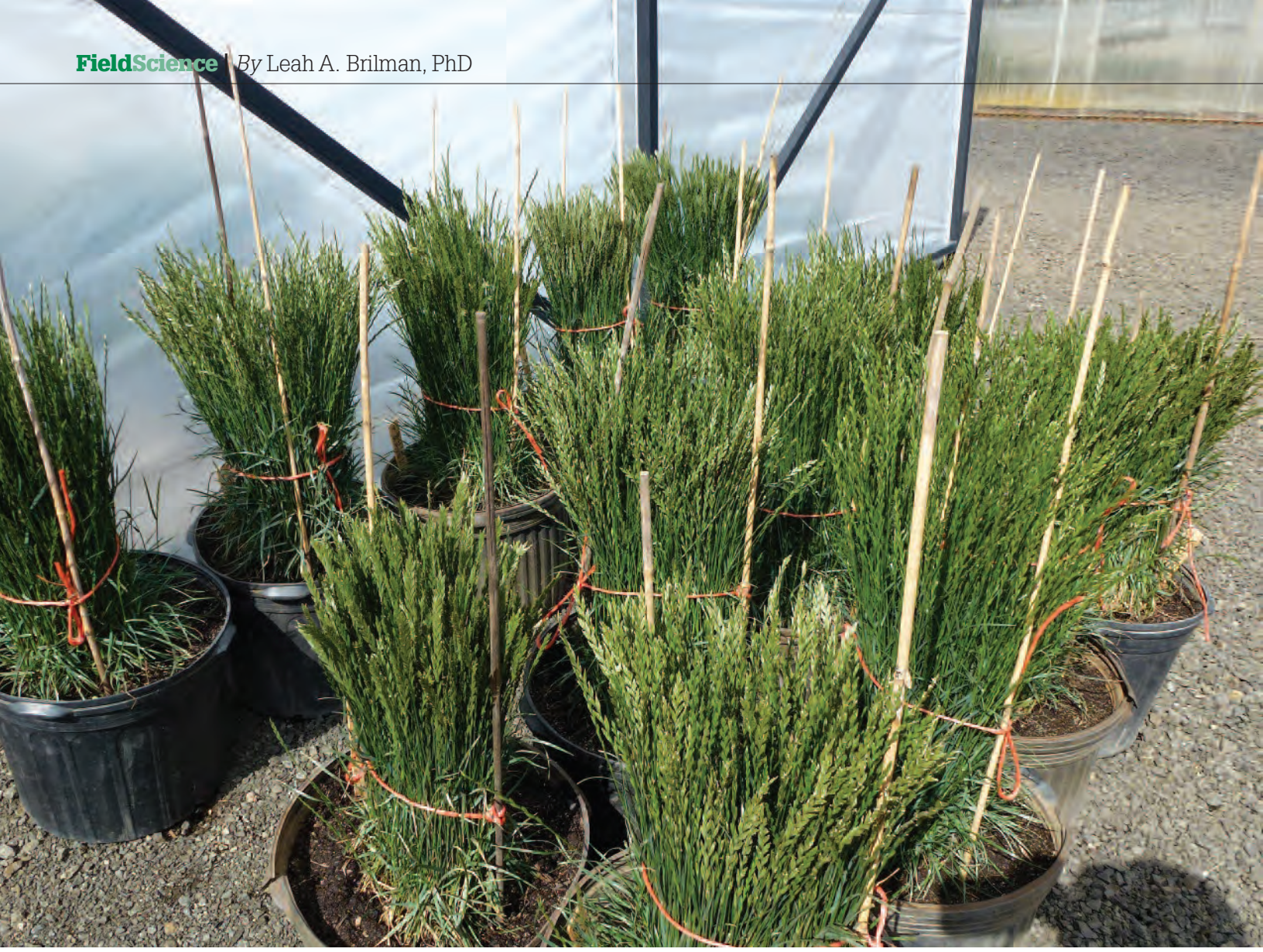


▲ **SELECTED PERENNIAL RYEGRASS** plants placed into an isolation cage for crossing.

Turfgrass breeding for sports

TURFGRASS BREEDERS may have a more difficult job than most other plant breeders. For the most part they deal with more than one species, usually at least four major species and many minor ones, and a vast geographic area for each species. What also complicates the breeding for the seed propagated species is breeders must breed at the same time for turf quality, disease resistance and other characteristics for turf performance and also for seed yield.

Most turfgrass species are cross-pollinated, self-incompatible species, which means the same plant cannot be the mother and the father. This makes development of inbred lines for hybrids or seed propagated varieties with one genotype unfeasible. Breeders must cross similar plants together to start the breeding process selected for the characteristics desired in the new cultivar. This means traditional breeding operates as a form of population improvement, with each individual seed in a variety genetically related to but distinct from others. By taking the portion of the population with the best of a certain characteristic, darkest green, highest stress tolerance, least disease, and crossing these together the breeder moves the mean of that characteristic up. The selected plants must still match for

Improvement of turfgrass varieties is dependent on being able to efficiently screen large numbers of plants for the desired characteristic(s).

many other characteristics such as color, date of seedhead appearance and height to make a uniform variety.

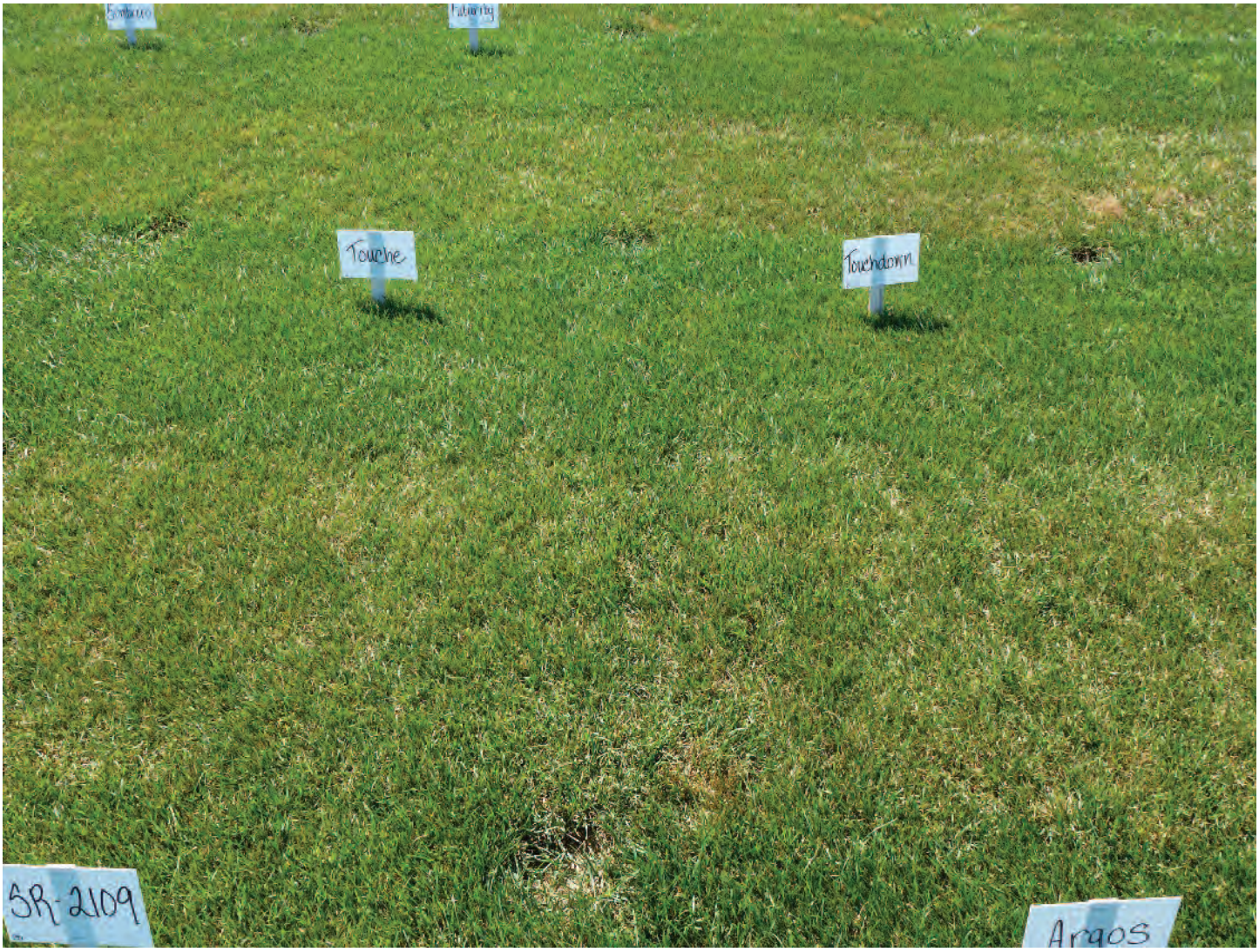
Kentucky bluegrass is the exception due to its apomictic reproduction. It is hard to get hybrids, with often only 10% of plants in a cross being the hybrids, the rest being genetically identical to the mother plant. These hybrids usually have all the chromosomes of the mother plant and about half of the father. Each plant is a shot in the dark but if you do get a good plant that is apomictic the progeny will all be the same and it can be a new variety.

The general outline for breeding is

1. Establish a goal (Improved wear tolerance, diseases resistance)
2. Decide how to screen for improvements (Select in turf trials or spaced plants)
3. Screen a large number of plants and select the best ones
4. Cross these plants together letting wind scatter the pollen (small crossing cages or bigger blocks of related plants), harvest seed, plant new trials
5. Evaluate progeny for selected improvement (perhaps select best plants again)
6. Seed from best plants or lines bulked together as Breeder Seed
7. Breeder Seed used to plant first seedstock field and enter into NTEP and other trials
8. Seedstock (Foundation) seed used to plant Certified fields

Improvement of turfgrass varieties is dependent on being able to efficiently screen large numbers of plants for the desired characteristic(s). The selected plants need to be crossed together and the progeny (offspring) evaluated again for the characteristic(s). If the characteristic is highly heritable the majority of the population may then have the characteristic or additional cycles of selection must be performed. Due to the complex inheritance of many desired characteristics being able to concentrate many of them in one population or variety is often difficult. It is often necessary to evaluate the selected plants and progeny over a number of years and environments to reliably screen for some characteristics. Screening for wear tolerance was

▼ **BREEDER BLOCK OF TALL FESCUE.** Seed from the isolated plants are planted in the greenhouse and spaced plants are established into a Breeder block (each row has plants derived from one plant). Look for uniformity and seed yield or these progeny. Usually also planted in turf plots. Poor performers will have the whole row eliminated.



▲ **KENTUCKY BLUEGRASS TRIALS** at Rutgers University with wear done on front half of each plot. Cultivar names are in the back of the plot.

often difficult since the size and speed of the machines made it difficult to screen large numbers of turf plots. Recently Rutgers University developed the Rutgers Wear Stimulator (Turf Slapper) that can apply wear over a large number of plots and has enable wear tolerance and recovery to be more easily integrated into varietal development.

Tall fescues with improved wear tolerance and the ability to demonstrate wear tolerance as younger plants has been a recent emphasis. Recent information by Dr. David Miner of Iowa State University suggests that addition of large seed quantities early in the season, even with wear applied, increases the percentage of tall fescue, perennial ryegrass or Kentucky bluegrass in the stand. Increased establishment occurred at rates up to 200 kg/ha for perennial ryegrass and 40 kg/ha for Kentucky bluegrass. Tall fescues were only slightly less effective than perennial ryegrass in establishing during play. Additional breeding work in tall fescues has emphasized drought tolerance as well as brown patch resistance in multiple locations, for durable resistance.

Perennial ryegrass breeding in the United States for many years has emphasized darker green dwarf varieties with high turf quality.

▲ **KENTUCKY BLUEGRASS BREEDER BLOCK**. Very uniform due to high apomixis.

Perennial ryegrass breeding in the United States for many years has emphasized darker green dwarf varieties with high turf quality. An important new characteristic has been the discovery and incorporation of genes for resistance to gray leaf spot disease, which is the same pathogen as rice blast disease, and has decimated stands of Perennial ryegrass breeding in the United States for many years has emphasized darker green dwarf varieties with high turf quality.perennial ryegrass in the transition zone of the United States. A bal-

ance must be achieved between resistance to this disease and resistance to other important pathogens such as brown patch and red thread. Wear tolerance as a major component in selecting new ryegrasses. Breeders have been crossing more winter-active wear tolerant ryegrasses with American germplasm to increase the wear tolerance during the colder months. An additional high priority in perennial ryegrass breeding has been salt tolerance. This is due to the increasing use of effluent water in many golf courses in the United States and elsewhere.

Hybrids of Texas bluegrass and Kentucky bluegrass have the potential to expand the range of Kentucky bluegrass. Many of these are more heat and drought tolerant than traditional Kentucky bluegrasses, although some new cultivars of Kentucky bluegrass have also been selected for more heat and drought tolerance. The other major advantage of these hybrids is their extensive rhizomes systems. In wear trials they have shown excellent wear tolerance, rapid recovery and more winter-active growth making them better suited for many applications.

▲ **PURE SEED COMPANY** seed yield trials for Kentucky bluegrass. Wide variability in maturity and appearance. Only a small fraction of these will make it to market.

▲ **WEAR TRIALS** on tall fescues at Rutgers University July 2011. New tall fescues are more wear tolerant even under heat stress.

In breeding of all species seed yield is just as important as diseases resistance or turf quality. Often if you find cultivars or experimentals that are only on the market a short time or are never marketed it is due to inadequate seed yield. We must often cycle one generation for a turf characteristic and then another for seed yield. Turf breeders have been very successful in improving turf quality and seed yield at the same time but we may not find that true in the future.

Development of new turf cultivars takes many steps and the diverse needs make it different from many other crops. Turf breeders must have patience and understand the many needs of customers plus seed growers. ■

Dr. Leah A. Brilman is the director of research and technical services for Pickseed/Seed Research of Oregon, www.sroseed.com.