	3	18
Syn3-88	12	5	5	7	29
Syn4-88	9	5	5	7	26
Cobra	5	3	4	6	18
National	4	0	3	3	10
Penncross	4	4	2	3	15
Pennlinks	5	5	3	2	18
Providence	7	5	5	6	23
Putter	5	5	5	7	22
Seaside	2	0	4	6	12
Southshore	3	2	2	4	11
SR1020	10	5	5	7	27

TPI = Turf Performance Index is number of occurrences a genotype was in top quality group for each date.

Table 12. Mean quality ratings of Syn1-88, Syn3-88, Syn4-88 and nine cultivars of creeping bentgrass, TAES-Dallas, TX, 1989, by 22 participants in the USGA summer research meetings.

Cultivar	Rating
	Quality 1-9, 9 = best
Syn1-88	5.8
Syn3-88	5.7
Syn4-88	6.7 a
Cobra	5.4
National	5.3
Pennncross	5.1
Pennlinks	5.4
Provident	4.8
Putter	6.0
Seaside	3.9
Southshore	5.1
SR1020	5.6

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan multiple comparsion procedures (k ratio=100).  
ns = nonsignificant.

Table 13a. Tiller counts on Creeping Bentgrass Variety Trials - TAES - Dallas, TX. Trials established Oct. 1988. Observations during October 1989 and Mar. 1990.

Cultivar	Tiller number Date		TPI
	Oct. 1989	March 1990	
Syn1-88	17.0	39.2	0
Syn3-88	19.3	49.7 a	1
Syn4-88	23.3 a	42.8	1
Cobra	17.2	38.8	
National	16.4	34.5	
Pennncross	16.7	38.7	
Pennlinks	21.7 a	47.3 a	2
Provident	19.8	51.3 a	1
Putter	18.7	45.2	
Seaside	15.0	28.6	
Southshore	14.1	33.5	
SR1020	18.7	51.7 a	1

Table 13b. (Cont.) Tiller counts on Creeping Bentgrass Variety Trials - TAES - Dallas, TX. Trials established November 1989. 1991 observations.

Cultivar	Date of Observation 1991							TPI
	May17	Jun24	Aug 09	Sep05	Oct10	Nov11	Dec13	
Syn1-88	68.2 <sup>ns</sup>	34.8	58.5 <sup>ns</sup>	53.0 <sup>na</sup>	68.8 <sup>ns</sup>	63.8 <sup>ns</sup>	44.0 a	6
Syn3-88	83.0	52.0 a	53.0	65.8	80.0	70.2	42.0 a	7
Syn4-88	75.5	50.2 a	49.0	66.8	74.0	61.8	47.5 a	7
Cobra	62.7	34.5	51.0	55.2	61.5	56.2	40.7 a	6
National	74.5	30.0	52.7	56.5	58.7	57.7	27.5	5
Pennncross	62.0	39.5 a	53.0	61.2	47.5	63.2	43.7 a	7
Pennlinks	68.7	34.0	69.7	64.2	65.2	68.2	30.7	5
Providence	73.0	34.2	55.7	61.5	70.2	63.2	37.5 a	6
Putter	74.5	35.0 a	58.2	58.0	58.5	62.2	41.0 a	7
Seaside	64.7	46.2 a	44.7	58.5	62.7	51.7	41.7 a	7
Southshore	54.0	31.7	58.7	57.0	56.0	62.2	36.2 a	6
SR1020	75.7	44.7 a	65.2	66.7	66.5	59.2	43.2 a	7

Table 13c. (Cont.) Tiller counts on Creeping Bentgrass Variety Trials - TAES - Dallas, TX. Trials established Nov. 1989. 1992 observations.

Cultivar	Date of Observation (1992)								TPI
	Jan14	Feb11	Mar19	Apr24	May21	Jun25	Jul24	Aug26	
Syn1-88	40.5 <sup>ns</sup>	51.5 <sup>ns</sup>	27.8 <sup>ns</sup>	34.2 <sup>ns</sup>	34.8 <sup>ns</sup>	41.0 <sup>ns</sup>	46.8 <sup>ns</sup>	57.0 <sup>ns</sup>	8
Syn3-88	41.8	48.8	31.0	37.5	35.8	44.2	40.3	61.0	8
Syn4-88	39.0	51.8	39.5	38.5	35.8	42.2	39.5	66.3	8
Cobra	36.2	44.7	31.0	39.7	34.5	43.7	43.7	50.7	8
National	41.7	46.7	29.0	36.5	36.2	43.0	39.7	52.7	8
Pennncross	42.2	51.0	29.5	35.7	33.7	32.7	40.5	64.5	8
Pennlinks	42.7	51.5	33.7	38.2	33.5	39.7	38.0	59.7	8
Providence	39.2	56.0	27.7	41.2	32.7	44.2	38.7	59.2	8
Putter	34.8	54.9	30.2	36.0	34.2	43.0	38.2	48.7	8
Seaside	41.5	50.5	29.7	39.2	33.2	43.2	35.0	58.0	8
Southshore	35.0	51.7	28.7	33.7	37.7	45.0	42.0	47.0	8
SR1020	40.5	54.5	34.2	43.7	34.2	42.0	32.7	54.2	8

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan multiple comparison procedures (k ratio=100). ns = nonsignificant.

TPI = Turf Performance Index is the number of occurrences a genotype was in the top statistical group.

Table 13d. (Cont.) Accumulative Turf Performance Index (TPI) Ratings from tiller counts from 1989 through 1992 for the Variety Trials at TAES - Dallas, TX.

Max # of observations	Years of Observations			
	89/90 2	91 7	92 8	Total 17
Syn1-88	0	6	7	13
Syn3-88	1	7	7	15
Syn4-88	1	7	7	15
Cobra	0	6	7	13
National	0	5	7	13
Pennncross	0	7	7	14
Pennlinks	2	5	7	14
Providence	1	6	7	14
Putter	0	7	7	14
Seaside	0	7	7	14
Southshore*	-	6	8	14
SR1020	1	7	7	15

Southshore established in 1990, first counts taken in 1991.

TPI = Turf Performance Index is the number of occurrences a genotype was in the top statistical group.

Table 14a. Root depths counts on Creeping Bentgrass Variety Trials - TAES - Dallas, TX. Established Oct. 1988. Syn3-88 and Syn4-88 were established in 1990.

Cultivar	1991 Observations						TPI
	Jun20	Aug05	Sep03	Oct10	Nov11	Dec13	
Syn1-88	10.6 <sup>ns</sup>	8.5 <sup>ns</sup>	5.9 <sup>ns</sup>	7.9 <sup>ns</sup>	8.6 <sup>ns</sup>	9.6 <sup>ns</sup>	
Syn3-88	9.4	8.6	5.1	7.0	8.6	7.3	6
Syn4-88	9.9	8.9	7.7	8.3	8.4	7.3	6
Cobra	11.2	8.3	6.5	7.7	8.4	9.6	6
National	8.0	8.2	6.4	8.0	10.3	8.4	6
Pennncross	10.5	7.6	7.2	7.7	8.4	7.6	6
Pennlinks	11.7	8.0	6.4	8.1	9.2	7.5	6
Providence	10.5	8.0	7.1	7.4	8.6	7.1	6
Putter	10.6	7.4	7.6	7.7	7.7	7.2	6
Seaside	9.3	8.0	6.4	6.9	8.2	6.7	6
Southshore	14.2	8.1	7.3	8.1	9.5	8.6	6
SR1020	11.7	7.0	5.7	6.2	8.5	7.7	6

Table 14b (Cont.) Root depths counts on Creeping Bentgrass Variety Trials - TAES - Dallas, TX.

Cultivar	1992 Observations								TPI	TPI
	Jan14	Feb11	Mar19	Apr23	May21	Jun25	Jul23	Aug26		
									<u>92</u>	<u>91-92</u>
Syn1-88	6.9 <sup>ns</sup>	6.9 <sup>ns</sup>	9.3 <sup>ns</sup>	8.6 <sup>ns</sup>	9.0 <sup>ns</sup>	8.9 <sup>ns</sup>	9.1 <sup>ns</sup>	6.1 <sup>ns</sup>	8	14
Syn3-88	6.4	6.4	7.6	6.7	7.4	8.1	8.8	7.7	8	14
Syn4-88	7.1	7.6	7.8	7.9	7.4	7.0	9.0	7.9	8	14
Cobra	6.9	8.4	8.8	8.7	8.4	7.1	9.5	8.6	8	14
National	7.0	7.5	8.5	8.2	9.0	9.4	10.1	7.9	8	14
Pennncross	6.7	6.6	6.8	7.8	7.7	8.1	8.8	9.9	8	14
Pennlinks	5.9	7.5	7.3	7.4	7.4	8.4	8.5	8.8	8	14
Providence	5.9	7.4	7.7	7.1	7.6	9.7	9.4	8.7	8	14
Putter	7.1	6.0	7.1	8.2	8.9	9.0	9.2	7.9	8	14
Seaside	5.5	6.3	7.3	8.8	8.0	7.7	10.0	8.6	8	14
Southshore	7.4	7.4	9.4	7.5	7.9	9.0	8.9	7.7	8	14
SR1020	6.9	7.1	7.3	7.6	8.1	8.9	8.5	8.9	8	14

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan multiple comparison procedures (k ratio=100). ns = nonsignificant.

TPI = Turf Performance Index is the number of occurrences a genotype was in the top statistical group.

Table 15. National Turfgrass Evaluation Program Creeping Bentgrass variety evaluation trials - TAES - Dallas, TX. Established Nov. 1990.

Cultivar	1991 Observation			1992							TPI
	May31	Dec31	Jan31	Feb29	Apr01	May01	Jun06	Jul01	Aug01	Sep01	
	Quality 1-9, 9 = best										91-92
Syn1-88	4.3	5.0	6.0a	5.7	6.3	6.0a	5.7	5.0	5.3	5.0	10
Syn3-88†	2.3	4.0	4.3	5.0	5.3	7.0	6.3	5.7	5.3	5.7	9
Syn4-88†	3.0	4.3	4.3	5.3	5.3	6.0a	6.7	5.3	5.3	5.0	9
BR1518	2.7	4.0	4.7	5.0	6.0	6.0	6.0	5.0	6.3	5.7	9
Carmen	2.3	4.7	4.3	5.0	6.3	6.7a	5.7	5.0	5.3	5.3	9
CBE	2.3	4.3	5.3a	5.7	6.3	6.7a	5.7	4.7	5.3	5.3	10
CBL	1.7	5.0	5.0	5.3	6.3	6.0a	6.3	5.7	6.0	5.7	10
Cobra	2.0	5.0	5.3a	5.3	6.7	7.0a	5.7	5.7	5.3	5.3	10
Forbes89	3.0	3.7	5.0a	5.3	5.7	6.0a	5.7	6.0	6.0	5.7	10
LOPEZ	2.0	4.7	5.0a	5.0	6.3	6.0a	6.3	5.0	5.3	5.7	10
MSCB-6	2.7	4.0	5.3a	5.7	6.0	6.0a	5.7	5.7	5.7	5.0	10
MSCB-8	3.3	3.7	4.7	5.3	5.7	6.3a	5.7	5.0	5.7	6.0	9
National	2.7	5.0	5.0a	5.3	5.3	5.7	5.7	4.7	5.7	5.0	9
Regent	2.3	5.0	5.3a	5.0	6.0	5.7	5.7	4.7	5.0	5.7	9
Penncross	3.3	5.0	5.0a	5.3	6.0	6.0a	5.7	5.3	5.7	5.0	10
Pennlinks	3.7	4.7	5.7a	5.3	5.7	6.3a	5.7	5.0	6.3	5.3	10
Providence	2.7	5.7	5.0a	5.7	6.7	7.0a	6.3	5.0	6.3	6.0	10
Putter	2.7	5.0	6.0a	5.7	6.3	6.7a	6.3	5.3	6.7	5.7	10
SR1020	3.3	5.3	5.3a	5.7	6.7	7.0a	6.7	5.3	5.7	6.3	10
UM8401	3.3	4.3	5.3a	5.3	6.0	6.0a	6.0	5.3	6.3	4.7	10
CV	ns	ns	*	ns	ns	*	ns	ns	ns	ns	
	43.8	20.0	11.8	13.1	12.2	9.0	10.8	9.2	12.2	13.8	

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan multiple comparison procedures (k ratio=100). ns = nonsignificant.

TPI = Turf Performance Index is number of occurrences a genotype was in top quality group for each date.

†Established Fall 1990



Table 16a. Tiller counts on National Turf Evaluation Program (NTEP) Creeping Bentgrass evaluation trials - TAES - Dallas, TX. Established Nov. 1989. Syn3-88 and Syn4-88 were established 1990.

1991 Observations								
Cultivar	May17	Jun24	Aug08	Sep10	Oct10	Nov11	Dec13	TPI
Syn1-88	46.0 <sup>ms</sup>	22.7 <sup>ms</sup>	34.7	34.3 <sup>ms</sup>	26.0 <sup>ms</sup>	41.7 <sup>ms</sup>	30.3 <sup>ms</sup>	7
Syn3-88*	.	32.7	31.7	37.3	27.7	38.0	34.7	7
Syn4-88*	.	18.3	32.7	27.7	27.3	25.0	27.3	7
BR1518	47.3	20.0	31.0	32.7	29.7	38.0	35.0	7
Carmen	45.7	28.7	36.7	32.3	30.0	28.7	35.7	7
CBE	44.7	23.7	48.3	32.3	21.3	33.7	33.3	7
CBL	56.3	28.3	40.0	22.7	22.0	33.0	24.0	7
Cobra	57.7	26.7	36.0	33.7	29.3	35.0	35.0	7
Forbes89	55.7	15.7	37.0	41.3	19.0	33.0	32.0	7
Lopez	35.3	30.3	39.3	25.7	20.7	39.0	26.7	7
MSCB-6	47.0	25.3	33.0	35.3	21.3	36.0	32.3	7
MSCB-8	41.0	19.7	44.3	41.7	23.0	38.3	24.3	7
National	44.0	22.0	28.7	30.3	25.3	36.3	28.7	7
Regent	43.3	28.3	36.0	29.0	20.3	27.3	30.3	7
Penncross	40.7	27.7	38.0	30.3	25.0	37.0	29.3	7
Pennlinks	48.3	23.7	39.0	33.7	19.3	31.3	35.0	7
Providence	48.7	26.0	35.0	35.3	26.7	36.0	26.0	7
Puter	52.0	30.0	41.7	41.0	26.7	29.3	32.7	7
SR1020	57.7	27.3	38.3	33.3	31.0	38.0	31.3	7
UM8401	52.0	23.3	27.3	34.0	33.3	33.0	30.0	7

Table 16b. (Cont.) Tiller counts on National Turf Evaluation Program (NTEP) Creeping Bentgrass evaluation trials - TAES - Dallas, TX. Established Nov. 1989.

1992 Observations										
Cultivar	Jan14	Feb11	Mar19	Apr24	May21	Jun25	Jul24	Aug26	Sep26	TPI
									92	91-92
Syn1-88	26.0 <sup>ns</sup>	38.0 <sup>ns</sup>	21.7 <sup>ns</sup>	34.0 a	21.7	33.3 <sup>ns</sup>	31.3 <sup>ns</sup>	46.3 <sup>ns</sup>	7	14
Syn3-88†	23.7	33.0	29.3	26.3 a	22.7	36.0	36.7	63.3	7	14
Syn4-88†	27.3	36.0	25.3	29.3 a	24.7 a	31.0	33.3	52.0	8	15
BR1518	23.7	38.7	33.7	24.7 a	25.7 a	32.3	34.7	64.0	8	15
Carmen	28.0	29.0	23.3	27.0 a	27.7 a	33.3	35.7	53.3	8	15
CBE	21.3	43.7	26.3	23.0	25.0 a	33.0	36.7	66.0	7	14
CBL	27.3	29.3	21.0	25.3 a	24.7 a	31.7	31.0	57.7	8	15
Cobra	31.0	34.0	20.3	28.0 a	30.0 a	34.7	30.7	55.7	8	15
Forbes89	19.7	35.7	19.0	23.0	30.0 a	35.7	32.3	57.0	7	14
Lopez	19.7	34.0	28.0	30.3 a	25.3 a	31.7	35.3	53.7	8	15
MSCB-6	26.3	30.7	26.7	26.7 a	23.0	34.7	33.7	59.0	7	14
MSCB-8	23.7	37.3	29.0	27.0 a	23.7	34.3	34.3	53.0	7	14
National	28.7	35.7	35.7	28.3 a	25.7 a	32.0	35.0	67.3	8	15
Regent	20.7	29.0	26.3	23.3	29.3 a	33.7	33.7	50.7	7	14
Penncross	23.3	31.3	25.7	28.3 a	24.0	31.3	29.7	57.3	7	14
Pennlinks	27.7	33.0	26.7	27.7 a	34.3 a	30.3	34.0	58.7	8	15
Providence	24.3	35.0	30.3	28.7 a	28.0 a	30.3	35.7	63.7	8	15
Putter	24.7	33.0	32.3	34.0 a	26.3 a	37.7	35.0	61.7	8	15
SR1020	29.3	38.7	32.7	23.7	29.0 a	35.0	33.0	56.3	7	14
UM8401	21.3	31.7	34.0	21.7	31.7 a	30.3	36.0	50.3	7	14

†Established fall 1990.

\*Means followed by an 'a' in the same column were in the highest statistical grouping using Waller/Duncan multiple comparison procedures (k ratio=100). ns = nonsignificant.

TPI = Turf Performance Index is number of occurrences a genotype was in top quality group for each date.

Table 17a. NTEP Root depth measurements on Creeping Bentgrass variety evaluation trials - TAES - Dallas, TX. Established Nov. 1989.

Cultivar	1991 Observations						TPI
	Jun20	Aug05	Sep03	Oct10	Nov11	Dec13	
Syn1-88	11.6 <sup>ab</sup>	9.2 <sup>ab</sup>	8.9 <sup>ab</sup>	9.3 <sup>ab</sup>	10.4 <sup>ab</sup>	8.2	5
Syn3-88†	9.4	7.4	6.5	8.7	9.6	11.0 a	6
Syn4-88†	9.6	7.3	6.6	8.5	9.5	12.2 a	6
BR1518	13.6	8.9	8.1	7.0	9.2	9.9 a	6
Carmen	12.9	9.7	7.2	6.8	10.6	11.2 a	6
CBE	13.0	7.6	7.3	8.7	9.6	8.2	5
CBL	14.0	6.4	8.5	8.3	10.7	9.5 a	6
Cobra	10.1	7.7	7.3	7.3	10.3	8.8 a	6
Forbes89	11.3	7.5	7.2	8.7	8.1	12.0 a	6
Lopez	12.8	9.5	8.8	8.2	9.7	8.5	5
MSCB-6	10.3	8.7	7.3	7.5	9.3	7.0	5
MSCB-8	9.1	7.5	9.0	9.5	9.6	9.3	6
National	11.7	9.3	8.4	8.0	9.5	10.0 a	6
Regent	12.0	9.1	7.7	8.5	10.4	8.7	5
Penncross	11.3	8.6	8.7	7.7	9.9	8.3	5
Pennlinks	11.2	7.5	7.8	6.5	11.1	11.0 a	6
Providence	9.5	8.9	7.6	8.5	11.7	12.2 a	6
Putter	11.3	8.2	9.8	7.7	8.5	9.7 a	6
SR1020	10.9	7.2	7.6	7.7	11.3	10.0 a	6
UM8401	10.1	7.6	8.8	6.8	7.9	10.2 a	6

†Syn3-88 and Syn4-88 were established in 1990.







































