Biological Control of *Poa annua* in Fairways

NTA Research Report
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Project Background:

Elimination of *P. annua* from golf course turf has been an objective of turfgrass managers and research personnel for decades. Its elimination from golf course fairways will enhance aesthetics, playability, save money and labor, and make the game a more positive experience for golfers. The use of a biological control to achieve this objective will be proactive environmental stewardship by the turfgrass industry.

Showing promise and warranting additional turf research is *Pseudomonas fluorescens* strain D7, a deleterious rhizosphere bacteria has been registered (EPA Reg No. 71975-U, 71975-WA-001) by Verdesian Life Sciences primarily as a biological control (herbicide) in the agricultural sector for the control of downy brome (*Bromus tectorum*). Limited research has been done on turfgrasses. Kennedy et al. (2001) in a laboratory study showed D7 did not inhibit the growth or germination of tall fescue, perennial ryegrass, or Kentucky bluegrass. In a silt loam soil in the growth chamber, D7 did not inhibit the root growth or germination of tall fescue, but did inhibit the germination (but not root growth) of perennial ryegrass. No research has been conducted to date on the effect of D7 on *P. annua*.

D7 shows promise as a biological control of weeds in the PNW, it was developed at WSU, has been under ongoing WSU research for over 20 years, and has been tested on numerous soils in the PNW. Anecdotal observations have indicated that D7 might have some control of annual bluegrass (Jim Connolly, personal communication, 2015); however, research data and findings are now needed to confirm, or dispute, the potential of this new biological product for the control of *P. annua* in turf.

Uniqueness of the study:

1. Potentially identify a biological control of *P. annua*.
2. A single application of D7 may provide long-term control (see Fig. 1).
3. D7 could provided control of *P. annua* presently in the seed bank over time, which is not possible with currently available herbicides.

Research Objectives:
1) Golf course study to determine the effects of timing and rates of D7 (fall only vs. fall + spring) on *P. annua* control in a mix *P. annua*/Kentucky bluegrass fairway over several years.

2) Effect of herbicide treatments (Tenacity + Xonerate and PoaCure) to initially knock down the *P. annua* population followed by D7 applications for long-term control. Biological controls typically start slow, giving essentially unacceptable control compared to chemical treatments; however, as the microorganism increases over several years it is anticipated it will eventually provide acceptable, continuous *P. annua* control (Fig. 1). Thus, with the combination there will initially be less *P. annua* to deal with and acceptable early control followed by later biological control.

Experimental Design & Methods:

Field studies were initiated at the WSU Palouse Ridge Golf Course in late fall 2015 with applications of D7 to a Kentucky bluegrass/*P. annua* fairway.

Study 1 - evaluate timing and rates of D7 (D7 applied only in year 1) for *P. annua* control over three years. D7 timings were fall only (11/16/15) and fall (11/16/15) + spring (4/6/16). D7 rates were 0, 2, 10, or 30 g/acre. PoaCure was also applied at 1.26 fl oz/1000 ft^2 for a chemical treatment for comparison. Fall only PoaCure was applied 11/16/15. Fall + spring PoaCure was applied 11/16/15 and 4/6/16, 4/20/16 and 5/4/16.

Study 2 - evaluate applications of herbicides (to initially knock back the *P. annua* population) followed by D7 applications over the top of the initial herbicide treatments. Herbicide treatments were: 1) PoaCure at 1.26 fl oz/1000 ft^2 in 3 applications spring 2016 (4/20/16, 5/4/16, and 5/18/15) and 3 applications fall 2016 (10/5/16, 10/19/16/, and 11/2/16) and 2) Tenacity (4 fl oz/1000 ft^2) + Xonerate (1.4 fl oz/1000 ft^2) in 3 applications fall 2016 (9/7/16, 9/21/16, and 10/5/16). D7 was applied at 2, 10, or 30 g/acre on 11/17/16. PoaCure and Tenacity + Xonerate will be applied spring 2017 and D7 will be applied in the fall 2017 and 2018. Plots will be evaluated for *P. annua* control, turfgrass quality, etc. for 2 additional years.

Results:
Study 1. The initial percentage of *P. annua* in the fairway was visually estimated at 30-35% (11/16/15). There was no statistical difference in *P. annua* control in either the fall only or the fall + spring treatments. This is somewhat to be expected as the D7 applications have theoretically not yet had time to be effective and the PoaCure treatments were primarily applied in the spring 2016 just prior to the 5/26/16 rating date. However, it had been anticipated that the single fall PoaCure application on 11/16/15 would have had some reduction in *P. annua* (see below Study 2). It is anticipated that continued PoaCure applications in 2017 will show a reduction in *P. annua*.

Study 2. The initial percentage of *P. annua* in the fairway was 35% (5/26/16), which was prior to application of D7 (11/17/16). The percentage of *P. annua* was again

rated on 8/24/16 and 9/21/16. Unlike study 1, the reduction in *P. annua* compared to the check by both Tenacity + Xonerate and PoaCure treatments was evident (Fig. 2). Compared to the initial rating (5/26/16) on 9/21/16 the *P. annua* in the check had increased 38% while *P. annua* in the Tenacity + Xonerate plots had decreased 11% and the PoaCure plots had a decrease in *P. annua* of 32%. D7 was applied in late fall 2016 and no results are yet available. Tenacity + Xonerate and PoaCure treatments will continue in 2017.

Expected Benefits:

Potentially a *P. annua* biocontrol program for fairways will be identified. A single application of D7 may provide long-term control of *P. annua*. Initially the golf course industry will benefit the most, as with many new products and programs. The use of a biological control will provide turfgrass managers an additional option to the use of chemical control measures and will be hopefully seen as sound environmental stewardship by the industry and general public.

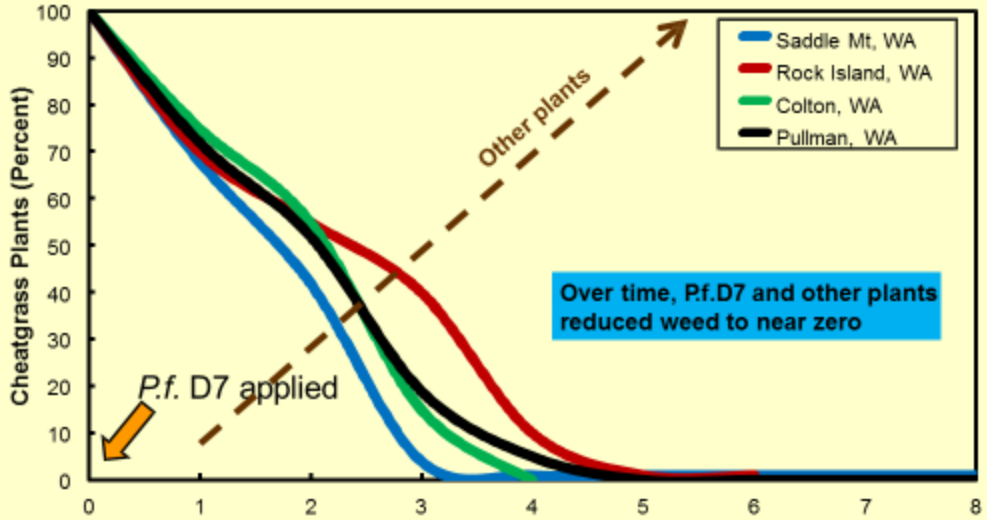
References:

Kennedy, A.C., B.N. Johnson, and T.L. Stubbs. 2001. Host range of a deleterious rhizobacterium for biological control of downy brome. Weed Sci. 49(6):792-797.

Kennedy, A.C., T.L. Stubbs, and J.C. Hansen. 2011. Microbial control of cheatgrass, jointed goatrass, and medusahead. www.fwaa.org/accounts/fwaa/data_documents/60/files/10b-dl-2011-12-13_130p_kennedy.ann.pdf

Verdesian Life Sciences. 2016. Verdesian Life Sciences announces new biological herbicide.

Fig. 1 Cheatgrass reduction over years following *a* D7 application.



5 replicate plots @ each site; P=0.05 for all years except t=0

Fig. 2. Percent change in *Poa annua* in a Kentucky bluegrass fairway