

Reduced Pesticide Approaches toward the Control and Management of Summer Decline of mixed stands of Annual Bluegrass (*Poa Annua L.*) and Bentgrass (*Agrostis sp.*) in Coastal California Golf Courses using the Biologically based product “Greenex”.

Nigel M. Grech, Howard D. Ohr, Steven D. Campbell.
Department of Plant Pathology. UCR, Riverside CA 92521 and

Ray Festa and Tom Massey
Morro Bay Golf Course, Department of General Services, Mono Bay CA
93442

Summer Decline of mixed stands of annual bluegrass and bentgrass have been ascribed to many factors including nutrition, heat stress, genotype and disease. Under coastal California conditions the major summer disease of annual bluegrass is Anthracnose caused by *Collectotric grminieola*, a fungus with global distribution that induces serious disease losses on recreational and amenity turf worldwide, including some species of bentgrass. Anthracnose can manifest itself in two distinct forms; basal rot (ABR) and Foliar blight (AFB) on bluegrass. Both can be present at the same time although basal rot is more serious as it rapidly kills plants by destroying their crowns. Anthracnose infected stands are often also infected with Pythium, a potential root pathogen of many grass species. In our studies in California we have consistently found Pythium species associated and inducing root damages to Anthracnose infected greens. Over the past three years, our group has studies the summer decline disease complex and in this article we report on the effectiveness of bio-rational approaches to the management of this devastating malady of recreational turf.

The incidence of both the ABR and AEB forms of Anthracnose can be sporadic and vary widely between seasons. Management of these disorders by golf course superintendents is difficult and requires intense programs. Research on Anthracnose is being conducted across the USA, but it is complicated by the fact that the incidence and the symptom expression by this pathogen are non-uniform from season to season. As such research trials often do not yield consistent statistical results over several seasons.

Fortunately our ongoing trial site is a coastal California course located at Morro Bay where we have found consistent symptom expression over several seasons. The prevailing marine climate at Morro Bay invariably results in summers that are cool and misty as compared to inland courses. Normally the mist dissipates by mid-morning to noon from which time the summer days are warm, clear and dry. Typically the greens receive irrigation daily during the early evening. We have used a non-playing nursery green for the last three years as our test site. The green has a uniform mix of annual bluegrass and bentgrass.

Over the last three years at Morro Bay we have experienced major disease episodes primarily during August. During September the grass normally generate some recovery growth before the onset of the fall. From our experience at this site several factors have consistently been implicated in this decline syndrome. We have observed during the past three years that major root stress (e.g. Aeration) during the July to August period substantially exacerbates symptom expression. We have also found that nutrition play major role and that the failure to attain optimum elemental levels in the green tissue during the early summer results in substantial more diseases. This has been particularly noticeable for phosphorus and its early season requirement for good root growth. Previous workers have reported on the influence of Nitrogen excesses in increasing the level of Anthracnose and that by reducing the application rates of N, lower disease level can be attained. We have found that it may also be advantageous to increase the levels of both P and K prior to the onset of disease expression as in our trial we have found this practice also results in lower disease. Phosphorus has frequently been reported as reducing disease levels in many crops including turf. Conditions during late Spring and early Summer at Morro Bay (cool temperatures, low organic matter etc.) are not conducive to optimal Phosphorus uptake by the grass roots and this effect may be made worse by the presence of Pythium on the roots. Phosphorus supply to roots is strongly mediated by soil microbes such as bacteria including *Bacillus subtilis*.

The California Golf industry is under intense pressure to reduce the level of pesticides applied to playing surfaces. The move towards a lower chemical dependency is primarily motivated by issues such as health risks, environmental exposure and ground water contamination. The golf industry (together with the agrochemical industries) has made substantial progress in adopting more environmentally benign pest management procedures.

Methods aimed at improving the efficiency of pesticide applications thereby reducing the amount applied have led to a concomitant reduced risk on the part of applicator and patron. It is clear that due to the intense disease pressure during the summer months and the health maintenance requirements of golf courses (in particular, greens), this period of the year becomes the superintendents nightmare, particularly with restricted re-entry compliance regulations. The attraction of alternative, reduced risk methods aimed at improving summer disease management of greens is obvious. The challenge is the integration of these methodologies with conventional fungicides. The first stage of project assessed various non-conventional approaches to the management of the summer decline disease complex and we describe in this article the result of a three years study with the biologically based material "GREENEX".

During the last three seasons we have determined that under our conditions the threshold level of disease maintenance based on our assessment methods (Fig. One) is in the range of one to 1.25(+/- 12%). Above these levels, the visual impact of this disease becomes very obvious to patrons and generally once above these loss levels on playing greens, it is difficult to obtain sufficient re-growth in the necrotic patches during the rest of summer. From a total of ninety-seven treatments we have screened over the last three seasons we report here on the field performance of "GREENEX" a treatment that has resulted in disease rating below 0.5 over the course of the seasons. In a later article we will publish the results of fungicidal trials and the integration of some of these with the products mentioned in this article in both research as well as commercial trials.

Microbial supplementation as well as nutritional modification has been shown in many crop systems to substantially contribute to the management of disease and environmental stresses (such as drought). The use of biological control agents and/or nutritional supplements has previously been shown to suppress a wide spectrum of disease inciting agents. Alone, however, these new technologies are not capable of maintaining golf screens in the pristine conditions golfers demand and have come to expect. In the future, non-conventional control methods for turf health management will play an increasing role and biologically based as well as nutritional products will become a more common sight in the superintendents' disease suppression arsenal.

The results from these studies clearly indicate that substantial levels of control are achievable with alternative non-fungicidal remedies such as Greenex. The disease control level achieved with Greenex over the seasons was generally similar in effectiveness to that achieved with contact fungicide such as Daconil and Fore (mancozeb). The potential for the integration of Greenex onto conventional summer decline disease management program may provide the superintendents with greater opportunity to develop reduced risk spray programs and more easily achieve statutory compliance in regard to worker safety and environmental protection.

Mean Health Rating Mid July — Mid August.

Product	1993	1994	1995
Greenex @ 300g per 1000sq ft in 30 liters, 14 day intervals	0.52b	0.35a	0.26b
Daconil @ 150 mls per 1000sq ft in 30 liters, 14 day intervals.	0.42a	0.25a	0.26a
Fore @ 240 mls per 1000sq ft in 30 liters, 14 day interval.	N/A	0.45ab	0.24a
Untreated	1.2c	1.4c	1.16c

Values in the same column followed by the same letters do not differ significantly from one another according to Duncans multiple range test (P=0.05). Mean values in each season were compared.

Product description.

Greenex® is a product formulation based primarily on a strain of *Bacillus subtilis*, a bacterium that is regarded in the literature as a biological control agent of certain pathogen fungi and other bacteria. This material has also been used for the suppression of algae in water features and on greens.