The Annual Bluegrass Population in Golf Greens— It Comes, Goes, Then Comes Back Again...

By Van Cline

(Editor's Note: Van Cline is currently pursuing a Ph.D. in Horticulture at the University of Minnesota and specializing in turfgrass science. His research is related to the ecological genetics of annual bluegrass in golf courses as affected by high temperature stress. Van is Manager of Customer Education for the Toro Company in Minneapolis, reporting to Dr. Jim Watson, where he is involved in a variety of customer relations activities with users of commercial mowing, irrigation and fertilizer products. He served on the Landscape Architecture faculty at the University of Minnesota, and consulted in landscape design and natural resource planning before joining Toro. Van holds a Bachelor of Science degree in Forestry, and a Master of Landscape Architecture degree from Iowa State University.)

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Annual bluegrass (*poa annua L.*) is one of the five most widely distributed plant species in the world, according to Dr. Michael Fenner, author of *Seed Ecology*. Dr. C.H. Peel of the Sports Turf Research Institute in Great Britain has described annual bluegrass worldwide as "absent only from areas of high temperature and low rainfall, from highly competitive plant communities such as tall grasslands, above the altitude of 1300m and on highly acidic soils." A species achieves this prevalent status in the plant world only by developing an extremely adapatable strategy to perpetuate itself. In other words, annual bluegrass has become very good at reproducing in a wide range of environments.

Golf course superintendents in the Midwest know what a successful and opportunistic species annual bluegrass is in golf turf. Its persistence in golf courses is testimony to its competitiveness, and provides a snapshot of its notable adaptability. Superintendents are well aware that once it invades a golf course, it is nearly impossible to get rid of it in any practical way. Despite the fact that it is never intentionally planted, annual bluegrass is inevitable in the golf business in the Upper Midwest.

What many superintendents don't know is that annual bluegrass is more prevalent in their turf at certain times of the growing season. Since 1988, we have monitored several mixed annual bluegrass - creeping bentgrass golf greens in the Twin Cities area. Population counts throughout the season have revealed a predictable fluctuation in the two species.

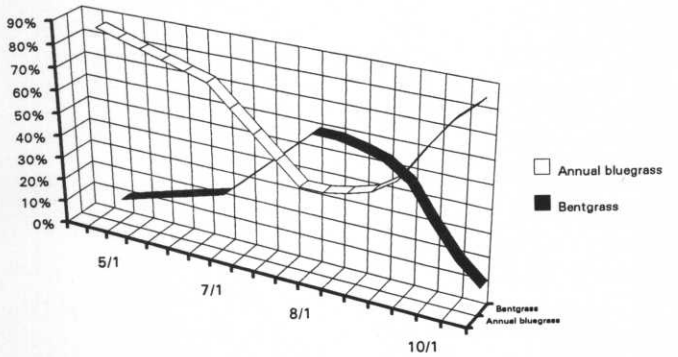

Fig. 1: A representation of population dynamics in golf greens
(fluctuations are exaggerated)

Annual bluegrass dominates the turf in the spring, by mid-summer the annual bluegrass population has declined and the creeping bentgrass population has increased, and during the fall the annual bluegrass comes on strong again as the creeping bentgrass population declines. The obvious queestion is: "Why?"

Many factors could influence this rhythmic population shift in greens. More than likely, a combination of several are in control of this dynamic. It could be due to the reproductive biology, or what is known as the life history, of annual bluegrass. The decline corresponds generally to the period following heavy flowering, starting mid-to late-June. Typically, weed species with annual life cycles put their energy and resources into flowering and seed production. Once they have accomplished that goal, the plant naturally declines and dies. The seed is left to germinate the next growing season and perpetuate the species by repeating the same cycle year after year. On golf greens, therefore, the natural death of tillers with an annual life history that have flowered and produced seed could be a reason for the mid-summer decline in the annual bluegrass population. Since plants are of different ages and don't all flower at the same time, there is a constant cover of annual bluegrass even though the proportion of plants to creeping bentgrass is less after the intense June seed production period. A qualifier to this theory, however, is the belief by many that annual bluegrass in golf greens is more perennial than annual. Perennial turf would be expected to provide a more consistent cover throughout the growing season. The belief that annual bluegrass in greens is perennial is only informed speculation at this point. The opposing theory is that most annual bluegrass plants in greens are truly annual, but because they are of different ages due to continuous germination of seed, the cover is continuous giving the turf the appearance of perennialty.

The other set of factors that could control the predictable fluctuation in annual bluegrass and creeping bentgrass populations is environmental. The growth of plants is determined by the internal biology or genetics of a species *and* by the environmental conditions in which they live. In the case of a golf green, the mid-summer decline of annual bluegrass generally corresponds with the hottest time of the growing season. It is possible that annual bluegrass' lower tolerance of heat stress could cause an overall reduction in vigor and competitiveness (or death in extreme heat)

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Bluegrass —

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in July and early August, opening the door for creeping bentgrass which is known to be more tolerant of high temperatures. Our measurements of soil temperature in greens has shown that the root zone can become significantly hotter than air temperatures during sunny mid-summer afternoons. A day in the low 90s could result in soil temperatures near 100°F in the root zone. Lethal temperatures for many plant species including annual bluegrass are known to be in the 105-110°F range. It is conceivable, therefore, that high temperature stress could be responsible for the mid-summer decline of annual bluegrass in greens.

Our population counts since 1988 on a mixed annual bluegrass-creeping bentgrass green lend some support to both theories (biological vs. environmental control of the annual bluegrass decline). The very hot years of 1988 and 1989 produced the most dramatic mid-season reduction in annual bluegrass. The record cool years of 1992 and 1993 produced the smallest declines.

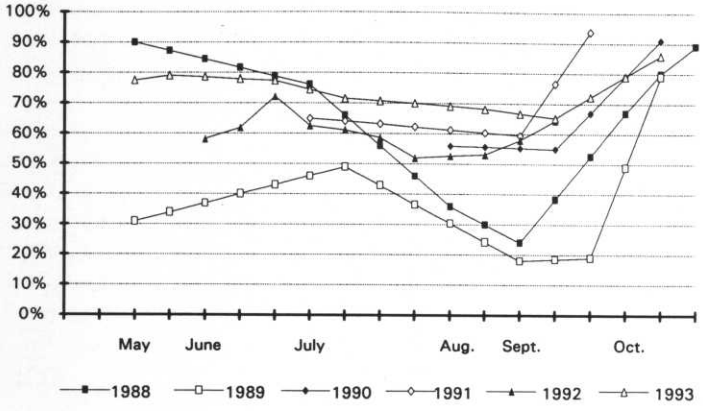
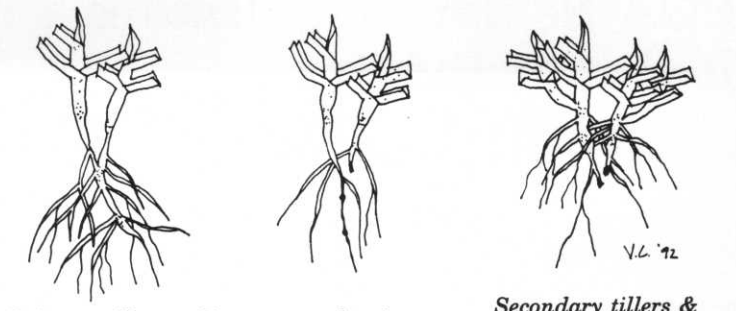


Fig. 2: % Poa annua in samples from a Twin Cities green 1988-1993

It would appear, therefore, that temperature is related to the extent of the population fluctuations. But, the fact that the annual bluegrass population still declined in the record cool years when temperatures didn't approach high stress levels seems to indicate that the reproductive cycle could also be a controlling factor.

We monitored the vigor of individual annual bluegrass plants throughout the growing season during this same period, and found that their root systems deteriorate and the number of tillers per plant decreases in conjunction with the mid-summer population decline. Root tissue appears to degenerate and rot away, which is consistent with high temperature damage. At the same time, the node at which tillers are joined degenerates and tillers separate. Later in the season as the annual bluegrass population recovers, new root tissue is produced, and a flush of new tillers occurs at nodes higher up the plant.

As somewhat of an aside, it is interesting to note the apparent relationship between the late-season resurgence of the annual bluegrass population and core aeration. Notice the dramatic increase in annual bluegrass illustrated in Figure 2 in the fall. Ecologically, conditions are perfect for



Primary tillers (early summer) — *Root system deteriorates primary tillers separate* — *Secondary tillers & adventitious roots develop (late summer)*

Fig. 3: Seasonal root and tiller transition

annual bluegrass growth following aeration. Soil on the green surface is exposed. Resources for growth are immediately available. Competition from neighboring plants is at a seasonal low. A large fresh seed bank is waiting. Temperatures and moisture are optimum for germination and seedling development. Common sense would indicate that core aeration, which relieves the turf of a season's worth of compaction, gives a significant advantage to the annual bluegrass population. Techniques for alleviating compaction and their effects on the species composition of a green is an area worthy of further research.

There are interesting questions related to the activity of the creeping bentgrass population while the annual bluegrass population is in decline. Is the creeping bentgrass released by the annual bluegrass retreat, or is the competitiveness of the creeping bentgrass during mid-season responsible in part for the annual bluegrass decline? In other words, does annual bluegrass set the pace and creeping bentgrass respond to the opportunity created by its mid-season decline, or does creeping bentgrass exert its strength in mid-season exacerbating the condition of the annual bluegrass? It is helpful to visualize a golf green as a dynamic miniature ecosystem that is subject to a continuous push and pull from the unique biology of the individual species and from the environment, which includes the stresses imposed by man. In that light, the green becomes a very complex system influenced by many factors simultaneously. Mathematically, the combinations of influences are almost limitless. It's easy to see, therefore, why managing greens is not as straightforward as the casual observer might think!

Research on the ecology of annual bluegrass in golf courses continues at the University of Minnesota with the goal of improving its control or its cultivation.