Converting poa greens to bentgrass

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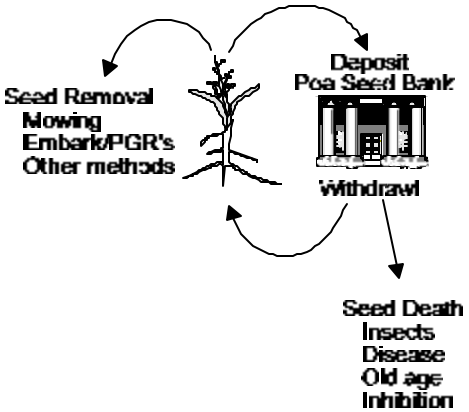
Summary: "It can't be done with our current technology", is a quote that you can bank on. That is the conclusion that has been drawn through review of key scientific publications, conversations with superintendents and the results of two simple experiments at Mesa Verde Country Club. Not only will you be unable to convert a poa green to predominantly bentgrass, but if you have a bentgrass green, you will have a difficult time preventing conversion to poa. These are not unexpected results, just disappointing. Read on to decide for yourself whether these statements hold up under your scrutiny.

Background: *Poa annua* (poa) putting greens can provide a premium golfing experience during most of the year in the cooler regions of California. Unfortunately, during the spring (and throughout the year in some locations), seed production can result in uneven greens surfaces. Likewise, when summer irrigation, traffic, compaction and salinity take their toll, by the fall poa can again become a bumpy and frustrating surface for golfers. *Agrostis palustris* (bentgrass), on the other hand, has greater salt tolerance, deeper roots (sometimes), and frequently survives when poa dies. It is the summer and fall survival advantage that bentgrass provides compared to poa that has resulted in the dream of converting poa greens to bentgrass.

The Problem: In 1995, the PACE Turfgrass Research Institute (PTRI) Research Committee identified conversion of poa greens to bentgrass as a research priority. Complete conversion from poa into bentgrass was not essential but increasing bentgrass populations from near zero to 50% was desirable. Moreover, conversion would have to take place while the green was still in play.

The poa seed bank: In order to understand the hurdles that an overseeding program must overcome, we need to understand first why poa is so successful. First and foremost, poa is an extremely active seed producer, which means that there are always high numbers of poa seeds in the soil waiting to germinate when the conditions are right. The poa seed in the soil is frequently referred to as the poa **seed bank** (Figure 1). The most important point illustrated in this figure is that even though there are a variety of ways in which poa seed gets "withdrawn" from the seed bank, the plant is such a prolific producer of seed that the "deposits" always far outweigh the "withdrawals". In fact, based upon research conducted by Gaussion and Branham, a poa soil seed bank can range between about 2 and 14 million seeds per 1000 square feet of soil in the top three inches (Gaussion and Branham, 1989). In contrast, the conventional bentgrass overseeding rate is 1.75 lbs of seed per 1000 sq ft, or about 9 million bentgrass seeds per 1000 sq ft. In other words, the number of poa seeds in the soil is often equal to, or even higher than the number of bentgrass seeds applied in overseeding programs.

Figure 1. Life-cycle of *Poa annua* (poa). The poa seed bank increases by deposits of seed in the soil. In order to reduce the seed bank, seed can either be removed (via clippings removal) from the plant to prevent a deposit, or once the seed has been deposited, it can be withdrawn by insects, disease, old age, and possibly using herbicides (not practical yet). Another method of reducing deposits into the seed bank is to kill the seed producing poa plant.



The frustrating thing about the poa seed bank is that any cultural practices that superintendents use to encourage the germination of overseeded bentgrass will also encourage the germination of

poa seeds. No one has yet come up with a way to selectively enhance bentgrass seed germination without also enhancing poa seed germination.

Tipping the scales: To be successful, a bentgrass overseeding program must tip the scales in favor of bentgrass compared to poa. This sometimes occurs in the fall when poa has succumbed to high salinity and has died. Drilling in bentgrass seed or broadcasting bentgrass seed over a verticut green sometimes leads to establishment in areas where the poa has been killed. However, these areas seem to revert to poa when environmental conditions become favorable for germination of poa seed in the seed bank. Seldom does the drilled or overseeded area remain bentgrass. The reason once again lies in the relative competitiveness of poa seed in the seed bank compared to bentgrass plants.

Poa plants -- worthy adversaries: In addition to having to compete with the poa seed bank, bentgrass also has to compete with the very high density, competitive stands that the poa plant produces. Studies conducted by PTRI revealed there are about 19 million poa plants per 1000 sq ft of greens surface. Poa may have an additional competitive edge due to the production of materials called allelochemicals which have been shown (Brede and Harris, 1987) to inhibit the growth of bentgrass and other turfgrasses. However, more research would be needed to determine whether allelochemicals are at work in our system here in California.

Poa can invade bentgrass greens through a variety of avenues, not the least of which is through transfer of poa seed on equipment and shoes. In a 1995 study conducted by Harivandi and Hagan (Harivandi and Hagan, 1995) it was illustrated just how difficult it is for bentgrass to compete with poa. These researchers evaluated about 20 bentgrass varieties for their ability to ward off invasion by poa under sand greens maintenance conditions. They found that poa was able to invade all varieties of bentgrass, with a range of competitive bentgrass displacement between 10% and more than 50% within three years. Using these figures, the best case scenario is that poa would displace about 3.33% of the bentgrass plants per year (10% poa invasion in the 3 years the trial was in place) and it would take more than 16 years to convert a green to 50% poa. In the worst case scenario, a bentgrass green would be converted entirely to poa within 6 years. Thus, even under ideal conditions for bentgrass growth and development, poa is capable of invading and displacing bentgrass plants. This factor combined with the presence of a poa seed bank reveals why conversion of a green from poa to bentgrass is unlikely using current knowledge and technologies.

Materials and Methods: The practice putting green at Mesa Verde Country Club remained under play during the course of the two experiments to duplicate the traffic conditions on a normal golf course green. Plots were four by four feet in size.

Experiment #1: Prior to the chemical pre-seeding treatments, the area was aerified (1/4 inch diameter hollow cores on a 2x2 inch spacing) and verticut in three directions. Chemical treatments directed at slowing existing turfgrasses (both poa and bentgrass) included Primo (cimectacarb, Ciba) at 0.25 and 0.50 oz/1000 sq ft in 4 gal/1000 sq ft and Scythe biological burn-down herbicide (Pelargonic acid, Mycogen) at 5% in 4 gal/1000 sq ft. Chemical treatments were applied on 5/1/96.

Southshore (Lofts, inc.)creeping bentgrass seed was applied 48 hrs after the chemical treatments. Seeding rate was 1.75 lbs/1000 sq ft and was applied using a shaker jar by mixing the seed with 150 g dry #30 silica sand and 18.2 g Peter's 20-20-20 fertilizer (0.5 lbs N/1000 sq ft). The seed was not exposed to the sand/fertilizer mixture until immediately prior to uniformly shaking the mixture onto each plot area. All plots were seeded and watered following application on 5/3/95. No additional fertilizers were applied to the standard overseeding treatment. The Primo and Scythe treated plots received two additional applications of fertilizer at 0.5 lbs N/1000 sq ft applied as a foliar spray in 4 gal/1000 sq ft.

Each plot was sampled by arbitrarily collecting plugs of turf using a 1 inch soil sampling probe on 7/26/95. Five subsamples were collected from each plot and placed into a plastic freezer bag and refrigerated prior evaluation. Each of the five plugs of turf from each plot were evaluated visually using a dissecting microscope and counting the number of bentgrass plants. The count of all

plants, poa and bentgrass, on five plugs was used to estimate the total number of plants per unit area of the green surface.

A second experiment was designed to evaluate intensive bentgrass seeding rates, 8 lbs Southshore/1000 sq ft. Plots were aerified using 1/4 inch hollow tines on a 2x2 inch spacing nine days prior to initial treatment. Chemical and fertilizer treatments included Primo at 0.5 oz/1000 sq ft with and without two additional fertilizer applications and fertilizer applications alone. The rational being that any added fertilizers might stimulate germination of existing poa seed in the seed bank and the bentgrass seed applied with the fertilizer over the surface may have a better chance of obtaining the fertilizer before the poa seed. Primo was applied on 10/5/95 and plots were seeded on 10/6/95. Plugs were collected using the same technique described for the first experiment on 12/7/95.

Results: Results of total plant counts in a sample plug indicates that there are 16.7 million established plants/1000 sq ft in the test area. The number of bentgrass seeds in the Shouthshore seed lot was estimated by weighing and counting three replicate seed samples. There were 11,295 ± 860 seeds per gram or about 5.1 million seeds per pound. The seeding rate of 1.75 lbs seed/1000 sq ft resulted in an application of 8.98 million seeds/1000 sq ft. The seeding rate for the second experiment was 8.0 lbs seed/1000 sq ft and resulted in the application of 41 million seeds/1000 sq ft.

The Scythe herbicide killed the foliage on all treated plots but new foliage grew up in 14 days. Table 1 below summarizes the results. Any treatment that damaged or slowed the growth of existing turf reduced the subsequent stand of poa. The Scythe and high rate of Primo both resulted in significantly fewer bentgrass plants compared to the non-treated plot. There also was no advantage to overseeding the plot area. These results suggest that overseeding at 1.75 lbs/1000 sq ft is not sufficient to increase bentgrass stands. In addition, treatments that reduce existing bentgrass plants or addition of fertilizer that may encourage poa seed in the seed bank to germinate may result in lower levels of bentgrass than were initially present. These results support the work of Harivandi and Hagan that clearly indicates that bentgrass competes with poa most effectively when it is high quality, healthy and vigorous (Harivandi and Hagan, 1995). Growth regulators that slow existing bentgrass plants or herbicides that severely damage existing bentgrass plants possibly result in providing a competitive advantage to the poa seed bank seeds.

Table 1. Results of first experiment. Average bentgrass plant count per sample of five 1 inch plugs. All plots received the standard overseeding treatment of 1.75 lbs Southshore seed/1000 sq ft plus 0.5 lb N/1000 sq ft. Values followed by the same letter are not significantly different (Fisher's LSD, p , 0.05).

Treatment	Number of bentgrass plants per five plugs
Primo 0.50 oz/1000 sq ft	4a
Scythe 5%	6a
Standard overseeding	11ab
Primo 0.25 oz/1000 sq ft	12ab
Non-treated	25 b

Wh Table 2. Results of second experiment. In this case the numbers reported are the total number of bentgrass plants observed per treatment consisting of five plugs from each of three replicates (15 total plugs). No increase in bentgrass establishment was observed.

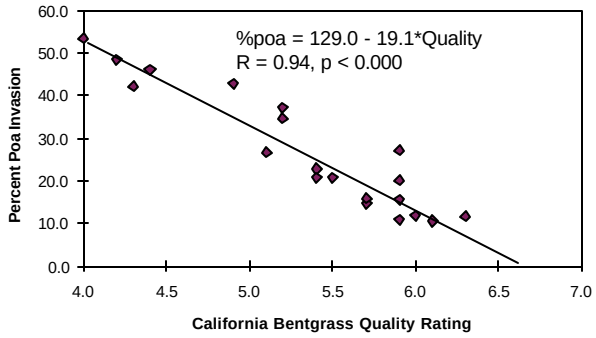
Treatment	Total number of bentgrass
Primo 0.50 oz/1000 sq ft Plus fertilizer	0
Primo 0.50 oz/1000 sq ft No fertilizers	0
Intensive overseeding No fertilizers	0
Intensive overseeding Plus Fertilizer	6
Non-treated	2

y wasn't the extremely high rate of 41 million bentgrass seeds per 1000 sq ft successful? Probably all of the factors described previously act against invasion of bentgrass seeds, including competition with the high density, already established stand of poa plants, as well as with germinating seeds from the poa seed bank. Whatever the reasons, under almost any

experimental or real-life regime, it appears that poa always wins hands down when it is matched with bentgrass.

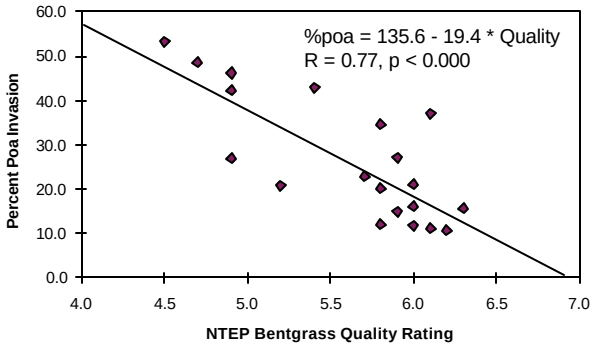
Preventing poa invasion into bentgrass -- the influence of bentgrass varieties: What was the difference between bentgrass varieties tested by Harivandi (see above) that caused different levels of poa invasion to occur? It appears to be turfgrass quality. Harivandi and Hagan noted that there appeared to be a correlation between turf quality and percent poa invasion. However, they did not analyze the data to determine if there were correlations between turf quality and poa invasion. When Harivandi and Hagan's data was analyzed by PTRI, their observations were confirmed (Figure 2). Varieties with higher quality ratings demonstrated lower levels of poa invasion.

Figure 2. Correlation between bentgrass variety quality rating and poa invasion (California quality ratings). When bentgrass variety quality ratings increase, poa invasion decreases. None of the varieties completely prevented poa invasion. An estimated quality rating of greater than 6.7 is needed to prevent poa invasion for three years. Data from Harivandi and Hagan, 1995.



In addition to the quality ratings collected in California, Harivandi and Hagan also examined the NTEP (National Turfgrass Evaluation Program) average quality ratings for the varieties evaluated in California. They found that a similar relationship between turf quality and poa invasion also existed (Figure 3). In both cases, a quality rating close to 7 was needed to prevent poa invasion for three years. Unfortunately, none of the varieties tested reported an average quality rating of greater than 7 and all varieties reported significant poa invasion during the three years the study was conducted.

Figure 3. Correlation between bentgrass variety quality rating and poa invasion (NTEP quality ratings). When bentgrass variety quality ratings increase, poa invasion decreases. None of the varieties completely prevented poa invasion. An estimated quality rating of greater than 6.9 is needed to prevent poa invasion for three years. Data from Harivandi and Hagan, 1995.



What about improved poa varieties? The primary goal of the bentgrass overseeding program is to improve the quality of the putting surface. One option is overseeding poa greens or replacing existing poa greens with an improved variety of poa that tolerates higher stress levels (heat, salinity, disease) and does not produce seed heads when mowed at green heights. This strategy depends upon effective overseeding and improved competition of the new variety compared to existing poa biotypes. Based upon the simple model presented earlier, it is unlikely that any turfgrass variety that is introduced into an existing poa green will be able to out compete the existing poa. The ability of existing poa plants to produce seed when mowed at 1/8 inch insures that current biotypes will persist until a turfgrass with higher reproductive ability (produces viable seeds when mowed at 1/8 inch) and competitive ability has been discovered. Therefore, new poa varieties should not be expected to perform better than bentgrass varieties in their ability to germinate and establish in an existing poa green.

Poa management in new bentgrass greens: There are currently no effective products for removing poa from bentgrass greens in the Southwest. The alternatives are hand weeding or

burning small poa plants out of the green before they begin to produce seed. This is a labor intensive and expensive process but it can delay the invasion of poa.

A key step in preventing poa invasion of new bentgrass greens is to eliminate poa from the entire golf course. If the fairways and roughs are warm season turfgrasses such as bermudagrass, the non-overseeded bermudagrass can be treated with a variety of herbicides that will kill poa postemergence and/or will prevent germination as a preemergence treatment.

If fairways are cool season turfgrasses or overseeded with a cool season turfgrass such as ryegrass, the options for control of *Poa annua* are greatly reduced. In cases where overseeding is desired, consider alternating overseeding the fairways one year and the roughs in the alternate years. This will allow more aggressive poa control programs to be implemented in areas that are not overseeded. Prograss can be used for poa control in cool season turfgrass, however, prolonged repeated use of Prograss can lead to selection of poa biotypes that are resistant to this herbicide. Alternating chemicals and areas that are overseeded and not overseeded (fairways and roughs) will help control poa on the entire course.

Preemergence herbicides, such as Betasan, can be used to prevent poa seed germination in a bentgrass green. The only concern using preemergence herbicides is that if existing bentgrass becomes damaged for some reason, the repair options are limited. This is because Betasan, or any preemergence herbicide will inhibit newly introduced seed from germinating and because bentgrass is slow to grow over damaged areas by stolons alone.

Poa: will the nightmare end? There are no simple solutions to the problems posed by annual bluegrass in California. In addition to searching for ways to fight poa, PTRI will continue to develop poa management systems that yield the highest quality poa greens possible. We will keep you up to date as research progress is made through PTRI and other studies.

References:

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