



# NATIONAL EVALUATION OF COOL-SEASON TURFGRASS WATER USE AND DROUGHT RESISTANCE

Progress Report, Feb. 21, 2017, The Lawn Institute

## ABSTRACT

This is an exciting new project that will evaluate, through a nationwide trial, Kentucky bluegrass and tall fescue for their water use and drought resistance. Data generated from this project will be used to identify, label and certify low-water using cool-season grass cultivars for use on lawns, parks, athletic fields and golf courses. We have been allocated \$5,000 per year for three years (\$15,000 total) to help with the funding of this project.

Kevin Morris, NTEP and Michael Kenna, USGA

## ANNUAL PROGRESS REPORT – FEBRUARY 2017

As discussed at last year's TPI Lawn Institute Research Committee meeting, the United States Golf Association (USGA) budgeted considerable funding to conduct a national water use and drought tolerance trial, utilizing the National Turfgrass Evaluation program (NTEP) as its evaluation organization. USGA is funding the building of rainout shelters and irrigation infrastructure at several locations, and is working with NTEP in determining testing protocols, data collection methods, etc. Besides data collection on water use and drought resistance parameters, the goal of this effort is for the EPA Water Sense® program to adopt these (or similar methods) and to agree to certify the first plant species with the Water Sense® label. USGA has become a Water Sense® partner and we have talked to the Water Sense® staff about certifying grasses and there is interest in this idea. EPA is very interested in the concept (they have never certified a plant or plants as water saving) as USGA Green Section Research Director Dr. Mike Kenna and I have met with them to discuss collaborative efforts. However, EPA needs to see more about the methods and tests, as well as we believe, some successful trials. Also, they will need our help in solving some legal requirements when certifying a product (could be unique for plants, however). Attachment A is our proposal that was submitted to WTSC last year and chosen for funding.

Since last year we have made considerable progress with this trial. We have assembled an advisory committee consisting of researchers, Turfgrass Water Conservation Alliance (TWCA), A-List representatives and other seed companies. The advisory committee has met via nine conference calls and has developed extensive protocols, including two approaches to evaluate drought (see Attachment D). The committee has also developed budgets for each approach. As it appeared that we would have sufficient entries and overall funding, we decided to go ahead with the establishment of a cool-season grass trial at 10 locations in fall 2016. One half of those locations use rainout shelters (Approach 1) and the other half utilize in-ground irrigation that will use Approach 2 (see Attachment B).

Because of space limitations (only around 30-35 entries can be accommodated), we limited the trial to only Kentucky bluegrass and tall fescue. We chose tall fescue over perennial ryegrass because of more interest from seed companies in submitting entries (than perennial ryegrass). Fortunately, when our deadline passed, we had received 32 entries (14 bluegrass, 18 tall fescue). We added three standards to the trial (one each of Ky. Bluegrass, tall fescue and perennial ryegrass). See Attachment C for the list of entries and sponsors.

Most locations planted the trial in fall 2016, while a few had to wait on infrastructure improvements (mostly irrigation), and therefore will plant in spring 2017. Planting plans were developed for both Approach 1 and 2 sites (see Attachment E). We intend to initiate drought treatments in 2017 on those locations with mature plots.

Rainout shelters have been ordered and these will be delivered this spring to each of the five Approach 1 sites. Installation will be performed by staff at each site with potential help from NTEP. As a part of the grant agreement, NTEP will return a portion of the funding allocated for rainout shelter purchases back to each researcher to help with installation and other initial expenses. Approach 2 sites will receive \$15,000 initial set-up costs for irrigation installation and/or other expenses.

The cost to run each trial location is high, and only a portion of that will be covered by USGA's donation (\$250,000). Entry fee levels were set at \$8,000 for the cool-season trial, which netted us just past the 30 paid entries we could accommodate. However, we still needed other donations and to that end, we secured funding from the Washington Turfgrass Seed Commission (\$105,000) and the Lawn Institute (\$15,000). Our budget for this trial can be found in Attachment F. We sincerely appreciate the support received from The Lawn Institute for the initiation of this trial.

## ATTACHMENT A

# *The Lawn Institute* **GENERAL RESEARCH GRANT APPLICATION**

(Applications must be submitted on this form or exact duplicate (2 page max). Email copies accepted in Microsoft Word only. Use no smaller than 10-point type.)

**Project Title:** USGA/NTEP National Water Use Trial – Cool-Season Species

**Principal Investigator(s):** Kevin N. Morris, Michael P. Kenna

**Institution:** National Turfgrass Evaluation Program, United States Golf Association Green Section

**Address:** (NTEP) BARC-West, Bldg. 005, Rm. 307, Beltsville, MD 20705  
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**Phone:** 301-504-5125 (KM), 405-743-3900 (MK)      **Email:** [kmorris@ntep.org](mailto:kmorris@ntep.org), [mkenna@usga.org](mailto:mkenna@usga.org)

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**Statement of problem or issues to be addressed by this project:** Turfgrass is being scrutinized for its water use, leading to restriction or replacement of turf in some areas, most notably California. Water utilities, looking to reduce outdoor water use, have led the charge to encourage homeowners, municipalities and businesses to reduce or replace turf, often by offering financial incentives. The turfgrass industry has been working to develop cultivars that use less water, but there is a need to evaluate, on a national scale, actual water use rates of these new cultivars. We propose establishing such a trial at multiple locations, using cool-season grass species to document water savings of new cultivars under rainout shelters and zone-level irrigation systems. In addition, parameters will be established in conjunction with EPA Water Sense®, or a similar organization to certify (or label) those grasses that meet the water saving/efficiency criteria. This EPA Water Sense® (or other organization) certification will allow breeders, seed companies, sod growers and others in the industry to market their products as ‘water saving’, hence not all grasses are equal in their water use. We feel this labeling effort will help to ‘destigmatize’ turf and allow for the use and promotion of water saving turfgrasses.

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**Proposed project completion date** (when results will be publicly available):

Results will be published as per normal NTEP policies; trial is completed in 2020, therefore, certification will be applied most likely in 2021

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**Descriptive summary of proposed research plan/project:** Research program will start in fall 2016 for *cool-season grasses*. Six to eight (or potentially more) locations will be utilized (depends on funding we receive from Lawn Inst, sponsor entry fees and other groups we solicit), with the locations split between Approach 1 (individual plot watering) and Approach 2 (zone level irrigation) - see following protocols. *Please note that the following protocols are a draft and may be modified somewhat, based on input and feedback from stakeholders.*

Rainout shelters will be built at 3-4 locations, particularly where summer rains are prevalent. Also, 3-4 sites will be built in drier locations, with four different irrigation zones, replicated twice, such that four irrigation levels (based on ET) can be implemented. Then, after plots are well established, Approach 1 (plot level watering) and Approach 2 (zone level irrigation) will be implemented at 3-4 sites each.

Approach 1 will measure the amount of water used by each plot for a set drought ‘season’ of approximately 100 days. Drying down to a prescribed level of green/brown cover will be the trigger to hand water a plot. Watering amounts will be recorded for each plot over the dry-down ‘season’. Approach 2 will be ET based and measure quality attributes over time, as well as amount of water needed to achieve a desired level of quality. Both approaches will be repeated for three growing seasons.

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**Current knowledge about project topic/area** (include citations where appropriate): This project is based on research conducted and published by Turfgrass Water Conservation Alliance members, Kansas State University, University of Arkansas, Texas A&M University and others (see references on page 2 of water use protocols below)

**ATTACHMENT A (page two)**

**Significant potential benefits of project findings:** This project will be the first to document, at multiple sites, water use of cool-season cultivars, in inches per year needed to achieve a particular level of quality or green cover, compared to noted standard cultivars. This is important because: 1) new drought tolerant cultivars need to be compared with older standard cultivars for actual water use and ability to maintain quality and green cover, 2) we need to show municipalities, water utilities, regulators and others that drought tolerant cultivars are available with documented water use data and 3) having a certification program that identifies and labels drought tolerant cultivars is essential to the continued use of turfgrass on lawns and other areas where water use is a major concern.

In addition, it is important the turf industry come together to cooperate on a project such as this, demonstrating that reducing water use is important to this industry, as well as to show that we have been successful in reducing water use. For the Lawn Institute, it is highly beneficial to join forces with the USGA, NTEP and other groups we are talking with (Washington Turfgrass Seed Commission, Irrigation Assoc., etc.) concerning the importance of this project. This will put the Lawn Institute in a leadership position, aligning with other national groups to focus on turfgrass water use and conservation.

**Deliverables** (list form and date available of information or technical advancements resulting from this project, i.e., peer-reviewed journal article(s); trade magazine article(s); educational talk(s); technical manual(s);

Data from each of three years collected, summarized and published on the NTEP web site, educational talks and articles for USGA, TPI and other organizations, successful certification of at least some entries by the chosen certifying organization or agency (EPA Water Sense® or other)

**Technical qualifications and expertise of investigators necessary to accomplish this project:**

Kevin Morris, Executive Director, NTEP  
 Michael Kenna, Director of Research, USGA Green Section

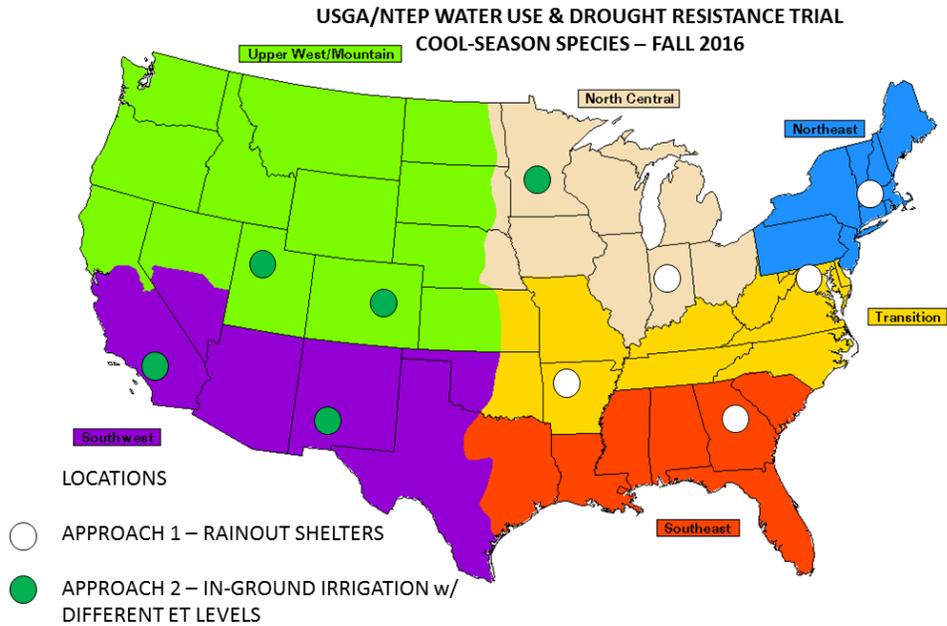
**Budget Requirements (U.S. Dollars) (based on 8 total sites – 4 each of Approach 1 and 2))**

	(Year)	(Total Budget)	(Funds Requested from The Lawn Institute)
1 <sup>st</sup>	<u>2017</u>	\$ 145,426	\$ <u>10,000</u>
2 <sup>nd</sup>	<u>2018</u>	\$ 145,427	\$ <u>10,000</u>
3 <sup>rd</sup>	<u>2019</u>	\$ 145,427	\$ <u>10,000</u>
	<b>Total</b>	<b>\$ 436,280</b>	<b>\$ <u>30,000</u></b>

**Current or Pending Source(s) of Other or Additional Project Funds or**

**Partners:** Source USGA (committed) Project Support \$ 250,000  
 Source Wash. Turf. Seed Comm. Project Support \$ 105,000  
 Source NTEP Project Support \$ 51,280  
**Total of "Other Support" \$ 406,280**

## ATTACHMENT B



### USGA/NTEP Water Use & Drought Resistance Trial Cool-season grass locations

Approach 1  
(restrict water  
For 100 days)



Amherst, Massachusetts  
College Park, Maryland  
Griffin, Georgia  
W. Lafayette, Indiana  
Fayetteville, Arkansas

Approach 2  
(reduced  
ET<sub>o</sub> levels)



St. Paul, Minnesota  
Las Cruces, New Mexico  
Riverside, California  
Logan, Utah  
Ft. Collins, Colorado

## ATTACHMENT C

### 2016 National Cool-Season Water Use/Drought Resistance Test

#### Entries and Sponsors

Entry No.	Name	Species	Sponsor
1	BAR PP 110358	Kentucky Bluegrass	Barenbrug USA
2	Barrari	Kentucky bluegrass	Barenbrug USA
3	Everest	Kentucky bluegrass	Jacklin Seed by Simplot®
4	Blue Note	Kentucky bluegrass	Mountain View Seeds
5	Babe	Kentucky bluegrass	Seeds, Inc.
6	NAI-13-132	Kentucky bluegrass	Columbia River Seed
7	NAI-13-14	Kentucky bluegrass	Columbia River Seed
8	Blue Devil	Kentucky bluegrass	Columbia River Seed
9	Dauntless	Kentucky bluegrass	Columbia River Seed
10	PST-K13-137	Kentucky bluegrass	Pure-Seed Testing, Inc.
11	PST-K13-143	Kentucky bluegrass	Pure-Seed Testing, Inc.
12	PST-K15-169	Kentucky bluegrass	Pure-Seed Testing, Inc.
13	PST-K11-118	Kentucky bluegrass	Pure-Seed Testing, Inc.
14	PST-K13-141	Kentucky bluegrass	Pure-Seed Testing, Inc.
15	Midnight	Kentucky bluegrass	Standard entry
16	SR 4650	perennial ryegrass	Standard entry
17	BarRobusto	tall fescue	Barenbrug USA
18	BAR FA 121095	tall fescue	Barenbrug USA
19	DLFPS 321/3677	tall fescue	DLF Pickseed USA
20	DLFPS 321/3679	tall fescue	DLF Pickseed USA
21	DLFPS 321/3678	tall fescue	DLF Pickseed USA
22	Nonet	tall fescue	Jacklin Seed by Simplot®
23	GO-AOMK	tall fescue	Grassland Oregon
24	Supersonic	tall fescue	Mountain View Seeds
25	Titanium 2LS	tall fescue	Mountain View Seeds
26	Thor	tall fescue	Columbia Seeds
27	Thunderstruck	tall fescue	Columbia Seeds
28	RS4	tall fescue	Landmark Turf & Native Seed
29	Kingdom	tall fescue	Site One Landscape Supply
30	MRS� TF15	tall fescue	Site One Turf & Landscape Supply
31	Catalyst	tall fescue	Standard entry
32	Stetson II	tall fescue	Site One Landscape Supply
33	PST-5SDS	tall fescue	Pure-Seed Testing, Inc.
34	PST-R511	tall fescue	Pure-Seed Testing, Inc.
35	LTP-SYN-A3	tall fescue	Lebanon Seaboard Corp.

## ATTACHMENT D

July 25, 2016 version

### **Trial details:**

1. Cool-season grass trials (two species) will be established in 10 locations for each species in fall 2016.
2. Data will be collected for three growing seasons: 2017, 2018 and 2019
3. Two approaches will be used:  
Approach 1 – individual plot watering and  
Approach 2 – zone level irrigation (see pages two and three for a description of each approach).
4. An equal number of rainout shelters and zone level irrigation plots will be built (see attached map and locations list). The rainout shelters will be utilized where summer rainfall is possible (and needs to be restricted).
5. Since plot space will be limited, the first priority for entries will include only Kentucky bluegrass and tall fescue. If space is not filled with those two species, some perennial ryegrass entries can be included in the trial.
6. Trial locations will be managed using a mowing height of 2 – 2.5” and fertilization of 0.25 – 0.33 lbs. of N/1000 sq. ft./growing month.
7. Digital image technology will be used to measure percent green cover on plots. Training will be provided to cooperators so that images are collected properly.
8. NTEP will hire additional staff to monitor the performance of trials, data and image collection, and to perform site visits.
9. Since the plot areas will be costly to build and the trial will require considerable labor to manage, each species trial will be limited to 30 total paid entries (plus 3 standards), 3 reps of each for a total of 100 plots at each test site.
10. USGA and NTEP will pursue certification/qualification and/or branding of drought tolerant or low-water using cultivars. Therefore, we anticipate that at the end of the trial period, the system will be in place to apply this certification (or brand) to those entries that qualify (qualification requirements will be in place before entry submission).



**Rainout shelters similar to this will be built and installed at five locations (see map)**

## ATTACHMENT D (page two)

Here are more details on the two proposed water use/drought approaches. These approaches are based on similar protocols reported by Kansas State University, University of Arkansas and others (see selected references below):

- 1) **Approach 1- Individual Plot Level Irrigation:** The amount of plant material per entry would need to be sufficient to establish to a final area of approximately 32.28 sq. ft per entry per site. (10.76 sq. ft./plot x 3 reps)
  - a. Year 1- Plots are fully established under full irrigation levels (plot size is 1 meter x 1 meter or 10.76 sq. ft.)
  - b. Years 2, 3, 4, etc.- Following uniform irrigation of all plots to initiate the study, full scale, automated irrigation is terminated, and individual plots are thereafter monitored on a regular basis (could be daily, bi-weekly, or weekly to correspond to particular watering frequencies allotted by the region or budget provided the cooperator) during the morning hours of the dry-down 'season'.
  - c. When quality attributes (wilt/firing/% green cover, etc.) of a specific plot or plots are noted to have fallen below a defined threshold (i.e. 50% green cover or another prescribed level), it is hand-irrigated with an amount of water necessary to recharge the root zone to field capacity (between ½" to 1"). Irrigation events are recorded on a per plot basis, so that total irrigation applied over the season can be calculated on a plot basis and statistics applied.
  - d. A dry-down 'season' would last around 100 days, then plots would be fully irrigated to assess recovery. Turf quality ratings will be collected as well during dry down and recovery.
  - e. A rain-out shelter will be employed for this approach. Data produced through the work would document 1) 'water quantity required (inches) per entry' for each location, 2) turfgrass quality before and during dry-down, during and after recovery, and a 3) ranking of the entries used.

Selected References:

Lewis, J.D. et al. 2012. Wilt-Based Irrigation in Kentucky Bluegrass: Effects on Visual Quality and Irrigation Amounts Among Cultivars. *Crop Sci.* 52:1881–1890. doi: 10.2135/cropsci2012.01.0033

Richardson, M. D. et al. 2009. Drought Tolerance of Kentucky Bluegrass and Hybrid Bluegrass Cultivars. Online. *Applied Turfgrass Science*. doi:10.1094/ATS-2009-0112-01-RS.

Richardson, M.D. et al. 2012. Irrigation Requirements of Tall Fescue and Kentucky Bluegrass Cultivars Selected Under Acute Drought Stress. Online. *Applied Turfgrass Science* doi:10.1094/ATS-2012-0514-01-RS.

Steinke, K. et al. 2010. Drought Response and Recovery Characteristics of St. Augustinegrass Cultivars. *Crop Sci.* 50:2076-2083. doi:10.2135/cropsci2009.10.0635. Published online 16 June 2010.

USGA Turfgrass and Environmental Research Online. Vol. 11, No. 6, June 1, 2012, p. 1-12.

<http://www.lib.msu.edu/cgi-bin/flink.pl/?recno=205406>



**Plots would be individually watered after they reach the desired drought stress threshold.**

## ATTACHMENT D (page three)

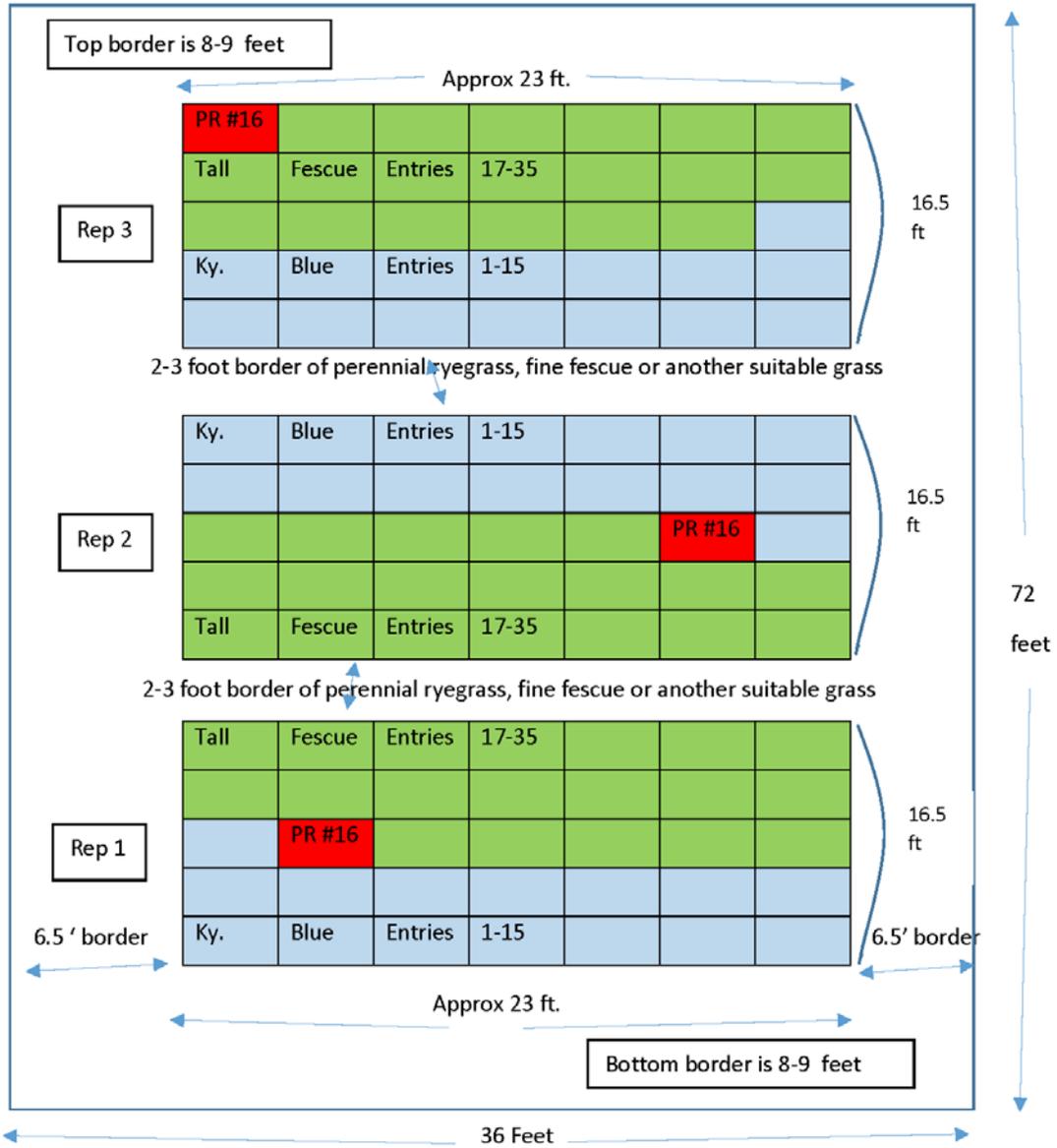
**Approach 2- Zone Level Irrigation:** Larger study area size (~3 to 4 times more area and plant material) would be needed for accommodating multiple studies or 'zones' of irrigation. The amount of plant material per entry would need to be sufficient to establish to a final area of approximately (3 ET levels x 3-6 entry reps/ET level x 10.76 sq. ft) ~200 sq. ft. per location (*depends on location irrigation design and availability*). This trial would not be conducted under rainout shelter due to size constraints.

- a. Year 1- Similar to Approach 1, a full set of replicated entries would be established, but within each of 3 target irrigation ET levels (zones). Plots (*1 m x 1 m or similar size*) will be fully established under full irrigation levels.
- b. Years 2-4- Irrigation treatments imposed. ET levels will correspond to 3 levels of historical reference evapotranspiration ( $ET_o$ ) for the location, the maximum of which should be near full water requirement (~0.75 x  $ET_o$  for cool-season) and lowest of which should be ~1/4 of this maximum level. Alternatively, if  $ET_o$  data are unavailable, one could arbitrarily apply defined amounts (i.e. 3/4" per week, 1/2" per week, and 1/4" per week to the respective zones.
  - i. Cool-season: 0.75 x  $ET_o$ , 0.5 x  $ET_o$ , 0.25 x  $ET_o$  applied 2x weekly
- c. Frequency of irrigation to plots would also be a constant 1 or 2 day per week irrigation schedule (*a single frequency should be decided on for all locations*).
- d. Irrigation scheduling to account for rainfall
  - i. Approach 1- Let system run regardless of rainfall, do not adjust irrigation
  - ii. Approach 2- Do not adjust schedule for any events <0.25". Account for 50% effective rainfall for all other events in adjusting irrigation applied for each zone. (For instance, if a 1" rainfall is received; all plots are turned off for one event. If 1/2" is received, only the low irrigation level may be turned off, but others receive appropriate % adjustments to account for 1/4" effective rainfall.
  - iii. Ultimately the key will be accurate accounting of total water received within each zone on a weekly basis.
- e. Quality attributes (*wilt/firing/% green cover, etc.*) of all plots within each irrigation level will be noted regularly during the study, just prior to an irrigation day during the morning hours.
- f. At the conclusion of the study, irrigation + rainfall for each zone would be totaled by week (~10-14 weeks in duration). Quality (>6) or other parameter (>75% green cover) of interest in determining acceptability would also be noted on a per plot basis for each week. Finally, the particular amount of water needed to sustain acceptable quality each week would be determined on a plot by plot basis and totaled for the study. This amount might fluctuate by week or month. For example, bluegrass may maintain acceptable quality with only 0.5 x  $ET_o$  in June, but in July or August, may require 0.75 to maintain acceptability. This method will account for weekly or monthly changes in minimal irrigation levels required.
- g. This approach is best suited for areas of the US that likely see visible drought stress arise in summer months where irrigation is not applied, i.e. (New Mexico, California, Colorado, etc.).
- h. Repeating the studies over three years will allow for upper and lower end seasonal requirements to be determined for each location.
- i. Data produced through the work would also document 1) 'water quantity required (inches)' per entry for each location, 2) turfgrass quality ratings at regular intervals, and a 3) ranking of the entries used.

# ATTACHMENT E

Sample Planting plan – USGA/NTEP Cool-Season Water Use/Drought Trial

## Approach 1 – Under Rainout shelter



Rainout shelter is 36 x 72 feet

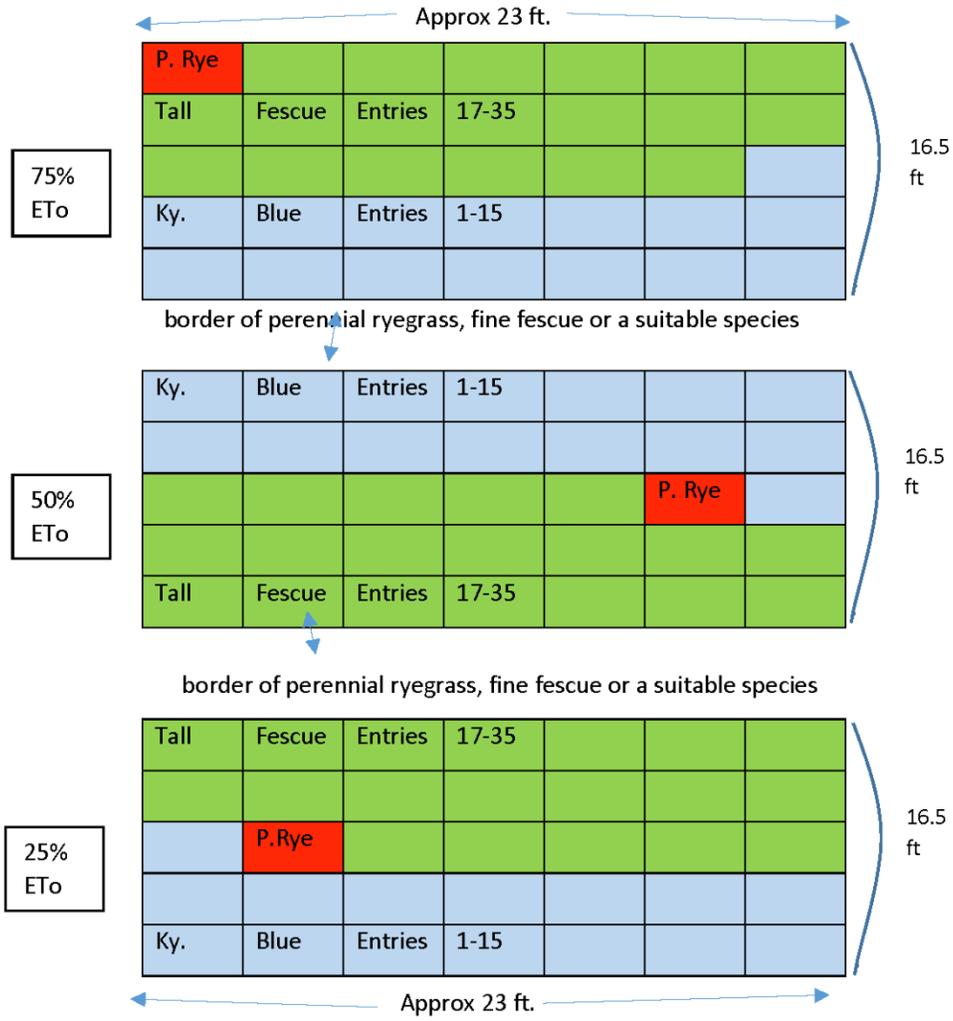
Plots are 1 meter x 1 meter (3.28 ft x 3.28 ft) (10.76 sq. ft.)

# ATTACHMENT E (page two)

Sample Planting plan – USGA/NTEP Cool-Season Water Use/Drought Trial

## Approach 2 – ETo Based

### REPLICATION 1



Plots are 1 meter x 1 meter (3.28 ft x 3.28 ft) (10.76 sq. ft.)

USGA NTEP WATER USE/DROUGHT TRIAL COST AND REVENUE ESTIMATES

	Approach 1 - plot watering					Approach 2 - zone level irrigation					TOTALS
	per location				TOTAL	per location				TOTAL	
	2016 establishment	2017 Yr 1 data collection	2018 Yr 2 data collection	2019 Yr 3 data collection		2016 establishment	2017 Yr 1 data collection	2018 Yr 2 data collection	2019 Yr 3 data collection		
Build shelter	15,000				15,000						
site prep/irrigation install						15,000					15,000
plot maintenance	5,000	5,000	5,000	5,000	20,000	5,000	5,000	5,000	5,000	20,000	
watering individual plots		9,000	9,000	9,000	27,000						
DIA pictures and processing		900	900	900	2,700		900	900	900	2,700	
processing of data		450	450	450	1,350		1,080	1,080	1,080	3,240	
miscellaneous						520	520	520	520	2,080	
<b>TOTALS -per trial site</b>					66,050					43,020	
<b>Number of sites</b>					5					5	
<b>TOTAL COSTS</b>					330,250					215,100	545,350
NTEP OVERHEAD (12.5%)											68,169
USGA support											-250,000
WA Turfgrass Seed Commission											-105,000
Lawn Institute											-22,500
Other Grants??											
<b>DEFICIT (to be covered by entry fees)</b>											236,019
<b>PAID ENTRIES</b>											
entry fee	32	8,000									256,000
<b>Scenario 1 - build five shelters and install five zone level irrigation sites - 10 total sites for one cool-season trial only</b>											
zone level costs are for three reps of three irrigation levels											

ATTACHMENT F