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PURPOSE

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Interspecific Hybridization as a New Approach to Improving Dollar Spot Resistance in Creeping Bentgrass

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SUMMARY

Interspecific hybridization between creeping and colonial bentgrasses was investigated as a way of incorporating the inherent dollar spot resistance from colonial bentgrass into creeping bentgrass at Rutgers University. Results of the projects included:

- Controlled crosses in a greenhouse were done to determine the frequency of hybridization.
- Hybrids between creeping and colonial bentgrass were recovered at low frequencies. The hybrids were then put into crossing blocks in the field and checked for fertility. They were found to be fertile, both through the pollen and the egg.
- The hybrids were also evaluated for dollar spot resistance in field tests. Some of the hybrids exhibited excellent dollar spot resistance.
- These results indicate that interspecific hybridization may be a useful new approach to creeping bentgrass improvement.

Creeping and colonial bentgrasses are important turfgrass species used extensively on golf course greens and fairways in temperate climates (12, 14). Creeping bentgrass is generally preferred, in part, because of its aggressive stoloniferous growth habit. One of the most important maintenance problems with creeping bentgrass is dollar spot disease, caused by the fungus *Sclerotinia homoeocarpa* (Figure 1). Fungal infection results in silver dollar-size dead areas in the turf that can coalesce to form large dead spots. No current cultivars are completely resistant to dollar spot, although recent releases do show improved resistance (7).

Currently, control of dollar spot disease relies heavily on fungicide treatments which can be expensive. Also, there is increasing pressure

on many golf courses to reduce the use of pesticides. Although colonial bentgrass is not as widely used as creeping bentgrass, it generally does have good resistance to dollar spot (10) and may be a source of genes that would be useful in improving the dollar spot resistance of creeping bentgrass.

Interspecific Hybridization

We have been working for several years on new approaches to improving dollar spot resistance in creeping bentgrass. One approach that has been successful in other crops is interspecific hybridization. Interspecific hybridization means crossing between two species. Usually there are biological barriers to such crosses, but interspecific hybridization is frequently possible between two related plant species. Interspecific hybridization is a process that often occurs naturally and is believed to be one of the mechanisms that con-



Figure 1. Symptoms of dollar spot on creeping bentgrass include silver dollar-size dead areas in the turf that can coalesce to form large dead spots.

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tributes to the generation of new species (15). Some important crops that originated from ancient natural interspecific crosses are wheat, oats, cotton, apple, and strawberry, to name just a few (6). In fact, many turfgrass species, including creeping and colonial bentgrasses, are believed to have originated from natural interspecific hybridization (8, 5).

Modern-day plant breeders have also used interspecific hybridization. It is an attractive approach when a related species has a particular trait that is desired in the crop species. The standard method is to cross the crop species with a related species producing an interspecific hybrid. This is followed by several generations of crossing back to the crop species, selecting those individuals that have the desired trait from the related species. For example, root-knot nematode resistance in many modern tomato cultivars originates from a gene from a wild species related to the cultivated tomato (9, 13). Similarly, many modern wheat cultivars have some genes introduced from rye that contribute to disease and insect resistance (11).

Hybrids between Creeping and Colonial Bentgrass

Interspecific hybridization has not yet been used by bentgrass breeders (4). For the past several years, we have been exploring the possibility that this may be a useful new approach to creeping bentgrass improvement. We are particularly interested in hybridization between creeping bentgrass and colonial bentgrass since colonial bentgrass has good resistance to dollar spot (10). Also, these two species have the same chromosome number, 28 (8), which makes interspecific hybridization more likely to be useful.

Our first step was to evaluate the frequency of interspecific hybridization and the fertility of the hybrids that were produced by setting up controlled crosses in a greenhouse. To do this, colonial and creeping bentgrass plants were vernalized in the field in 1997. Some plants, including the bentgrasses, require a period of cold temperature and short days before flowering can occur. This process is called vernalization.

5061



TH15



Figure 2. Dollar spot resistance of plant TH15, an interspecific hybrid between colonial and creeping bentgrass, compared with plant 5061, its creeping bentgrass parent. The photographs were taken on 9-13-03.



Figure 3. Variation in appearance of progeny from a cross between interspecific hybrid #15 and a creeping bentgrass plant. The plant in the center is more similar to colonial bentgrass whereas the two plants on either side are more similar to creeping bentgrass. The photograph was taken on 9-15-04.

In the spring of 1998, plants were removed from the field and were brought into the greenhouse and controlled crosses were established. Flowers of a colonial bentgrass plant and a creeping bentgrass plant that were at the same developmental stage were bagged together in cloth bags. Seeds recovered from the colonial bentgrass plants were germinated, and some of the seedlings were confirmed to be interspecific hybrids, where pollen from the creeping bentgrass plant fertilized an egg from the colonial bentgrass plant. Overall, we found that hybrids between creeping bentgrass and colonial bentgrass could be produced at low frequencies (1).

The hybrids recovered were vernalized in the field in 1999 and analyzed for fertility in 2000. This was important because in order for interspecific hybridization to be a useful method, the hybrids need to have some level of fertility since it will be essential to cross the hybrids back to creeping bentgrass. The results indicated the hybrids were fertile, both through the pollen and the egg (1).

The next step was to determine if any of the colonial x creeping interspecific hybrids produced had improved dollar spot resistance, relative to the creeping bentgrass parent. To do this, the interspecific hybrids and their creeping bentgrass parents were vegetatively replicated and planted in a randomized complete block design. The field was inoculated with the dollar spot fungus (3). The plants were rated for disease severity at approximately weekly intervals throughout the season. In field tests carried out in 2001 and 2002, some of the interspecific hybrids exhibited excellent dollar spot resistance (2). Similar results with these plants were also obtained in the 2003 field test (Figure 2).

These results were promising regarding the potential of interspecific hybridization in creeping bentgrass improvement. The next step in this project was to cross an interspecific hybrid with a creeping bentgrass plant and to evaluate the progeny of that cross for dollar spot resistance. In 2002, one of the hybrids was crossed with a creeping bentgrass plant and about 1000 progeny were



Figure 4. Variation in dollar spot susceptibility in progeny from a cross between interspecific hybrid #15 and a creeping bentgrass plant. The plant on the left had no dollar spot symptoms, whereas the plant on the right was severely affected. The photograph was taken on 9-15-04.

obtained. These plants were field-tested for dollar spot resistance in 2003 and 2004. This population of plants is very interesting since there is huge variation in appearance among plants. Some plants resemble colonial bentgrass in having a more upright growth habit, while others have the spreading, aggressive growth of creeping bentgrass (Figure 3). There is also variation in the susceptibility of the plants to dollar spot. Some individuals have a similar level of dollar spot as creeping bentgrass and some have improved resistance (Figure 4).

Overall, interspecific hybridization between creeping and colonial bentgrass does look like a useful method to introduce dollar spot resistance to creeping bentgrass. We are currently involved in new studies to try to identify the genes in colonial bentgrass that are important for dollar spot resistance.

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