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This publication includes lecture notes of papers presented at the 2004 New Jersey Turfgrass Expo. Publication of these lectures provides a readily available source of information covering a wide range of topics and includes technical and popular presentations of importance to the turfgrass industry.

This proceedings also includes research papers that contain original research findings and reviews of selected subjects in turfgrass science. These papers are presented primarily to facilitate the timely dissemination of original turfgrass research for use by the turfgrass industry.

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Dr. Ann Brooks Gould, Editor
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EVALUATION OF IRRIGATION REQUIREMENTS AND WATER USE CHARACTERISTICS AMONG THREE BENTGRASS SPECIES

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Water availability for irrigation of turfgrasses has become a key concern due to widespread water use restrictions, making water conservation a top priority for turfgrass growers and managers across many areas of the country. One strategy for reducing turfgrass irrigation requirements is to utilize grasses that require less water. The use of grasses that have a combination of traits for drought resistance and that also persist with reduced water may increase chances for survival during periods where irrigation may be restricted. Greater insight into water use characteristics and irrigation requirements of various grass species is essential for identifying grasses that tolerate reduced water inputs and also for developing efficient irrigation management practices.

Deficit irrigation is the practice of deliberate under-irrigation of a plant to below its maximum water demand. This irrigation strategy has been successfully applied in many agronomic and horticultural crop species, resulting in overall water savings and increased water use efficiency. Investigations where deficit irrigation has been used have also been conducted on several cool- and warm-season turfgrass species, including Kentucky bluegrass (*Poa pratensis*), perennial ryegrass (*Lolium perenne*), tall fescue (*Festuca arundinacea*), Bermudagrass (*Cynodon dactylon*), and zoysiagrass (*Zoysia japonica*). These studies have generally demonstrated that many turfgrasses can tolerate certain levels of deficit irrigation with little or no loss in aesthetic turf quality. Furthermore, the proper use of a deficit irrigation strategy, either through decreased irrigation quantity or irrigation frequency, has also been related to increases in turfgrass water use efficiency and decreases in total water use.

While there have been investigations conducted on deficit irrigation for other turfgrass species, information is generally lacking on the effects of deficit irrigation and general irrigation requirements of bentgrasses (*Agrostis* spp.), which are popularly utilized as turf for golf course tees, greens, and fairways. The minimum water requirements for bentgrass species have not been evaluated, particularly with regard to variability in requirements among different bentgrass species used for high maintenance, close-cut turf. Furthermore, comparisons of water use and drought resistance characteristics among bentgrasses have also not been determined. This information would be valuable for providing better irrigation management recommendations for conserving water in bentgrasses, as well as providing insight on selecting bentgrasses better adapted to limited irrigation conditions. Therefore, the primary objectives of this study were to: (i) determine minimum water requirements for maintaining acceptable quality fairway established to creeping (*A. stolonifera*), colonial (*A. capillaris*), and velvet (*A. canina*) bentgrasses; and (ii) examine and compare water use characteristics and water use efficiencies of these bentgrass species under varying levels of deficit irrigation.

The study was conducted from July to November in 2002 and 2003 at the Rutgers University Horticulture Research Farm II, North Brunswick, NJ. To quantitatively control irrigation and soil moisture under field conditions, this study was conducted on field plots covered with a fully automated, mobile “rainout” shelter that excluded rainfall from test plot areas. Plots were irrigated three times per week at four levels of irrigation quantity based on the percentage of maximum potential daily water loss through actual evapo-

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transpiration (ETa) (100, 80, 60, and 40% ETa replacement). ETa was determined using minilysimeters installed in well-watered plots receiving 100% ETa irrigation three times per week. Turf performance under the four irrigation regimes was evaluated by measuring visual turf quality, canopy spectral reflectance parameters, soil moisture depletion rates, and canopy photosynthetic rates. Cumulative water use was determined using minilysimeters installed within plots of each of the irrigation treatments. Long-term plant WUE was evaluated based on carbon isotope analysis of plant tissue sampled from plots at different stages of drought stress.

Our results demonstrated that irrigating at 100% ETa was not necessary to maintain acceptable turf quality and physiological processes in creeping, colonial, and velvet bentgrasses, and that the minimum water requirements depended on species and season of the year and varied between years. Colonial bentgrass required irrigation at 80 to 100% ETa, while creeping and velvet bentgrasses required irrigation at 60 to 80% ETa to maintain acceptable turf performance in the summer (July and August) of 2002. Velvet bentgrass maintained better turf growth at 60% ETa for a greater duration than creeping bentgrass during this period, indicating lower minimum water requirements for velvet bentgrass. The comparison of irrigation requirement between the two years revealed that minimum irrigation requirement to maintain acceptable turf performance was generally lower in 2003 than in 2002. In 2003, plants were able to maintain acceptable performance with 60% ETa irrigation throughout the majority of the summer treatment period for all species. The lower irrigation requirements in 2003 could be attributed to the combination of higher relative humidity, lower air temperatures, decreased wind speed, and lower solar radiation during July and August that could result in lower evaporative demand. The minimum irrigation requirement for all three species was less in the fall months (September and October) compared to that in the summer months in both years. Irrigating at 40% ETa in the fall treatment period in both 2002 and 2003 was sufficient to maintain acceptable visual quality, canopy growth parameters, and canopy photosynthesis compared to plots receiving 100% ETa. This was most likely due to changes in ETa rates resulting from lower evaporative conditions in the fall months

Deficit irrigation also resulted in a decrease in total water use for all three species, particularly in the summer months. In July of 2003, utilizing 60% ETa replacement that was not detrimental to quality and other physiological parameters resulted in approximately 15 to 20% reduction in plant water consumption. While differences in water use between the species were not apparent during October, during conditions of higher evaporative demand in July, a general trend between species water use was observed: velvet bentgrasses had lower water use, while colonial bentgrasses had the highest water use at each of the irrigation treatments. These results were also related to inherent plant water use efficiencies of each bentgrass species. According to carbon isotope discrimination values, velvet bentgrass had the highest water use efficiency, while colonial bentgrass had the lowest efficiency among the three species.

In summary, colonial bentgrass had the highest water use and irrigation requirement, while creeping and velvet bentgrass exhibited lower water consumption and water requirement. Among the three species, velvet bentgrass plots retained a greener color, higher canopy photosynthetic rates, and lower soil moisture depletion for a longer time than creeping and colonial bentgrass under deficit irrigation regimes. These results indicated that velvet bentgrass had lower water requirements than the other bentgrass species. Furthermore, this study demonstrated potential irrigation savings of 20 to 40% in the summer, depending on species, and 60% savings in the fall months, with minimal impact on bentgrass quality and other physiological parameters. Consequently, the use of deficit irrigation practices could be an essential component in the development of irrigation management programs that result in both water and monetary savings in managing bentgrass fairways. Morphological and physiological factors associated with differences in drought resistance and water use among the bentgrasses are under further investigation.