White Paper: Perspective on Creeping Bentgrass, Agrostis stolonifera L.

Bruce Macbryde

White Paper: Perspective on Creeping Bentgrass, *Agrostis stolonifera* L.

USDA/APHIS/BRS
(Bruce MacBryde, ver. 5/31/2006; final)

Introduction
to
"White Paper: Perspective on Creeping Bentgrass, *Agrostis stolonifera* L."

(USDA/APHIS/BRS)

Purpose

This white paper is intended to provide background scientific knowledge on the biology and ecology of *Agrostis stolonifera*. No overview of the basic biology and ecology of the species was available prior to this undertaking.

Context

Agrostis stolonifera (creeping bentgrass) is the species most utilized for golf courses in temperate areas worldwide. A strain has been genetically engineered to be tolerant to the herbicide glyphosate, in order to control especially the weedy species *Poa annua* (annual bluegrass) on golf courses. The USDA's Animal and Plant Health Inspection Service (APHIS) has been petitioned to grant non-regulated status to this glyphosate-tolerant strain.

Glyphosate is the most extensively used herbicide worldwide, and *Agrostis stolonifera* is an outcrossing perennial widespread in managed and natural environments. It hybridizes with many species of *Agrostis* (bentgrass) and *Polypogon* (rabbitsfoot grass) found in the United States. Creeping bentgrass and several of the hybridizing species can be weedy or invasive in some situations. The white paper is a summary document, which is heavily referenced, to provide a scientific overview on biology and ecology and a guide to the non-agronomic information about *Agrostis stolonifera*.

History

As part of the regulatory review process on the petition, a December 2003 version of the "Perspective" comprised much of the APHIS Biotechnology Regulatory Services (BRS) preliminary risk assessment, which APHIS-BRS has referenced in several Federal Register notices relating to the petition. The Perspective's scientific information played an important part in the APHIS-BRS decision to prepare an Environmental Impact Statement (EIS) under the National Environmental Policy Act to assess potential impacts from granting the petition and has been useful for some aspects of the EIS drafting.

The white paper [also linked below] has been peer-reviewed in accordance with the December 2004 directive of the Office of Management and Budget for peer review of scientific information.

http://www.aphis.usda.gov/peer_review/downloads/cbg-wpFinal.pdf

White Paper: Perspective on Creeping Bentgrass, *Agrostis stolonifera* L.

USDA/APHIS/BRS (B. MacBryde, ver. 5/31/2006)

Foreword

Creeping bentgrass (*Agrostis stolonifera*) has been utilized as a forage species for centuries, and as a turf species for many decades. It now occurs worldwide in temperate areas. However, basic information on *Agrostis stolonifera* from the non-agronomic biological and ecological literature had not previously been consolidated. Consequently, this white paper presents a general overview on *Agrostis stolonifera* biology and ecology as a native and naturalized species, with certain aspects focusing on the United States and Canada. This synthesis and summary provide perspective on *Agrostis stolonifera* and a pathway to the diverse literature[1], to advance understanding, research and application.

Contents

1. Overview of the Genus *Agrostis* and its Species

1.1. Some field grasses were called *Agrostis* by Theophrastus (*ca*. 371-287 BC), the director of Aristotle's garden in Athens (Greene 1909). Bentgrasses (*Agrostis*) are in the convenient grouping called cool-season grasses, with a C_3 photosynthetic pathway (*cf*. Campbell *et al*. 1999; Goverde *et al*. 2002). Within the family Poaceae (Gramineae), the genus *Agrostis* is in the tribe Poeae (including Aveneae and Agrostideae), which also contains oats (*Avena*), and in the subtribe Agrostidinae (Soreng *et al*. 2003; *cf*. Clayton & Renvoize 1986; Watson & Dallwitz 1992, 1998, 1999; Mabberley 1998). The genus might include 150-200 species, occurring primarily and probably originating evolutionarily in the Northern Hemisphere in western Eurasia (the European region), with some species having evolved in the Southern Hemisphere and temperate to cold-temperate areas of tropical mountains. The generic limits of *Agrostis* are not obvious (*e.g.* Phillips & Chen 2003; Edgar & Forde 1991), and sometimes *Podagrostis* (Björkman 1960), *Bromidium* (Rúgolo de Agrasar 1982) and *Lachnagrostis* (Edgar 1995; Jacobs 2001) are considered distinct (Soreng *et al*. 2003). The noun "bent" is a Middle English word for a grassy place and/or its grasses (from Old English "beonot-"); broad secondary meanings include a reedy grass or stiff stalk of coarse grass (MW 2003). As a common name, various species in more than a dozen genera of grasses have been called bents

[1] Much of the information in this review is obtainable only by continually noting the references as they are cited and reading the titles.

(*e.g.* reed bent, silky bent), and as well a sedge (*Carex*) and a bulrush (*Scirpus*), but bent has been associated especially with species of the genus *Agrostis* since at least 1677 (Piper 1923; MW 2003).

1.2. In the United States, 35 species of *Agrostis* in the broad sense (*sensu lato*) are native or naturalized, with 17-19 of them also in Canada (see Table 1). There are 26-29 native species of *Agrostis* in the USA, and 7-9 established introductions, mainly from Eurasia (7 or 8 of these species are entirely introduced, 1 or 2 mostly so). If the genus is instead considered in the narrow sense (*sensu stricto*) (Soreng & Peterson 2003), two of the native species would be placed in *Podagrostis* (Grisebach) Scribner & Merrill and one each of the introduced species in *Bromidium* Nees & Meyen and *Lachnagrostis* Trinius (Table 1). Overall taxonomy within the genus *Agrostis* is unsettled and difficult. There is no comprehensive worldwide or definitive U.S. taxonomic treatment (*cf*. Hitchcock & Chase 1951; Carlbom 1967; Simpson 1967; Harvey 1993, 2004; Kartesz 2006), but there are some thorough floristic treatments and a few definitive regional taxonomic studies (*e.g*. Philipson 1937; Björkman 1960; Widén 1971; Romero García *et al*. 1988b; Tutin 1980; Rajbhandari 1985, 1987; Koyama 1987; Edgar & Connor 2000; Rúgolo de Agrasar & Molina 1992, 1997a). Consequently, the number of North American species stated above is a distillation reflecting different judgements.

1.3. Cytological study of chromosomes (karyology) along with experimental hybridization have provided central taxonomic insights, as polyploidy (multiplication of the basic set of paired chromosomes) plays a significant role in the evolution of the genus and within some species (*e.g.* Sokolovskaya 1938; Davies 1953; Jones 1953, 1956a-1956c; Björkman 1951, 1954, 1960; Carlbom 1969; Vovk 1970; Widén 1971; Sokolovskaya & Probatova 1974; Tateoka 1975; Tateoka & Michikawa 1987; Rumball & Forde 1977; Romero García & Blanca 1988; Romero García *et al*. 1988a; Frey 1997; Tomić & Šurlan-Momirović 1999; Tomić *et al*. 2003; Bonos *et al*. 2002; Vergara & Bughrara 2003). Substantial taxonomic insight also has come from the study of floret anatomy and histology (*e.g.* Björkman 1960; Romero García *et al*. 1988b). Most species tend to be accepted as distinct, *i.e.* not controversial taxonomically, although many species have received little scientific attention. The general stability includes all five of the species of main agronomic interest (Tables 1 & 2) (Beard & Beard 2005; Aldous & Chivers 2002):

- creeping bentgrass, *Agrostis stolonifera* (Warnke 2003);
- colonial bentgrass, *Agrostis capillaris* (Ruemmele 2003);
- velvet bentgrass, *Agrostis canina* (Brilman 2003; Brilman & Meyer 2000);
- dryland (including Highland) bentgrass, *Agrostis castellana* (Brede & Sellmann 2003);
- redtop, *Agrostis gigantea* (Brede & Sellmann 2003; Balasko *et al*. 1995).

1.4. Nevertheless, using the subtle biological distinctions frequently requires acumen and expertise for identification of the species of whole plants, whether in flower or not (*e.g.* Widén 1971; Tutin 1980; Steiner & Lupold 1978; Steiner 1982; Romero García *et al*. 1988b; Chicouène 1989; Hartvig 1991; Sell & Murrell 1996; Copping 1974; Cope 1991; Adams 1996; Batson 1998a; Behrendt & Hanf 1979; Nittler & Kenny 1969), or the seeds (Hillman 1918, 1930; Musil 1942, 1963; van der Burg *et al*. 1979). Identification can be facilitated by lab analysis (*e.g*. Yamamoto & Duich 1994; Clark *et al*. 1989; Freeman & Yoder 1994; Ohmura *et al*. 1997; Hollman *et al*. 2005; Scheef *et al*. 2003; Ridgway *et al*. 2003; Bonos *et al*. 2002). Routinely, diverse studies either lack full identification,

reporting just *Agrostis* sp. or the plural *Agrostis* spp. (*e.g.* Mountford & Peterken 2003); or they have misidentification (from tradition, assumption or error), either of the species of interest (*e.g.* Scott & Hallam 2002) or by not realizing the population has more than one species.

1.5. For example, there is a need in USA for increased awareness to better distinguish *A. capillaris* and *A. stolonifera* from *A. castellana* (*e.g.* Hartvig 1991), which was rather recently found to be dominant in southeastern Australia by Batson (1996, 1998a) (*cf.* Romero García *et al*. 1988b; Paunero 1947; Brede & Sellmann 2003; Ruemmele 2000a, 2003; Brilman 2001a; Brede 2000; Funk 1998; Edgar & Connor 2000; Edgar & Forde 1991; Sell & Murrell 1996; Cope 1991; Hubbard 1984; Tutin 1980; Steiner & Lupold 1978; Shildrick 1976, 1980; Scholz 1962, 1965; Griffin 1965; Madison 1961; USDA 1948, 1961; Musil 1942; Bartels 1943; Schoth 1930, 1939; Levy & Saxby 1931; Hillman 1930; Henry 1928). Similarly, there is a need to better distinguish *A. canina* and *A. vinealis*, brown bentgrass (Widén 1971; *cf.* Brilman 2003; Warnke 2003; Wipff & Rose Fricker 2001; Funk 1998; Vester 1999; Fryčková 1996; Sell & Murrell 1996; Cope 1991; Hubbard 1984; Tutin 1980; *cf.* Kurchenko 1979a). Thus what may be regarded as the variability of a species in natural or managed populations can actually be more than one species' behaviors intermingled. Fortunately *Agrostis stolonifera* is a distinct and relatively familiar species, particularly in the scope of turf species and golf courses (*cf.* Casler & Duncan 2003; Ruemmele 2000b).

1.6. *Agrostis* is additionally complex in naturally forming F_1 (first-generation) hybrids, which are generally low in fertility or sterile but sometimes vegetatively vigorous, and occur perhaps not infrequently between various species. Such hybrids varyingly include all five of the main agronomic species (*cf.* Brede & Sellmann 2003; Warnke 2003), as well as *Agrostis idahoensis*, Idaho bentgrass (of agronomic interest – Brede & Sellmann 2003; Brede 2004), *A. vinealis*, and several other germane species (see Tables 1 & 2, and Davies 1953; Jones 1956a-1956c; Camus 1958; Björkman 1960; Widén 1971; Bradshaw 1975a, 1975b; Sell & Murrell 1996; Lambinon *et al*. 2004; Paunero 1947; Romero García *et al*. 1988b; Edgar & Forde 1991; Edgar & Connor 2000; Batson 1998a; Wipff & Rose-Fricker 2000, 2001; Wipff & Fricker 2001; Belanger *et al*. 2003c, 2003b; Christoffer 2003). There are a few clear examples of F_2 hybrids (*i.e.* the second generation, F_1 hybrids crossed with each other) (Bradshaw 1975a; Sell & Murrell 1996), and of backcrosses of F_1 hybrids to a parental species (Forde 1991; Edgar & Connor 2000; Batson 1998a; Belanger *et al*. 2003b). In some areas where the *Agrostis* species are native or naturalized, the hybrids are recognized as sometimes being a significant component of vegetation (Widén 1971; Bradshaw 1975a; Sell & Murrell 1996; Edgar & Connor 2000). This composition can occur even with sterile plants because of their vegetative reproduction.

1.7. A summary on the pertinent hybridizations is in Figure 1 and Table 1. In Table 2 are basic details (not all-encompassing) on these species in the USA and their crossing (which is inherently complicated but not atypical in grasses and some other wild plants), along with additional information as follows:

- Notable botanical synonyms (thus subordinate, not just alternative names);
- Common names (*cf.* Monteith 1930; USGA 1932);
- Ranges (where native, and along with the Table 1 information, where naturalized);

- Ploidy (a polyploid has 3 or more sets of chromosomes; frequent levels are **bolded**) (*cf*. Levy & Feldman 2002; Gaut 2002; Soltis *et al*. 2003):
  ***n* = *x* = 7**, the basic set of chromosomes in a male or female gamete, **haploid**
  2*n* = 2*x* = 14, the paired parental sets of chromosomes usual in body cells, **diploid**
  2*n* = 3*x* = 21, three sets of chromosomes usual in the plant's body cells, triploid
  2*n* = 4*x* = 28, four sets of chromosomes usual in plant's somatic cells**, tetraploid**:
    allotetraploid (amphidiploid) = 2 unlike paired sets, AABB (*e.g.* hybrid's sets doubled)
    autotetraploid = 4 sets alike, AAAA (*e.g.* within sp., crossing plants' sets doubled)
    segmental allotetraploids = ~ alike, ± halfway, ~ unalike: *e.g.* AAĀĀ, AAÃÃ, AAḀḀ
  2*n* = 5*x* = 35, five sets of chromosomes usual in plant's somatic cells, pentaploid
  2*n* = 6*x* = 42, six sets of chromosomes usual in plant's somatic cells, **hexaploid**
  2*n* = 7*x* = 49, seven sets of chromosomes usual in plant's somatic cells, heptaploid
  2*n* = 8*x* = 56, eight sets of chromosomes usual in plant's somatic cells, octoploid
  aneuploidy = inexact multiple of chromosomes in all body cells, *e.g.* 2*n* - 1, 2*n* + 2
  aneusomaty = chromosome number varies ± as in aneuploidy within one plant's body cells
- Genomic configuration (*i.e.*, subgenomes or ancestral chromosome sets, *e.g.* AABBCC);
- *Agrostis stolonifera* hybrids with three species of the genus *Polypogon*, rabbitsfoot-grass or beardgrass (*e.g.* Conley 1993; Barkworth 2004; Giraldo-Cañas 2004).

1.8. Natural intergeneric hybrids have been reported in Europe (Stace 1975) and Taiwan between a few species of *Agrostis* and *Calamagrostis* Adanson, which has one naturalized and 25 native species in the United States and Canada. The hybrid of *Agrostis stolonifera* and *Calamagrostis tenella* has been called ×*Agrocalamagrostis stebleri*. However, the species that was in *Calamagrostis* is now considered to be an *Agrostis*, called *Agrostis schraderiana* (or *A. agrostiflora*) (synonym *C. tenella*) (Hess *et al*. 1967; Tutin 1980), and it does not occur in the New World. Natural interspecific hybrids involving other species of *Agrostis* have also been found, but either one or both of the parental species do not occur in the United States and Canada.

2. Distribution and Conservation of *Agrostis* Species

2.1. Many species of *Agrostis* are natively widespread in temperate areas, whereas other indigenous species or taxa (*i.e.* subspecies or botanical varieties) are regional, local or rare (WCMC 1998). Using the Natural Heritage Network's assessment criteria (Master *et al*. 2000), several *Agrostis* in the United States are variously rare (Table 1). There is an endemic species in Hawaii, several endemic taxa in California and/or Oregon, an endemic species in Wyoming (Yellowstone National Park), and a rare species in Wyoming, California and Russia (Kamchatka Peninsula) (CNPS 2001, 2005; ONHIC 2004; Tercek *et al*. 2003; Tercek & Whitbeck 2004; Tercek 2005).

2.2. None of these rare *Agrostis* are now listed as endangered or threatened under Federal law; under State law, in California *A. blasdalei* var. *marinensis* (Marin bentgrass) was listed in 1978 as rare, but in 1998 no plants could be found at its single known site, and it is considered a synonym under the species by Harvey (1993, 2004), CNPS (2001, 2005) and Kartesz (2006) rather than being a distinct biological entity. Creeping bentgrass (*A. stolonifera*) probably occurs in meadow or wetland habitats of some threatened or endangered species of animals and plants listed under Federal law, although confirmation may be needed on the identification of this grass in their habitats (*e.g.*, for the threatened western orchid Ute ladies-tresses, *Spiranthes diluvialis*).

3. The Species Creeping Bentgrass, *Agrostis stolonifera*

3.1. *Agrostis stolonifera* L. is a robust, fast-growing perennial which is biologically and ecologically very variable, phenotypically plastic (adjusting locally) and evolutionarily adaptive (*i.e.* genetically), with vegetative spread and reproduction by stolons (horizontal aboveground stems or runners), wind-pollinated flowers, and tiny (0.07 mg) seeds (*i.e.* caryopses) dispersed by wind, water and animals (Sell & Murrell 1996; Romero García *et al*. 1988b; Grime *et al*. 1988; Kik *et al*. 1990a, 1990b, 1991; Grime & Hunt 1975; Kurchenko 1975; Eriksson 1989; Shipley *et al*. 1989; Davies & Singh 1983; Misra & Tyler 2000b; Aston & Bradshaw 1966; Jónsdóttir 1991b; Ahmad & Wainwright 1976; Wu 1976, 1981; Kik 1989; Badiani *et al*. 1998; Kaligarič 2001; Teyssonneyre *et al*. 2002; Bradshaw & Hardwick 1989; *cf*. Donohue 2003; Grime & Mackey 2002). Generally the species is an allotetraploid (Jones 1956b, 1956c; Warnke *et al*. 1998; Chakraborty *et al*. 2005), but it also has cytotypes of higher ploidy and other such chromosomal complexity (aneuploidy, aneusomaty, and accessory or B-chromosomes), at least within its native range in the Old World — see Table 2 and Kik *et al*. (1992, 1993). Correlations usually are not taxonomically consistent within its very broad natural range, but sometimes the main ecological and/or genetic tendencies in a region are featured either as informal groups or formally as botanical varieties (*e.g.* Philipson 1937; Paunero 1947; Jansen 1951; Widén 1971; Romero García *et al*. 1988b; Sell & Murrell 1996).

3.2. For example in Great Britain and Ireland, Sell & Murrell (1996) point out that the varieties in their region are ecological, but nonetheless recognize taxonomically *Agrostis stolonifera* (**1**) var. *marina*, forming a close turf in salt marshes and areas within tidal spray — stolons few and usually short, culms (stalks) becoming erect, panicles (flower clusters or inflorescences) often rather lax, usually not lobed; (**2**) var. *calcicola*, forming a close turf on chalk downs — stolons either many and short or absent and plants tufted, culms erect or basally bent, panicles narrow and meager; (**3**) var. *maritima* (synonym *A. stolonifera* var. *compacta*), mainly coastal, in loose sand, isolated plants — stolons many and widely creeping, culms usually much inclined, panicles usually dense and lobed; (**4**) var. *palustris*, in wet places in the lowlands — stolons long, often many, with no indication of tufting, culms tall and usually few, panicles usually dense and lobed; and (**5**) var. *stolonifera*, in a wide variety of grasslands and waste places, isolated plants — usually with stolons many and widely creeping, culms becoming erect, panicles long and usually narrowly pyramidal.

3.3. In four contrasting populations in Netherlands habitats, Kik *et al*. (1990b; *cf*. Jansen & Wachter 1940) found different relationships of habitat and stolon number per plant: (1) in a salt marsh, plants had many short thin stolons; (2) in a sand dune, plants had a few long thin stolons; and (3) in an inland meadow, plants had a few long thick stolons. A polder population (on estuary land obtained over a decade earlier by holding back the sea) had all three biotypes, which were genetically distinct.

3.4. The related species *Agrostis capillaris* L. (synonym *A. tenuis* Sibth.) has similarly been observed to be quite variable and fine-tuned to a range of habitats (*e.g.* Bradshaw 1959a, 1959d, 1960; Kershaw 1958; McNeilly & Antonovics 1968; Chadwick & Salt 1969; Tasker & Chadwick 1978; Acheroy & Lefèbvre 1983; Roxburgh *et al*. 1994; Funtova & Malyshev 2001; Leyer 2005; Helgadóttir & Snaydon 1985, 1986; Rothanzl

2002; Dostál *et al*. 2005; and Zhao *et al*. 2006; López *et al*. 1997; Balocchi & López 2001; Wilson & Rapson 1995).

4. Creeping Bentgrass Distribution and Utilization

4.1. Creeping bentgrass has become naturalized in temperate to cold-temperate regions throughout the world (*cf*. Woodward *et al*. 1986; White & Smithberg 1980; Tompkins *et al*. 2000, 2004), for example in New Zealand, southern Australia including Tasmania, South Africa, South America including Tierra del Fuego, Patagonia and the Andes, North America, and on remote islands such as Hawaii, the Juan Fernández Islands, the Falkland Islands, Gough Island and Tristan da Cunha. *Agrostis stolonifera* is native in Eurasia principally (also Iceland and North Africa), but has an ambiguous status (perhaps native locally) in northern USA and/or in Canada at some salt marshes and freshwater lakes (Hitchcock & Chase 1951; Voss 1972; Dore & McNeill 1980; Harvey 2004). However four close relatives, the other main agronomic species (Tables 1 & 2), are clearly native only in Eurasia or Europe (*e.g.* Widén 1971; Romero García *et al*. 1988a; Warnke *et al*. 1998; Vergara & Bughrara 2003). In the USA, creeping bentgrass is definitely mostly if not entirely naturalized, and probably arrived well before the 1750s (*cf*. Sauer 1942, 1976; Cronon 1983; Richardson 1818; Odland 1930; Monteith 1930), introduced with seed or hay as forage for cattle, sheep and horses (as in other regions, *e.g.* Argentina – Rúgolo de Agrasar & Molina 1992). Once popular for pasture in the USA, the species has been suggested for reseeding on some western grasslands (*e.g.* USDA Forest Service 1940; Davis 1952; Fransen & Chaney 2002). It is now naturalized in all the states and recorded (*i.e.* mapped present) in the majority of counties, except in the warmer southern portions of states in the Southeast (Kartesz 2006; *cf*. USGA 1922a; Ward 1969; Moncrief 1964; Ferguson 1964; Schmidt & Blaser 1967; Xu & Huang 2001; Huang & Liu 2003; Pote & Huang 2003; Rachmilevitch *et al*. 2006).

4.2. Under grass forages, *Agrostis stolonifera* and *A. tenuis* (*i.e. A. capillaris* in accord with Tutin in *Flora Europaea* 1980; Widén 1971; *cf*. Kerguélen 1975; Table 2) are included in Annex I ("List of Crops Covered under the Multilateral System") of the International Treaty on Plant Genetic Resources for Food and Agriculture (IT/PGRFA), which was established November 3, 2001. It entered into force June 29, 2004; parties include the European Community and Canada. Access to certain genetic resources of the listed crops will be regulated multilaterally, as will sharing of benefits, including transfer of technology and payment of an equitable portion of commercial benefits from use of these genetic resources. The treaty derived from the similar International Undertaking on Plant Genetic Resources (IU) (begun in 1983 and last agreed to in 7/2001). FAO's Commission on Genetic Resources for Food and Agriculture (with the United States among its 167 member nations) held the last IU negotiations over 7 years, and the resultant IT/PGRFA was adopted by the FAO Conference (184 members) in 11/2001 (Japan and USA abstaining; USA signed in 11/2002). The Convention on Biological Diversity welcomed the "International Seed Treaty" (IT/PGRFA), anticipating it will be a key international agreement dealing with issues concerning plant genetic resources for food and agriculture (*cf*. Fowler 2004; PGGR 2003).

4.3. The IT/PGRFA could intend the inclusion of creeping bentgrass even though not considering it a major grass forage. With some differences in use (circumscription) of *Agrostis* names (section 5.9), the history of the *A. stolonifera* listing warrants checking for confirmation of the species intended by reviewing how the name was brought into

consideration. Hammer & Spahillari (1999) recognize all five main agronomic species (*A. canina*, *A. capillaris*, *A. castellana*, *A. gigantea*, *A. stolonifera*) as minor crops of Central Europe with genetic resources of value because of their utilization for fodder (*e.g.* Balasko *et al*. 1995; DeFrance & Burger 1966; Tomić *et al*. 1999, 2003; Chorlton *et al*. 1997, 2000; Karlsen 1988; Laser & Opitz von Boberfeld 2004; Dumortier *et al*. 1996; Kratochwil *et al*. 2002; Hill *et al*. 1992; López *et al*. 1999; Flores *et al*. 2000; Faville *et al*. 1995; Bañuelos & Obeso 2000; Pieper & Burlison 1930; de Coninck & Bay 1816; Richardson 1818; Haggar 1976; Frame 1990; Sheldrick *et al*. 1990), with both of the latter species of additional value for revegetation ("recultivation") and soil stabilization and improvement (*cf*. Smith & Bradshaw 1979; Wainscott 1961), and with all but *A. gigantea* of "ornamental" value (*i.e.* as lawn grasses or turf). An overview on this species (redtop) with its turf history is given by Brede & Sellmann (2003).

5. Creeping Bentgrass – Establishing a Major Turfgrass

5.1. In the 1890s seeds of a few *Agrostis* species, sometimes including small amounts of *A. stolonifera*, were gathered in mixtures from semi-wild pasture populations in central Europe (present-day Austria and Hungary) and likely first imported to establish golf courses (Duich 1985; Warnke 2003). A large bentgrass seed trade (with ± 6,000,000 seeds per pound) continued for several decades, especially from a range of semi-wild locales across Germany (Edler 1930) (annual imports 388,500 lbs to 294,000 lbs from 1927-1930 – USGA 1930b), and from an increasing production in New Zealand (USGA 1922b, 1922c, 1925b, 1930b; Hillman 1921, 1930; Henry 1928; *cf*. Levy 1924; Suckling & Forde 1978; and Nikolov 1975; Balocchi *et al*. 1998; López *et al*. 1999). Moreover seed was gathered from free-living (naturalized) U.S. populations in coastal New England from about 1900, and chiefly 1924-1934 in the low coastal region of Oregon but also Washington and northwestern California, as well as farther inland in western Oregon and perhaps Washington (Hillman 1921, 1930; Henry 1928; USGA 1925a, 1931; Monteith 1930; Carrier 1921; Odland 1930; Schoth 1930, 1939; Hyslop 1930). Additional seed was imported mostly from crop production in southeastern (maritime) Canada, as well as inland in Alberta (Clark 1922; Tregillus 1926; Malte 1928; LeLacheur 1930; Henry 1928; Hillman 1930).

5.2. The many shipments of "South German mixed bent" seed were variously comprised of mostly *Agrostis capillaris* with some *A. canina*, about 10% or less *A. gigantea*, and sometimes a trace of *A. stolonifera* (Hillman 1921, 1930; Henry 1928; USGA 1922c, 1930b; Piper & Oakley 1922b; Oakley 1923a; Monteith 1930). Considering the relatively wild sources of seed from populations in Europe (*cf*. Hultén & Fries 1986), perhaps *A. vinealis* was also included (*cf*. Sell & Murrell 1996; Scholz 2000; Vester 1999; Ridgway *et al*. 2003). Hillman (1930) reported that a distinct bentgrass seed which was being termed "hybrid seed" was coming from Germany under the names "creeping bent" and "German bent", in "recent years…practically all the seed of some lots", and that the real nature of these plants was under study.

5.3. The bentgrass seed imported from New Zealand (*e.g.* 162,600 lbs in 1929 and an impressive 508,900 lbs or 254 tons in 1930) was eventually found to be not solely *Agrostis capillaris* (*cf*. Suckling & Forde 1978; Rapson & Wilson 1992a, 1992b; Karataglis 1980b, 1986), but to include *A. castellana* (which earlier had been considered just a local ecological variation), and to additionally include its hybrids with *A. capillaris* (Rumball & Forde 1977; Edgar & Forde 1991; Batson 1998a; Steiner & Lupold 1978;

Henry 1928) — which have been called *A.* ×*fouilladeana* (rather than *A.* ×*fouilladei* P. Fourn. [1934], *nomen nudum* – see Lambinon *et al*. 2004). Similarly, the inland bentgrass of western Oregon and Washington is increasingly being recognized not as a dryland or upland (*i.e.* non-coastal) variation of *A. capillaris* (marketed as 'Highland' bentgrass), but as a landrace of the species *A. castellana* (Henry 1928; Hillman 1930; Schoth 1930, 1939; USDA 1948, 1961; Madison 1961; Griffin 1965; Funk 998; Brede 2000; Brilman 2001a; Ruemmele 2000a, 2003; Brede & Sellmann 2003; *cf*. Vergara & Bughrara 2003).

5.4. The bentgrass seed from the imports and North America was widely distributed and sown on developing golf courses, and as well for municipal parks, playgrounds and fine lawns, with the intention that the most appropriate of the bentgrasses for a site would come through (*cf*. Wilson & Rapson 1995; Rapson & Wilson 1988; Lesica & Allendorf 1999). With golf's rapid geographic expansion, on most of the new courses *Agrostis stolonifera* emerged over the years to be dominant in the turf in many regions, except in the cool Northeast where *A. canina* sometimes out-competed the other bentgrasses (Monteith 1930; USGA 1922c, 1930a; Piper & Oakley 1922b, 1922a; Oakley 1923a; *cf*. Skogley 1973; Hurley 1973; Brilman & Meyer 2000; Ruemmele 2000b; Rose-Fricker *et al*. 2004; Hollman *et al*. 2005). Thus creeping bent's characteristics became familiar. Experience for turf was also gained with *A. capillaris* (called Rhode Island bent, later colonial bent), which was introduced to New England early for pasture — it is mentioned in 1747 (Odland 1930) and likely was present a century earlier (*cf*. Cronon 1983; Sauer 1942). Production to respond to the emerging desire (1900-1905) for sports turf and lawns began by gathering seed from naturalized stands in Rhode Island and southern Connecticut, and subsequently Massachusetts. Imports from Germany and New Zealand as well as southeastern Canada later shifted the Rhode Island production to growing *A. canina* and *A. stolonifera* (Odland 1930; Hillman 1930). *Agrostis gigantea* was also common in New England, and care needed to avoid gathering it, but there was deliberate adulteration too in this seed trade (Carrier 1921; Tregillus 1926; Hillman 1930). Stuckey & Banfield (1946) reported finding *Agrostis* in Rhode Island with unusual morphology and aneuploidy (*cf*. Anderson 1948); these plants are now considered hybrids of *A. capillaris* and *A. gigantea* (Björkman 1954; Widén 1971; Bradshaw 1975a; Edgar & Forde 1991; *cf*. Sell & Murrell 1996), which are called *A.* ×*bjoerkmanii*.

5.5. So over several decades, creeping bentgrass transitioned from being considered a growth form or obscure minor kind of wild bent sometimes showing up in the "South German mixed bent" seed in small quantities, to a highly desirable foreign species in short supply (Piper & Oakley 1921, 1922a; Monteith 1930). Through U.S. production efforts (Monteith 1941), including encouraging propagation by stolons rather than seeds, *Agrostis stolonifera* became the most successful and popular grass for putting greens (Taylor 1957; Radko 1968), and now is grown extensively and managed intensively for greens as well as tees and fairways — and that is the chief focus in continuing to improve it agronomically (*e.g.* Hurley & Murphy 1996; Morris 2003; Warnke 2003). The species is additionally investigated as a forage (Balasko *et al*. 1995; Tomić *et al*. 1999, 2003), and of interest for restoring some mine sites involving heavy metals (Smith & Bradshaw 1979) and for water treatment (Löser *et al*. 1999; Tyrrel *et al*. 2002; Mazer *et al*. 2001). Sell & Murrell (1996) state that *A. stolonifera* var. *marina* has been used in the formation of lawns. There are more than 1,000 holdings of genetic resources of *Agrostis* species in various countries (Williams 1996), and still exploration for germplasm of *A. stolonifera* for turf from populations in its native range (*e.g.* Romani *et al*. 2002; *cf*. Xie *et al*. 2003).

5.6. Ordinarily the modern turf cultivar (*e.g.* Robinson *et al*. 1991; Brauen *et al*. 1993; Hurley *et al*. 1994; Engelke *et al*. 1995) is seeded, and is a clustering of *A. stolonifera* genotypes bred and selected for a set of distinctive traits (*e.g.* Holt & Payne 1952; Lush 1990; Engelke 1993; Cattani *et al*. 1996; Cattani 1999; Cattani & Struik 2001; Sweeney *et al*. 2001; Murphy *et al*. 2003; DaCosta & Huang 2003; Croce *et al*. 1999; Rogers 1992; Huff & Landschoot 2000; Stier 2003; and Wilkinson & Beard 1972; Warnke *et al*. 1997; Golembiewski *et al*. 1997a, 1997b; Caceres *et al*. 2000; Casler *et al*. 2003; Kubik *et al*. 2003), rather than being a single genetic line distributed by vegetative propagation as in earlier decades (*e.g.* Metcalf 1922; USGA 1924c, 1924b, 1924a, 1930a; Piper & Oakley 1921, 1924; Carrier 1923, 1924; Oakley 1923b, 1924; Radko 1968; Bengeyfield 1968; *cf*. Abramashvili 1978).

5.7. From its 1923 beginnings in the Pacific Northwest Coast region (Schoth 1930, 1939; Hyslop 1930; USGA 1930b; Monteith 1941; Ferguson 1948; Pojar & MacKinnon 1994; Franklin & Dyrness 1973), the production of seed of bentgrasses for turf for the USA and internationally has become a modern industry concentrated in western Oregon in the Willamette Valley (125 mi × 25-30 mi) between the coast and Cascade Range of mountains. About 6,000 acres are in production, mostly for creeping bentgrass (North & Odland 1935; Cattani *et al*. 2004; *cf*. Wright 1980; Jonassen 1980; Rumball & Robinson 1982; Chastain & Young 1998). Background on this region is provided in several accounts (Bowen 1978; Johannessen *et al*. 1971; Habeck 1961; Nelson 1919; Mueller-Warrant *et al*. 2003; Clark & Wilson 2001; Hulse *et al*. 2004).

5.8. The U.S. turfgrass industry frequently equates creeping bentgrass with *Agrostis palustris* or sometimes *A. stolonifera* var. *palustris*, but this usage does not agree with the detailed botanical concepts of Hubbard (1984) or Sell & Murrell (1996) where the plants are native, and are also utilized. This U.S. habit or convention may reflect the influence of the manual by Hitchcock & Chase (1951, and reprint in 1971) (Chase being the sole reviser of Hitchcock 1935; *cf*. Hitchcock 1905, Piper 1918), instead of recognizing newer taxonomic benchmarks such as *Flora Europaea* (1980 for the grass family, Poaceae or Gramineae, with *Agrostis* by Tutin) and *The Jepson Manual* (1993, *Agrostis* by Harvey). Moreover, with the originating introductions of creeping bentgrass seeds for years from various European locales and countries and the broad U.S. seed distribution (dispersal), and subsequent adaptation, selection and breeding efforts, the germplasm in USA is a richly heterogeneous mixture quite unlike the native ecological race (ecotype) in Europe that Sell & Murrell (1996) characterize under *A. stolonifera* var. *palustris* (*cf*. Rozema & Blom 1977; Davies & Singh 1983; Winkler *et al*. 2003; Panter & May 1997; Aston & Bradshaw 1966; Olff *et al*. 1993; Ahmad & Wainwright 1976; McNeilly *et al*. 1987; Misra & Tyler 2000b, 2000a; Kik 1987; Kik *et al*. 1990a, 1990b, 1992). Another legacy problem lingering in the USA and Canada is an overly broad scope in use of the name *A. stolonifera* (or *A. alba*) (*e.g.* Malte 1928; Gleason 1952; Gleason & Cronquist 1963; Steyermark 1963; Munz 1968; Cronquist *et al*. 1977; Stubbendieck *et al*. 1982; but *cf*. Welsh *et al*. 1993), occasionally even using the name *A. stolonifera* var. *stolonifera* (rather than *A. stolonifera* var. *major*) for the plants usually called redtop and now well accepted as *A. gigantea* (*e.g.* in Europe, Tutin 1980; Sell & Murrell 1996; and in North America, Fassett 1951; Voss 1972; Bailey *et al*. 1976; McNeill & Dore 1976; Dore & McNeill 1980; Pohl 1978; Gleason & Cronquist 1991; Harvey 1993, 2001; Yatskievych 1999).

5.9. Four themes (discovery, research, biological classification, scientific nomenclature) are interwoven in the 250-year historical to current usage of several *Agrostis* names, reflecting improved understanding but lags in communication (*cf*. Spooner *et al*. 2002). (**1**) The natural variation of creeping bentgrasses in Europe led to early recognition of many formal distinctions, such as *Agrostis stolonifera* L. (1753), *A. palustris* Huds. (1762), and *A. stolonifera* var. *compacta* Hartm. (1832). (**2**) The name *Agrostis gigantea* Roth (1788) for redtop was its second name, regarded for a while as superfluous. However, redtop's earlier name of *Agrostis alba* L. (1753) unfortunately was based nomenclaturally (*i.e.* standardized) on a specimen found to be a *Poa nemoralis* L. (wood bluegrass), and so "*Agrostis alba* L." had to become a technical synonym for that species (and thus no longer available for use). (**3**) On a different theme, the determination and classification of biological entities, it was not obvious that the plants called *A. stolonifera* and the plants now called *A. gigantea* represented two species rather than variations of one biological species. If considered to be one (*e.g.* Malte 1928), the species' name had to be the earlier *A. stolonifera*, and the redtop plants were then called *A. stolonifera* var. *major* (Gaudin) Farw. Within this broadly circumscribed single species, all of the more "creeping" bentgrasses would be called *A. stolonifera* var. *stolonifera*, or these plants could still be regarded to have additional inherently distinct populations such as *A. stolonifera* var. *palustris* (Huds.) Farw. or *A. stolonifera* var. *compacta*. (**4**) With increasing familiarity and scientific study, *Agrostis gigantea* has become understood to be a biologically distinct species (as Linnaeus had discerned; Table 2), a hexaploid with rhizomes (underground stems) and panicles that stay open after flowering, whereas *A. stolonifera* is a predominant tetraploid with stolons and panicles that close after flowering. Similarly, *Agrostis castellana* has been recognized to be biologically distinct from *A. capillaris*, and *A. vinealis* distinct from *A. canina*. (**5**) On the other hand, from thorough study of many native European populations of *Agrostis stolonifera* (*sensu stricto*, *i.e.* creeping bentgrass in the narrow sense excluding "var. *major*"), broad ecological amplitude and extensive variability have been found without substantial inherent discontinuites (sections 3.1-3.2) (*e.g.* Kik *et al*. 1990a; Vergara & Bughrara 2003; *cf*. Kurchenko 2002). The usage of common names in North America (Tables 1 & 2) has also become more stable (*cf*. Henry 1928; Monteith 1930; USGA 1932), but can still be variable, and entangled or confused.

5.10. Consequently, when going beyond the extensive information on turf mainly for golf courses, in the North American literature in particular alertness is needed as to the species intended (see Table 2 synonymy). However, the identity of the plants studied frequently cannot be ascertained from the report, and the research is less useful, because several *Agrostis* species occur in the area of study and the plant characteristics were not distinguished nor a taxonomic reference stated (nor the actual originating source clear if research plants were supplied). As provisional pragmatic assumptions, *A. alba* tends to mean redtop (*A. gigantea*); *A. stolonifera* to mean creeping bentgrass but sometimes redtop, and occasionally both (*i.e*. the name used broadly or *sensu lato*, sometimes with *A. stolonifera* var. *major* for redtop and *A. stolonifera* var. *palustris* for creeping bentgrass, but possibly *A. stolonifera* var. *stolonifera* used for either); and *A. palustris* is *A. stolonifera* (creeping bentgrass). This confusion makes other literature especially useful in North America for gaining insights on the population dynamics and ecology of the species creeping bentgrass (*A. stolonifera*, synonym *A. palustris*) in natural to variously managed systems.

6. Creeping Bentgrass Habitats, Ecology, and Reproduction

6.1. In Europe where *Agrostis stolonifera* has been taxonomically clear for decades and much more studied in the general environment (although not as much as an amenity turfgrass), the habitats of this common species range from salt marshes and dunes to chalk cliffs, inland marshes, streamsides and ditches, grasslands and pastures, including locales periodically flooded, open woodlands, damp arable land, paths, urban parks and lawns, and rough ground such as roadsides (Sell & Murrell 1996; Hubbard 1984; Jansen & Wachter 1940; Grime *et al*. 1988; Silvertown *et al*. 1999; Schröder *et al*. 2005; Rozema & Blom 1977; Eertman *et al*. 2002; Burgess *et al*. 1990; Gipiškis 2000; Raven 1986; Panter & May 1997; Gilbert *et al*. 2003; van Eck *et al*. 2004; Kennedy *et al*. 2003; Kohler *et al*. 2000; Hald 2002; Croxton *et al*. 2002; Roovers *et al*. 2004; Cornish 1954; Thompson *et al*. 2004; Ross 1986). Similarly in the USA, the species occurs in coastal habitats (*e.g.* Caldwell & Crow 1992; Wu 1981; USGA 1925a) and has become widely established inland, for example reported in Missouri habitats (Yatskievych 1999) along the margins of ponds and lakes and on streambanks, in moist disturbed areas, various grasslands (including upland prairies), moderately moist (mesic) to rather dry upland forests, on roadsides and railroad embankments, and in sidewalk crevices.

6.2. Creeping bentgrass is grazed by cattle, sheep and horses, as well as rabbits and hares and migratory wildfowl in Europe such as the wigeon *Anas penelope* and various species of geese (Cadwalladr *et al*. 1972; Owen & Thomas 1979; Loonen & van Eerden 1989; Groot Bruinderink 1989; Chang *et al*. 2005), and it is used for nest building by grebes (Ridley 1930). *Agrostis castellana* may be grazed by Canada geese (*Branta canadensis*) (*cf*. Conover 1991). Throughout the year, creeping bentgrass at impoverished mine sites can be the main food of the Eurasian field vole, *Microtus agrestis* (Stoddart 1982; Hunter *et al*. 1987). It is a larval food plant for the widespread small heath butterfly *Coenonympha pamphilus* (Goverde & Erhardt 2003). *Agrostis stolonifera* can host fungal endophytes (*cf*. Clay & Schardl 2002; Faeth 2002; Malinowski & Belesky 2000; Schardl *et al*. 2004), as can *A. capillaris*, *A. castellana*, *A. gigantea* and several native *Agrostis* species (Spooner & Kemp 2005; Aldous & Mebalds 1995; Aldous *et al*. 1994; Thrower & Lewis 1973; Bradshaw 1959b; Saikkonen *et al*. 2000; Zabalgogeazcoa *et al*. 2003; White *et al*. 1992; White & Chambless 1991; Zenbayashi *et al*. 1996).

6.3. The numerous tiny seeds of creeping bentgrass are dispersed by the wind and on water (Wolters *et al*. 2005), sometimes to lake islands (Nilsson & Nilsson 1978; Roden 1998), and consumed and sometimes dispersed (still viable) by cattle, sheep, horses, white-tailed deer (*Odocoileus virginianus*), fallow deer (*Dama dama*), and brent geese or brants (*Branta bernicla*) (Welch 1985; Cosyns *et al*. 2005a; Myers *et al*. 2004; Gill & Beardall 2001; Chang *et al*. 2005), and the seeds are also dispersed externally on cattle hair (Couvreur *et al*. 2004). In addition to the seeds, jointed pieces of the stolons (*i.e.* with nodes) can be carried downstream by the water (Mitlacher *et al*. 2002; Widén 1971; Nilsson *et al*. 1994; Andersson *et al*. 2000; Vogt *et al*. 2004; Boedeltje *et al*. 2003, 2004; Goodson *et al*. 2003; Levine 2000, 2001, 2003; Wolters & Bakker 2002). Seeds of *A. canina* and *A. capillaris* also are known to be viably dispersed by passing through livestock (Bruun & Fritzbøger 2002; Pakeman *et al*. 2002; Cosyns *et al*. 2005a, 2005b), *A. capillaris* through rabbits (*Oryctolagus cuniculus*) (Cosyns *et al*. 2005b), and *A. gigantea* through white-tailed deer (Myers *et al*. 2004) and as well by water (Merritt & Wohl 2006). Seeds of *A. capillaris* are also dispersed externally by domesticated and wild ungulates (*via* hair and hooves) (Couvreur *et al*. 2004; Mouissie *et al*. 2005;

Heinken & Raudnitschka 2002) and are eaten and apparently dispersed by ants, and the plants are sometimes associated with ant-mounds (Rothanzl 2002; Kovář *et al*. 2001; Kovář & Kovářová 1998; Dostál 2005).

6.4. *Agrostis stolonifera* is documented (Grime *et al*. 1988) to have a "competitive-ruderal" ecological strategy in the well-known C-S-R (competition–stress–ruderality) system of plant strategies or functional types (Grime 1977, 1988, 2001), which thus includes weedy characteristics (Booth *et al*. 2003; Baker 1965, 1972, 1974; Keeler 1985, 1989) in relation to competitors and disturbance (*e.g.* Schippers *et al*. 2001; Hill *et al*. 2002; Wilcox 1998; Marshall 1990; Goldsmith 1978; Owen *et al*. 2004; Lenssen *et al*. 2004). The plant's roots (*cf*. Fitts 1925a; Murphy *et al*. 1994; Boeker 1974; Lehman & Engelke 1991; Steer & Harris 2000; Beard & Daniel 1966; Ralston & Daniel 1972; Krans & Johnson 1974; Bowman *et al*. 1998; Christians *et al*. 1981) and shoots (stolons) actively forage in space, exploiting pockets of nutrient enrichment and vegetation gaps (Crick & Grime 1987; Hunt *et al*. 1987; Grime *et al*. 1988; *cf*. Glimskär & Ericsson 1999; Glimskär 2000). Being a clonal perennial organism, the plant can function in a modular way (*e.g.* Jónsdóttir 1991b, 1991a; Tamm *et al*. 2002), with the leafy plantlets (rooted tillers) along a stolon able to become somewhat independent (Agha *et al*. 2001; Marshall & Anderson-Taylor 1992). Consequently, severed stolons or dispersed pieces of jointed stolon are more readily able to establish new plants (Boedeltje *et al*. 2003; Widén 1971; *cf*. Fitts 1925b; Carrier 1923, 1924).

6.5. The species often reproduces primarily vegetatively, spreading or "creeping" by the stolons (*cf*. Hoeltzener & Maitre 2004), which may become divided (*e.g.* by an animal or machine) and continue growing from the stolon nodes as separate plants, ramets with the same genotype (thus clones). In the intensely managed golf course, the turf is mowed very short often (*cf*. McCartney 2003) and sometimes cut vertically to reduce thatch; consequently flowering is curtailed but fragmentation of plants is likely. In unstable natural habitats such as dunes, more seeds are produced than in grassier habitats such as a meadow. A single panicle may average from 100-200 to as many as 1,480 florets in semi-natural habitats (Prieto-Baena *et al*. 2003), and the plant may have panicles at somewhat different stages of maturity. Separate plants of the same genotype (*i.e.* ramets of the same genet) adjust to their immediate surroundings, so do not necessarily flower simultaneously. For details on these aspects, see Smith 1972; Grime *et al*. 1988; Boedeltje *et al*. 2003; Kik 1987; Kik *et al*. 1990a, 1990b, 1993; Wilson & Thompson 1989; Purves & Law 2002; Lenssen *et al*. 2005; Tamm *et al*. 2002; Jónsdóttir 1991a, 1991b; Olff *et al*. 1993; Pakeman & Marshall 1997.

6.6. The flowering period, the seasonal duration (months, weeks or days) of the species bringing forth flowers, varies with the region where the plants occur, for example with a shorter season in the North (*e.g.* Widén 1971; *cf*. Heide 1994; Cooper & Calder 1964). The daily duration (1-4 hrs) of a plant's flowering perhaps differs somewhat among the *Agrostis* species, but also depends on the day's weather. The anthesis period, when the flower begins and ends shedding its pollen during the 24-hr day, is characteristic of the *Agrostis* species and fine-tuned to the local conditions. In field-plot or greenhouse and lab studies (*e.g.* Philipson 1937; Davies 1953; Ponomarev & Rusakova 1968; Fei & Nelson 2003), the pollen of creeping bentgrass shed for a few mid-morning hours (exact times differing with locale) or again (but perhaps not usually) in early-mid afternoon, and the pollen grains were viable for no more than 3 hours. *Agrostis stolonifera* in semi-natural habitats may average 545 pollen grains per anther, thus 1,635 per floret, and up to

some 2,420,000 per panicle (Prieto-Baena *et al*. 2003). The species is mainly sexually outcrossing (Davies 1953), with some turf strains perhaps obligately so, but it can also self-pollinate (*e.g.* Belanger *et al*. 2003b; Tomić *et al*. 1999) (a highly selfing turf clone was recently detected – Warnke *et al*. 1998). *Agrostis* species in a locality might be reproductively somewhat isolated temporally by the sequence of their daily anthesis, for example with *A. canina* releasing pollen pre-dawn – dawn, *A. stolonifera* ± mid-morning, and *A. capillaris* variously early- mid- late afternoon. Reports for *A. gigantea* seem to be inconsistent; *A. castellana* might be earlier than *A. stolonifera*; and *A. vinealis* is bimodal with ± pre-dawn and evening shedding (*cf*. Christoffer 2003).

6.7. In experimental field-plot studies on pollen dispersal and intraspecific (within-species) crossing and potential hybridization with other species of *Agrostis* and with *Polypogon* (Wipff & Fricker 2001; Belanger *et al*. 2003b; Christoffer 2003), viable pollen of creeping bentgrass went as far as 1,400 (or 1,417) feet (determined by testing progeny). Calculating from their data on the intraspecific progeny from an experimental array of linearly placed plants, Wipff & Fricker (2001) estimated that plants would be receiving donor pollen and crossing at a 0.02% level up to 4,296 ft (about 0.8 mile) away from the pollen-dispersing (*i.e.* source) plants. Based on independent data from a fairly similar experiment (Belanger *et al*. 2003b), pollen dispersal and as well variation in fitness of the pollen donor were considered in a computer model (Meagher *et al*. 2003). The model found that pollen dispersal and gene introgression (crossing and subsequent diffusion into a different population – *cf*. Anderson 1949, 1953; Arnold 1997, 2004; Lanchier & Neuhauser 2005) would be limited at some sites and extensive at others, depending on local conditions such as exposure to the wind. In a large-scale experimental study (Watrud *et al*. 2004; Watrud 2005), pollen dispersal and gene flow were found to occur mostly within about 1.25 miles and extend up to 13 miles. All four of the recent studies concluded that hybridization can occur in the field between *A. stolonifera* and some naturalized or native species (Tables 1 & 2). This recent work using molecular techniques thus confirms and enriches earlier reports, from experimental hybridization and the study of chromosomes (*e.g.* Davies 1953; Jones 1956a-1956c; Björkman 1960; Romero García & Blanca 1988; Forde 1991), and from fieldwork and the taxonomic analysis of plants' morphology (*e.g.* Murbeck 1898; Weber 1920; Malte 1928; Fouillade 1933; Juhl 1952; Bradshaw 1958; Widén 1971; Romero García *et al*. 1988b; Meerts & Lefèbvre 1989).

6.8. Of the 10 (or 11) species of *Agrostis* with which it is known that *A. stolonifera* could directly hybridize in USA (Figure 1, Tables 1 & 2), the most likely crossing is with *A. capillaris*, forming *A.* ×*murbeckii*; and to a lesser extent crossing with *A. gigantea*. *Agrostis capillaris* is most likely to cross with *A. castellana*, forming *A.* ×*fouilladeana*, which can backcross into *A. capillaris*, and for some years these species and their hybrids were imported unknowingly from New Zealand all misnamed as "colonial bentgrass" (or "*Agrostis capillaris*") and were widely distributed (section 5.3). The species *A. capillaris* is also likely to cross with *A. gigantea*, forming *A.* ×*bjoerkmanii*, as found in Rhode Island (section 5.4). The various hybrids are for the most part sterile or with very low fertility, but can be vegetatively vigorous (Table 2). Hybridization and introgression have always been aspects of domestication and improvement of crops and ornamentals (*cf*. Gepts 2002; Anderson 1961). Various new lab techniques facilitate working with hybrid turfgrasses (*e.g.* Brilman 2001b; Ovesná *et al*. 2002), and efforts are underway to hybridize *Agrostis* species for traditional reasons such as bringing in disease resistance (*e.g.* Belanger *et al*. 2003a, 2003b, 2004; Li *et al*. 2005).

6.9. *Agrostis stolonifera* seeds can germinate soon after their dispersal or persist for a while in the seed bank then germinate or be gone within 1-1½ years, but with some seeds remaining viable in the soil for at least 4 years (Thompson & Grime 1979; Jutila b. Erkkilä 1998a, 1998b; Mitlacher *et al*. 2002; Ferris & Simmons 2000; Díaz-Villa *et al*. 2003; Shipley *et al*. 1989, 1991; Amiaud *et al*. 2000; Hölzel & Otte 2004; Wolters & Bakker 2002; Brenchley & Warington 1930; Jalloq 1975; Roberts 1981; Hendry *et al*. 1994; Hutchings & Booth 1996; Toole & Koch 1977). There can also be persistent (and sometimes quite long-term) seed banks to recruit for example *A. canina* (Matus *et al*. 2003; Pakeman & Small 2005), *A. capillaris* (Smith *et al*. 2002; Pakeman *et al*. 1998; Pakeman & Small 2005; Dougall & Dodd 1997; Meerts & Grommesch 2001; *cf*. Edwards & Crawley 1999; Balocchi *et al*. 1998), *A. castellana* (Traba *et al*. 2004; Rampton & Ching 1966, 1970), *A. gigantea* (Wagner *et al*. 2003; Williams 1978), and *A. vinealis* (Bakker *et al*. 1996; *cf*. Pons 1989).

7. Creeping Bentgrass in the Landscape

7.1. *Agrostis stolonifera* presence in vegetation is quite variable, depending upon habitat and management. The species can be competitive and become a dominant (Silvertown *et al*. 1992; Durrett & Levin 1998), for example in moderately grazed pastures (Howe & Snaydon 1986; Bullock *et al*. 1996, 2001; Jutila 1999; Oomes *et al*. 1996; Schulte & Neuteboom 2002; Loucougaray *et al*. 2004; van Oene *et al*. 1999) and various habitats of roadsides (Ross 1986). Or it can occur in early succession and decline over the years or decades, for example on maturing sand dunes or in hay meadows (Pennanen *et al*. 2001; Olff *et al*. 1993; Olff & Bakker 1991). Creeping bentgrass establishes in areas relatively open or bare (seeding into disturbed areas or gaps) and as well in areas somewhat dense and diverse biotically (*e.g.* Fustec *et al*. 2005; Elmarsdottir *et al*. 2003; Greipsson & El-Mayas 1999; Wolters & Bakker 2002; Stockey & Hunt 1994; Klötzli & Grootjans 2001; Bullock 2000; Jalloq 1975; Cody *et al*. 2000; Staniforth & Scott 1991; Levine 2000, 2001, 2003). Even though now cosmopolitan, the species is rarely aggressively invasive (*i.e.* transformative) (Pyšek *et al*. 2004) in natural or semi-natural areas, as on Gough Island (South Atlantic) and Marion Island (sub-Antarctic) (Jones *et al*. 2003; Gremmen *et al*. 1998; Pammenter *et al*. 1986; Frenot *et al*. 2001, 2005). Several different *Agrostis* F_1 hybrids and/or introgressed backcrosses (Tables 1 & 2) can be notable aspects of some vegetation (*e.g.* Widén 1971; *cf*. Nilsson *et al*. 1994; Sell & Murrell 1996; Fouillade 1911, 1933; Lambinon *et al*. 2004; Romero García *et al*. 1988b; Edgar & Forde 1991; Edgar & Connor 2000; Stuckey & Banfield 1946). The F_1 hybrids of *A. stolonifera* and *A. capillaris*, *i.e. A.* ×*murbeckii*, can out-compete both parents and be plentiful and apparently long-lived in intermediate areas between parental habitats (Forde 1991; Ater 1993; Meerts & Lefèbvre 1989; Widén 1971; Bradshaw 1958, 1959c).

7.2. *Agrostis stolonifera* forms hybrids called ×*Agropogon lutosus* (synonym ×*Agropogon littoralis*) (Sell & Murrell 1996; Hubbard 1984; Bradshaw 1975b; Qian & Sun 1998; Weiller *et al*. 1995; Edgar & Connor 2000; Rúgolo de Agrasar & Molina 1997b; Welsh *et al*. 1993; Barkworth 2004; Harvey 2004; Randall 2002; Christoffer 2003) with *Polypogon monspeliensis* (annual rabbitsfoot-grass), which is a mostly European species naturalized in many countries worldwide that occurs in wet-moist habitats to abandoned arable fields, and also is sometimes cultivated in gardens (*e.g.* Barkworth 2004; Godfrey & Wooten 1979; Welsh *et al*. 1993; Pojar & MacKinnon 1994; Conley 1993; Harrison *et al*. 2002; Gelbard & Harrison 2003; Robbins 1940; RBGK

1984) (Tables 1 & 2). Annual rabbitsfoot-grass tolerates salinity (Partridge & Wilson 1987; Mahmood *et al*. 1996) and can be common in estuaries and suitable inland wetlands (Kuhn & Zedler 1997; Callaway & Zedler 1998; Stromberg 1997; Roalson & Allred 1997; Zedler & Kercher 2004; Shaltout & El-Sheikh 1991; Sharaf El-Din *et al*. 1993; Hussey *et al*. 1997). In South Australia, this species (as well as *Agrostis avenacea*) are hosts for organisms associated with the disease floodplain staggers (Davis *et al*. 1995; Bertozzi & McKay 1995; McKay *et al*. 1993); its straw is allelopathic (releasing an inhibiting chemical) (Inderjit & Dakshini 1995). *Agrostis stolonifera* itself can occur in middle to upper margins of salt marshes, and some ecotypes have considerable salt tolerance (*e.g.* Gray & Scott 1977; Gray 1972; Cadwalladr *et al*. 1972; Eertman *et al*. 2002; Wolters & Bakker 2002; Ungar 1978; Jutila b. Erkkilä 1998a; Pehrsson 1988; Hanslin & Eggen 2005; McCarty & Dudeck 1993; Rozema & Blom 1977; Tiku & Snaydon 1971; Ahmad & Wainwright 1976, 1977; Ahmad *et al*. 1981; Wu 1981; Ashraf *et al*. 1986a, 1986b; Kik 1989; Hodson *et al*. 1985; McNeilly *et al*. 1987; Aston & Bradshaw 1966), which is a trait of agronomic interest (*e.g.* Marcum 2001; Kuo *et al*. 1994; *cf*. Wu & Huff 1983). *Polypogon viridis* (water beardgrass) also forms hybrids with *A. stolonifera*, which are called ×*Agropogon robinsonii* (Table 2). These *Polypogon* species also hybridize with each other (forming *Polypogon* ×*adscendens*). Both *Polypogon* species are in Ciba-Geigy's *Grass Weeds* (Häfliger & Scholz 1981), but neither is considered a major world weed (Holm *et al*. 1997, 1979).

7.3. *Agrostis stolonifera* is included in BASF's *Grass Weeds in World Agriculture* (Behrendt & Hanf 1979) and in Ciba-Geigy's *Grass Weeds* (Häfliger & Scholz 1981) — occurring in all five habitats that they score: grasslands, aquatic biotopes, perennial crops, rotation crops, and waste places, but it is not considered a major world weed (Holm *et al*. 1997, 1979; Weber 2003). The species is also reported as a weed or weedy for example in Japan (Enomoto 2000), Australia (Brown & James 1998; Carr *et al*. 1992; Hussey *et al*. 1997; Rozefelds *et al*. 1999), New Zealand (Reid 1998), Chile (Matthei *et al*. 1993), Germany (Holm *et al*. 1979; Lonchamp 2000), Denmark (Andreasen *et al*. 1996), the U.K. (Hubbard 1984), and Canada (Darbyshire 2003; Eggens 1972). In the United States it is not listed as a Federal noxious weed. Nonetheless in USA the species is sometimes noted as weedy or invasive beyond golf turf (*i.e.* the rough) and in lawns, grasslands and wetlands, including riparian areas (*e.g.* Jordan 2001; Williams *et al*. 2000; Dudley 1998; Morrison 2002; Levine 2000, 2001, 2003; Steed & DeWald 2003; *cf*. Daehler 2005).

7.4. Other agronomic bentgrasses of European origin and variously naturalized (Table 1), with which creeping bentgrass is able to hybridize (Figure 1, Table 2; *cf*. section 6.8), are also sometimes or in some areas considered weeds or invasives and can be of management concern: *Agrostis gigantea*, *A. castellana*, *A. capillaris*, and *A. canina* (*e.g.* Randall 2002; Holm *et al*. 1979; Weber 2003; Häfliger & Scholz 1981; Behrendt & Hanf 1979; Grime *et al*. 1988; Hubbard 1984; Barthram *et al*. 2002; Håkansson & Wallgren 1976; Williams 1970, 1973a, 1973b, 1975, 1977, 1978; Skuterud 1984; Courtney 1981; Bylterud 1984; Darbyshire 2003; Roland & Zinck 1998; Pojar & MacKinnon 1994; Wilson *et al*. 2004; Parks *et al*. 2005; Riege & Del Moral 2004; Biek 2000; Matthei *et al*. 1993; Ramírez *et al*. 1992; San Martín *et al*. 2002; Pauchard & Alaback 2004; Edgar & Connor 2000; Walker & Lee 2002; Walker 2000; Sessions & Kelly 2000, 2002; Davis & Guy 2001; Rose *et al*. 1995; White 1991; Harris 1974; James & Atkinson 1979; Batson 1998a-1998c; Hill *et al*. 1996; Hussey *et al*. 1997; Godfree *et al*. 2004; Boyd 1976; Enomoto 2000; Tsuyuzaki 1993).

7.5. Of those four species, *Agrostis gigantea* (redtop), *A. capillaris* (colonial bentgrass) and *A. castellana* (dryland bentgrass) are more closely related to *A. stolonifera* (Table 2). Redtop and colonial bentgrass are in general considered more weedy than creeping bentgrass (section 7.4). In the C-S-R system of plant functional types (Grime 1988, 2001), *A. gigantea* also is a competitive-ruderal strategist, whereas *A. capillaris* is a C-S-R generalist (Grime *et al*. 1988).

7.6. Some species of *Agrostis* have a robust capacity to adapt genetically and establish populations tolerant to heavy metals and metalloids, for example on soil at contaminated mine sites (Bradshaw 1952; Bradshaw *et al*. 1965; Bradshaw & Hardwick 1989). All five of the main agronomic species as well as *A. vinealis* (Farrow *et al*. 1981) and the common native *A. scabra* (Archambault & Winterhalder 1995; Koch *et al*. 2000) are among these facultative metallophytes. Arsenic, cadmium, copper, lead, manganese, nickel and zinc can be prominently involved, and the plants on a site able to tolerate one or more of these ordinarily toxic substances. The zone between tolerant and nontolerant biotypes can be narrow, and without hybrids. Some of the research (*cf*. Bone & Agnes 2001; Levin 2001) has led to classic evolutionary studies used in teaching (*e.g.* Briggs & Walters 1997), and to efforts for mine-site reclamation and ecological restoration (*e.g.* Cotter-Howells & Caporn 1996; Lepp *et al*. 1997; De Koe 1994; *cf*. Lesica & Allendorf 1999) and water-quality improvement by biofiltration (Hares & Ward 1999). *Polypogon monspeliensis* also has good potential for management of wastewater contaminated with selenium or arsenic (Ye *et al*. 2003).

7.7. The repertoire of *Agrostis stolonifera* (Duwensee 1993) includes biotypes tolerant to copper (Wu & Bradshaw 1972; Wu *et al*. 1975; Masarovičová and Holubová 1998; Briggs & Walters 1997), copper and nickel (Jowett 1958), copper and zinc (Wu & Antonovics 1975), and lead and zinc (Gregory & Bradshaw 1965; *cf*. Harkot & Czarnecki 1999). A biotype of its hybrid *Agrostis* ×*murbeckii* tolerant to zinc has been detected (Gregory & Bradshaw 1965). Creeping bentgrass has also adapted to serpentine (Marrs & Proctor 1976), natural rock outcroppings high in magnesium and low in available calcium and water-holding capacity (Baker *et al*. 1993), thus an exclusive habitat where some species are unable to survive but some species have evolved and only occur (*i.e.* endemics).

7.8. Colonial bentgrass (the zinc-tolerant hybrid's other parent) has been studied most, and there are metal-tolerant cultivars for reclamation available commercially (Jowett 1964; Gregory & Bradshaw 1965; Jain & Bradshaw 1966; McNeilly 1968; McNeilly & Antonovics 1968; Antonovics 1968; Jones *et al*. 1971; Mathys 1973; Gartside & McNeilly 1974; Whalley *et al*. 1974; Simon 1977; Simon & Lefèbvre 1977; Nicholls & McNeilly 1979, 1985; Smith & Bradshaw 1979; Karataglis 1980c; Karataglis *et al*. 1985; Symeonidis *et al*. 1985a; Meharg & Macnair 1991; Watkins & Macnair 1991; De Koe *et al*. 1992; Boon *et al*. 1998; Meerts & Grommesch 2001; Griffioen & Ernst 1989; Griffioen *et al*. 1994; Malcová *et al*. 2003; Rydlová & Vosátka 2003). *Agrostis capillaris* also has biotypes with multiple-metal tolerance, to variously two, three or four metals, and that can have large within-population variability (Hertstein & Jäger 1986; Symeonidis *et al*. 1985b; Karataglis 1982, 1980e, 1980a, 1980d; Humphreys & Nicholls 1984; Turner 1970; McNeilly & Bradshaw 1968). Separate evolutionary adaptations apparently have resulted in the similar metal-tolerance traits of some biotypes (Nicholls & McNeilly 1982; Al-Hiyaly *et al*. 1988, 1990, 1993). The other agronomic species and some metal-tolerance studies include *A. canina* (Gregory & Bradshaw 1965),

A. castellana (De Koe *et al*. 1992; De Koe & Jaques 1993; Schat *et al*. 2002) and *A. gigantea* (Hogan *et al*. 1977a, 1977b; Hogan & Rauser 1979, 1981; Rauser 1984a, 1984b; McLaughlin & Crowder 1988).

7.9. "What is it about the genome of *Agrostis* species that they can evolve tolerance to almost any metal anywhere…?" (Macnair 1987). These species are considered metal excluders rather than hyperaccumulators (Memon *et al*. 2001; Lasat 2002; Pollard *et al*. 2002). *Agrostis capillaris* for example avoids cadmium, copper, lead, and zinc by precipitating them in the rhizosphere (Dahmani-Muller *et al*. 2000). The genetics and physiology of such metal-tolerant plants are now better delineated and precise understanding is becoming possible (*e.g.* Macnair 1990, 1993; Macnair *et al*. 2000; Schat *et al*. 2000; Hall 2002; Memon *et al*. 2001).

8. Biotechnological Developments in *Agrostis*

8.1. Many publications are providing substantial current overviews on aspects of the improvement of plants for various purposes and genetic engineering. Recent summaries include technological developments over 100 years and prospects (*e.g.* McCown 2003; Chandler 2003), and comparing crop domestication, conventional plant breeding, and genetic engineering (Gepts 2002). There are overviews on genetic engineering for turf and forage grasses (*e.g.* Wang & Ge 2006; Wang *et al*. 2001; Maqbool *et al*. 2002; Chai & Sticklen 1998; Lee 1996), and on transgenic turfgrasses and risk assessment in considering the release of a particular modified plant into the environment (*e.g.* Johnson & Riordan 1999; Day & Lee 1997). Consequent experiments to better understand aspects of the biology of these species are the pollination and hybrid studies noted above (sections 6.6-6.7). The purpose of other experiments (in the greenhouse or a field trial) (*e.g.* Lee *et al*. 1997; Gardner *et al*. 2003, 2004; Fei & Nelson 2004; Reichman *et al*. 2006; Hart *et al*. 2005; Wang *et al*. 2003) is to evaluate the transgenic plant's biology for any unexpected effects, or to study the trait put into the plant to see if the result is as desired. Semi-popular and professional trade articles on methods and potential benefits perceived in the genetic engineering of turfgrasses are also available (*e.g.* Lee *et al*. 1995; Sticklen 2001; Harriman & Suttner 2003; Litrenta 2003; Ostmeyer 2004a, 2004b, 2004c; Jones 2005).

8.2. In *Agrostis*, genetic engineering (on an experimental basis in several countries) has succeeded, and next steps are proceeding with at least four species: especially *Agrostis stolonifera* (Krans *et al*. 1982; Blanche *et al*. 1986; Tanpo *et al*. 1992; Terakawa *et al*. 1992; Zhong *et al*. 1991, 1993; Sticklen *et al*. 1996; Xiao & Ha 1997; Basu *et al*. 2003; Luo *et al*. 2004, 2005; Fu *et al*. 2005a; Wang & Ge 2005), as well as *A. canina* (Pitcher *et al*. 2000; Pitcher & Zilinskas 2002), *A. capillaris* (Chai *et al*. 2003, 2004) and *A. gigantea* (Asano & Sugiura 1990; Asano *et al*. 1991; Asano & Ugaki 1994). Various lab methods now exist (*e.g.* van den Eede *et al*. 2004; Rakoczy-Trojanowska 2002) to deliver gene(s) (DNA) of interest into a plant's genome. At least five methods can transform material of *Agrostis* species: (1) microprojectile bombardment or biolistic transformation (Hartman *et al*. 1994; Lee *et al*. 1995; Lee & Day 1998); (2) silicon carbide fibers or whiskers (Asano *et al*. 1991; Dalton *et al*. 1998); (3) electroporation (Asano *et al*. 1991; Asano & Ugaki 1994; Asano *et al*. 1998; Sugiura *et al*. 1998); (4) polyethylene glycol (Lee *et al*. 1996; Lee & Day 1998); and (5) *Agrobacterium tumefaciens* (Pitcher *et al*. 2000; Yu *et al*. 2000; Chai *et al*. 2000; Kim *et al*. 2001; Pitcher & Zilinskas 2002; Chai *et al*. 2003, 2004; Luo *et al*. 2004; Han *et al*. 2005; Hu 2005). The traits of interest (*cf*. Chandler

2003) include (1) tolerance/resistance to particular herbicides (Hartman *et al*. 1994; Lee *et al*. 1995; Asano *et al*. 1997, 1998; Sugiura *et al*. 1998; Chai *et al*. 2003; Z.-Y. Wang *et al*. 2003; *cf*. Fisher & Wright 1980; Heim *et al*. 1993); (2) resistance to particular diseases (Warkentin *et al*. 1998; Chai *et al*. 2002; Dai *et al*. 2002; Guo *et al*. 2003; Fu *et al*. 2005b) or insects (Hu 2005); (3) herbicide and disease resistance together; and (4) stress tolerance (McKersie & Bowley 2001; Aswath *et al*. 2005; Xing *et al*. 2005). A potential management system using a herbicide that also reduces fungal diseases was successful in reducing the diseases in transgenic herbicide-resistant *A. canina* and *A. stolonifera* (Y. Wang *et al*. 2003).

9. References

Abramashvili, G.G. 1978. [Vegetative propagation of *Agrostis stolonifera* ssp. *stolonifera*.] *Biulleten' Glavnogo Botanicheskogo Sada* 109: 46-50.

Acheroy, M., and C. Lefèbvre. 1983. Étude sur des populations d'*Agrostis tenuis* Sibth.: Variation morphologique et écotypes édaphiques. *Acta Oecologica* 4: 83-95.

Adams, K. 1996. Grass gripes. *Essex Field Club Newsletter* (Dept. Life Sciences, Univ. East London, Stratford, England) No. 19: 5-7.

Adema, E.B., J.A. Elzinga and A.P. Grootjans. 2004. Effects of microbial mats on germination and seedling survival of typical dune slack species in the Netherlands. *Plant Ecology* 174: 89-96.

Agha, S.K., E.A.C. Price and C. Marshall. 2001. Effect of local shading and drought both singly and combined on tiller ramets of *Agrostis stolonifera* L. *Pakistan Journal of Biological Sciences* 4: 1336-1338.

Ahmad, I., and S.J. Wainwright. 1976. Ecotypic differences in leaf surface properties of *Agrostis stolonifera* L. from salt marsh, spray zone and inland habitats. *New Phytologist* 76: 361-366.

Ahmad, I., and S.J. Wainwright. 1977. Tolerance to salt, partial anaerobiosis and osmotic stress in *Agrostis stolonifera* L. *New Phytologist* 79: 605-612.

Ahmad, I., S.J. Wainwright and G.R. Stewart. 1981. The solute and water relations of *Agrostis stolonifera* L. ecotypes differing in their salt tolerance. *New Phytologist* 87: 615-629.

Aldous, D.E., and I.H. Chivers. 2002. *Sports Turf and Amenity Grasses: A Manual for Use and Identification*. Landlinks Press, Collingwood, Victoria, Australia. 152 pp.

Aldous, D.E., and M.I. Mebalds. 1995. Evaluation of endophyte in creeping bentgrass (*Agrostis stolonifera*) and common bentgrass (*A. capillaris*). Vol. 2: 49-58 in *Proceedings of the Second Australian Turfgrass Research Institute [ATRI] Turf Research Conference* (ed. J. Kaapro). ATRI, Sydney.

Aldous, D.E., M.I. Mebalds and K.L. Blaze. 1994. Endophytes in creeping bentgrass (*Agrostis stolonifera* and *A. palustris*). *Australian Parks & Recreation: Quarterly Journal of the Royal Australian Institute of Parks and Recreation* 30(4): 29-30.

Al-Hiyaly, S.A.K., T. McNeilly and A.D. Bradshaw. 1988. The effect of zinc contamination from electricity pylons — evolution in a replicated situation. *New Phytologist* 110: 571-580.

Al-Hiyaly, S.A.K., T. McNeilly and A.D. Bradshaw. 1990. The effect of zinc contamination from electricity pylons — contrasting patterns of evolution in five grass species. *New Phytologist* 114: 183-190.

Al-Hiyaly, S.A.K., T. McNeilly, A.D. Bradshaw and A.M. Mortimer. 1993. The effect of zinc contamination from electricity pylons. Genetic constraints on selection for zinc tolerance. *Heredity* 70: 22-32.

Allen, R.B., P.D. McIntosh and J.B. Wilson. 1997. The distribution of plants in relation to pH and salinity on inland saline/alkaline soils in Central Otago, New Zealand. *New Zealand Journal of Botany* 35: 517-523.

Amiaud, B., A. Bonis and J.-B. Bouzillé. 2000. Conditions de germination et rôle des herbivores dans la dispersion et le recruitement d'une espèce clonale: *Juncus gerardii* Lois. *Canadian Journal of Botany* 78: 1430-1439.

Anderson, E. 1948. Hybridization of the habitat. *Evolution* 2: 1-9.

Anderson, E. 1949. *Introgressive Hybridization*. John Wiley & Sons, New York. 109 pp.

Anderson, E. 1953. Introgressive hybridization. *Biological Reviews* 28: 280-307.

Anderson, E. 1961. The analysis of variation in cultivated plants with special reference to introgression. *Euphytica* 10: 79-86.

Andersson, E., C. Nilsson and M.E. Johansson. 2000. Plant dispersal in boreal rivers and its relation to the diversity of riparian flora. *Journal of Biogeography* 27: 1095-1106.

Andreasen, C., H. Stryhn and J.C. Streibig. 1996. Decline of the flora in Danish arable fields. *Journal of Applied Ecology* 33: 619-626.

Antonovics, J. 1968. Evolution in closely adjacent populations. V. Evolution of self-fertility. *Heredity* 23: 219-238.

Archambault, D.J., and K. Winterhalder. 1995. Metal tolerance in *Agrostis scabra* Willd. from the Sudbury, Ontario area. *Canadian Journal of Botany* 73: 766-775.

Arnold, M.L. 1997. *Natural Hybridization and Evolution*. Oxford University Press, New York. 215 pp.

Arnold, M.L. 2004. Transfer and origin of adaptations through natural hybridization: Were Anderson and Stebbins right? *Plant Cell* 16: 562-570.

Arthur, J.H. 1949. New Zealand chewings fescue and browntop. *Journal of the Board of Greenkeeping Research* 7: 236-243.

Asano, Y., and K. Sugiura. 1990. Plant regeneration from suspension culture-derived protoplasts of *Agrostis alba* L. (redtop). *Plant Science* 72: 267-273.

Asano, Y., and M. Ugaki. 1994. Transgenic plants of *Agrostis alba* obtained by electroporation-mediated direct gene transfer into protoplasts. *Plant Cell Reports* 13: 243-246.

Asano, Y., Y. Otsuki and M. Ugaki. 1991. Electroporation-mediated and silicon carbide fiber-mediated DNA delivery in *Agrostis alba* L. (redtop). *Plant Science* 79: 247-252.

Asano, Y., Y. Ito, M. Fukami, M. Morifuji and A. Fujiie.1997. Production of herbicide-resistant, transgenic creeping bent plants. *International Turfgrass Society Research Journal* 8: 261-267.

Asano, Y., Y. Ito, M. Fukami, K. Sugiura and A. Fujiie. 1998. Herbicide-resistant transgenic creeping bentgrass plants obtained by electroporation using an altered buffer. *Plant Cell Reports* 17: 963-967.

Ashraf, M., T. McNeilly and A.D. Bradshaw. 1986a. The potential for evolution of salt (NaCl) tolerance in seven grass species. *New Phytologist* 103: 299-309.

Ashraf, M., T. McNeilly and A.D. Bradshaw. 1986b. Tolerance of *Holcus lanatus* and *Agrostis stolonifera* to sodium chloride in soil solution and saline spray. *Plant and Soil* 96: 77-84.

Aston, J.L., and A.D. Bradshaw. 1966. Evolution in closely adjacent plant populations. II. *Agrostis stolonifera* in maritime habitats. *Heredity* 21: 649-664.

Aswath, C.R., S.H. Kim, S.Y. Mo and D.H. Kim. 2005. Transgenic plants of creeping bent grass harboring the stress inducible gene, *9-cis-epoxycarotenoid dioxygenase*, are highly tolerant to drought and NaCl stress. *Plant Growth Regulation* 47: 129-139.

Ater, M. 1993. Biologie et Génétique évolutive de Populations du Complexe spécifique *Agrostis capillaris* L. – *Agrostis stolonifera* L. (Poaceae). Laboratoire de Génétique Évolutive et d'Écologie végétales, Université Libre de Bruxelles, Brussels, Belgium.

Badiani, M., A.R. Paolacci, A. Fusari, I. Bettarini, E. Brugnoli, M. Lauteri, F. Miglietta and A. Raschi. 1998. Foliar antioxidant status of plants from naturally high-CO_2 sites. *Physiologia Plantarum* 104: 765-771.

Bailey, L.H., E.Z. Bailey and Staff of L.H. Bailey Hortorium. 1976. *Hortus Third: A Concise Dictionary of Plants Cultivated in the United States and Canada*. Macmillan, New York. 1290 pp.

Baker, A.J.M., J. Proctor and R.D. Reeves, eds. 1993. *The Vegetation of Ultramafic (Serpentine) Soils; Proceedings of the First International Conference on Serpentine Ecology, University of California at Davis, 19-22 June 1991*. Intercept Ltd., Andover, Hamps., England, U.K. 509 pp.

Baker, H.G. 1965. Characteristics and modes of origin of weeds. Pp. 147-172 in H.G. Baker and G.L. Stebbins, eds., *The Genetics of Colonizing Species: Proceedings of the First International Union of Biological Sciences Symposia on General Biology, Asilomar, Calif., 1964*. Academic Press, New York.

Baker, H.G. 1972. The migration of weeds. Pp. 327-347 in D.H. Valentine, ed., *Taxonomy, Phytogeography, and Evolution*. Academic Press, London, England, U.K.

Baker, H.G. 1974. The evolution of weeds. *Annual Review of Ecology and Systematics* 5: 1-24.

Bakker, J.P., M. Dekker and Y. de Vries. 1980. The effect of different management practices on a grassland community and the resulting fate of seedlings. *Acta Botanica Neerlandica* 29: 469-482.

Bakker, J.P., E.S. Bakker, E. Rosén, G.L. Verweij and R.M. Bekker. 1996. Soil seed bank composition along a gradient from dry alvar grassland to *Juniperus* shrubland. *Journal of Vegetation Science* 7: 165-176.

Balasko, J.A., G.E. Evers and R.W. Duell. 1995. Bluegrasses, ryegrasses, and bentgrasses. Vol. 1: 357-373 in R.F. Barnes, D.A. Miller and C.J. Nelson, eds., *Forages: An Introduction to Grassland Agriculture*, 5th Ed. Iowa State University Press, Ames.

Balocchi-L., O., and I. López-C. 2001. Rol de las especies pratenses nativas y naturalizadas en las praderas permanentes del Sur de Chile. Pp. 285-299 in *Proceedings, Simposio Internacional en Producción Animal y Medio Ambiente*. Departamento de Zootecnia, Facultad de Agronomía, Pontificia Universidad Católica de Chile, Santiago.

Balocchi-L., O., I. López-C. and J. Lukaschewsky-P. 1998. Características físicas y germinativas de la semilla de especies pratenses nativas y naturalizadas del Dominio Húmedo de Chile. I: *Agrostis capillaris* L., *Arrhenatherum elatius* (L.) P. Beauv. ex J. & C. Presl ssp. *bulbosum* (Willd.) Schübl. & G. Martens, *Bromus valdivianus* Phil., *Paspalum dasypleurum* Kunze ex Desv. y *Trifolium dubium* Sibth. *Agro Sur (Valdivia)* 26(1): 11-25.

Bañuelos, M.J., and J.R. Obeso. 2000. Effect of grazing history, experimental defoliation, and genotype on patterns of silicification in *Agrostis tenuis* Sibth. *Écoscience* 7: 45-50.

Barkworth, M.E. 2004. *Polypogon* Desf., Beardgrass. (5/04 ms., 3 pp.) for Flora of North America Editorial Committee, M.E. Barkworth, K.M. Capels, S. Long and M.B. Piep, eds., *Flora of North America North of Mexico, Vol. 24, Magnoliophyta:*

Commelinidae (in part): Poaceae (Part 1) with publication planned in 2007. Oxford University Press, New York.

Bartels, L.C. 1943. Woodend bent grass: Seed wanted for aerodromes. *Journal of Agriculture (Melbourne)* (Aug.): 377-380.

Barthram, G.T., D.A. Elston, C.P.D. Birch and G.R. Bolton. 2002. Defoliation and site differences influence vegetative spread in grassland. *New Phytologist* 155: 257-264.

Basu, C., A.P. Kausch, H. Luo and J.M. Chandlee. 2003. Promoter analysis in transient assays using a GUS reporter gene construct in creeping bentgrass (*Agrostis palustris*). *Journal of Plant Physiology* 160: 1233-1239.

Batson, M.-G. 1996. The Ecology of *Agrostis* spp. (Bent grass) Invasion into Temperate Pastures. Ph.D. Thesis, University of Melbourne, Ellinbank, Victoria, Australia. 251 pp.

Batson, M.-G. 1998a. *Agrostis castellana* (Poaceae), dominant *Agrostis* species, found in bent grass pastures in south-eastern Australia. *Australian Journal of Botany* 46: 697-705.

Batson, [M.-]G. 1998b. *Control of Bent Grass in Pastures*. Department of Natural Resources and Environment, State of Victoria [Australia], Agriculture Notes AG0764. 3 pp.

Batson, M.-G. 1998c. Length of rhizome and depth of burial affect the regeneration of bent grass (*Agrostis castellana* Boiss. et Reuter). *Australian Journal of Agricultural Research* 49: 1141-1146.

Beard, J.B., and H.J. Beard. 2005. *Beard's Turfgrass Encyclopedia for Golf Courses, Grounds, Lawns, Sports Fields*. Michigan State University Press, East Lansing. 513 pp.

Beard, J.B., and W.H. Daniel. 1966. Relationship of creeping bentgrass (*Agrostis palustris* Huds.) root growth to environmental factors in the field. *Agronomy Journal* 58: 337-339.

Beetle, A.A. 1945. A new section Microphyllae in *Agrostis*. *Bulletin of the Torrey Botanical Club* 72: 541-549.

Behrendt, S., and M. Hanf. 1979. *Grass Weeds in World Agriculture: Identification in the Flowerless State*. BASF Aktiengesellschaft, Ludwigshafen am Rhein, Germany. 160 pp.

Belanger, F.C., S. Bonos and W. Meyer. 2003a. A new approach to dollar spot resistance in creeping bentgrass. Page 27 in *Proceedings of the Twelfth Annual Rutgers Turfgrass Symposium, Cook College, January 9-10, 2003* (eds. J. Murphy, D. Corrington and B. Fitzgerald). Rutgers University, New Brunswick, New Jersey.

Belanger, F.C., K.A. Plumley, P.R. Day and W.A. Meyer. 2003b. Interspecific hybridization as a potential method for improvement of *Agrostis* species. *Crop Science* 43: 2172-2176.

Belanger, F.C., T.R. Meagher, P.R. Day, K. Plumley and W.A. Meyer. 2003c. Interspecific hybridization between *Agrostis stolonifera* and related *Agrostis* species under field conditions. *Crop Science* 43: 240-246.

Belanger, F.C., S. Bonos and W.A. Meyer. 2004. Dollar spot resistant hybrids between creeping bentgrass and colonial bentgrass. *Crop Science* 44: 581-586.

Bell, G.E., and T.K. Danneberger. 1999. Temporal shade on creeping bentgrass turf. *Crop Science* 39: 1142-1146.

Bengeyfield, W.H. 1968. Turf establishment — stolonizing. *USGA Green Section Record* 5(6): 16-17.

Bertozzi, T., and A. McKay. 1995. Incidence on *Polypogon monspeliensis* of *Clavibacter toxicus* and *Anguina* sp., the organisms associated with "floodplain staggers" in South Australia. *Australian Journal of Experimental Agriculture* 35: 567-569.

Biek, D. 2000. *Flora of Mount Rainier National Park*. Oregon State University Press, Corvallis. 506 pp.

Björkman, S.O. 1951. Chromosome studies in *Agrostis*. (A preliminary report.) *Hereditas* 37: 465-468.

Björkman, S.O. 1954. Chromosome studies in *Agrostis*. II. *Hereditas* 40: 254-258.

Björkman, S.O. 1960. Studies in *Agrostis* and Related Genera. Symbolæ Botanicæ Upsalienses 17: 1-112.

Blanche, F.C., J.V. Krans and G.E. Coats. 1986. Improvement in callus growth and plantlets formation in creeping bentgrass. *Crop Science* 26: 1245-1248.

Boedeltje, G., J.P. Bakker, R.M. Bekker, J.M. van Groenendael and M. Soesbergen. 2003. Plant dispersal in a lowland stream in relation to occurrence and three specific life-history traits of the species in the species pool. *Journal of Ecology* 91: 855-866 + Appendices S1 & S2 (4 pp.).

Boedeltje, G., J.P. Bakker, A. ten Brinke, J.M. van Groenendael and M. Soesbergen. 2004. Dispersal phenology of hydrochorous plants in relation to discharge, seed release time and buoyancy of seeds: The flood pulse concept supported. *Journal of Ecology* 92: 786-796 + Appendices S1 & S2 (7 pp.).

Boeker, P. 1974. Root development of selected turfgrass species and cultivars. Pp. 55-61 in *Proceedings of the Second International Turfgrass Conference* (ed. E.C. Roberts). International Turfgrass Society, American Society of Agronomy (ASA) and Crop Science Society of America (CSSA), Madison, Wisconsin.

Bohner, A. 2003. Floristische Diversität im Spannungsfeld zwischen Landwirtschaft und Naturschutz. Pp. 29-39 in *9. Alpenländisches Expertenforum zum Thema Das österreichische Berggrünland — ein aktueller Situationsbericht mit Blick in die Zukunft, 27-28 März 2003, Bundesanstalt für alpenländische Landwirtschaft [BAL] Gumpenstein, Irdning, Austria*.

Bone, E., and A. Farres. 2001. Trends and rates of microevolution in plants. *Genetica* 112/113: 165-182.

Bonis, A., J.-B. Bouzillé, B. Amiaud and G. Loucougaray. 2005. Plant community patterns in old embanked grasslands and the survival of halophytic flora. *Flora* 200: 74-87.

Bonos, S.A., K.A. Plumley and W.A. Meyer. 2002. Ploidy determination in *Agrostis* using flow cytometry and morphological traits. *Crop Science* 42: 192-196.

Boon, G.T., L.A. Bouwman, J. Bloem and P.F.A.M. Römkens. 1998. Effects of a copper-tolerant grass (*Agrostis capillaris*) on an ecosystem of copper-contaminated arable soil. *Environmental Toxicology and Chemistry* 17: 1964-1971.

Booth, B.D., S.D. Murphy and C.J. Swanton. 2003. *Weed Ecology in Natural and Agricultural Systems.* CABI Publishing, Wallingford, England, U.K. 288 pp.

Bowen, W.A. 1978. *The Willamette Valley: Migration and Settlement on the Oregon Frontier*. University of Washington Press, Seattle. 120 pp.

Bowman, D.C., D.A. Devitt, M.C. Engelke and T.W. Rufty Jr. 1998. Root architecture affects nitrate leaching from bentgrass turf. *Crop Science* 38: 1633-1639.

Boyd, M. 1976. Four ways of controlling bentgrass. *Journal of Agriculture (Melbourne)* 74: 196-198.

Bradshaw, A.D. 1952. Populations of *Agrostis tenuis* resistant to lead and zinc poisoning. *Nature* 169: 1098-1099.

Bradshaw, A.D. 1958. Natural hybridization of *Agrostis tenuis* Sibth. and *A. stolonifera* L. *New Phytologist* 57: 66-84.

Bradshaw, A.D. 1959a. Population differentiation in *Agrostis tenuis* Sibth. I. Morphological differentiation. *New Phytologist* 58: 208-227.

Bradshaw, A.D. 1959b. Population differentiation in *Agrostis tenuis* Sibth. II. The incidence and significance of infection by *Epichloë typhina*. *New Phytologist* 58: 310-315.

Bradshaw, A.D. 1959c [1958]. Studies of variation in bent grass species. I. Hybridization between *Agrostis tenuis* and *A. stolonifera*. *Journal of the Sports Turf Research Institute* 9: 422-429.

Bradshaw, A.D. 1959d. Studies of variation in bent grass species. II. Variation within *Agrostis tenuis*. *Journal of the Sports Turf Research Institute* 10: 1-7.

Bradshaw, A.D. 1960. Population differentiation in *Agrostis tenuis* Sibth. III. Populations in varied environments. *New Phytologist* 59: 92-103.

Bradshaw, A.D. 1975a. *Agrostis* L. Pp. 579-583 in C.A. Stace, ed., *Hybridization and the Flora of the British Isles*. Academic Press, London.

Bradshaw, A.D. 1975b. *Agrostis* L. × *Polypogon* Desf. = ×*Agropogon* P. Fourn. Pp. 583-584 in C.A. Stace, ed., *Hybridization and the Flora of the British Isles*. Academic Press, London.

Bradshaw, A.D., and K. Hardwick. 1989. Evolution and stress — genotypic and phenotypic components. *Biological Journal of the Linnean Society* 37: 137-155.

Bradshaw, A.D., T.S. McNeilly and R.P.G. Gregory. 1965. Industrialisation, evolution, and the development of heavy metal tolerance in plants. *Ecology and the Industrial Society; British Ecological Society Symposium* 5: 327-343.

Brauen, S.E., R.L. Goss and A.D. Brede. 1993. Registration of 'Putter' creeping bentgrass. *Crop Science* 33: 1100.

Brede, A.D. 2000. Four more unconventional grasses to know and love. *TurfGrass Trends* 9(12): 8-13.

Brede, A.D. 2004. 'GolfStar', a turf, ornamental, and reclamation cultivar of North American native Idaho bentgrass. *HortScience* 39: 188-189.

Brede, A.D., and M.J. Sellmann. 2003. Three minor *Agrostis* species: Redtop, highland bentgrass, and Idaho bentgrass. Pp. 207-223 in M.D. Casler and R.R. Duncan, eds., *Turfgrass Biology, Genetics, and Breeding*. John Wiley & Sons, Hoboken, New Jersey.

Brenchley, W.E., and K. Warington. 1930. The weed seed population of arable soil, I. Numerical estimation of viable seeds and observations on their natural dormancy. *Journal of Ecology* 18: 235-272 & plate 12.

Briggs, D., and S.M. Walters. 1997. *Plant Variation and Evolution*, 3rd Ed. Cambridge University Press, Cambridge, England, U.K. 521 pp.

Brilman, L.A. 2001a. Colonial bentgrass: An option for fairways. *Golf Course Management* 69(1): 55-60.

Brilman, L.A. 2001b. Utilization of interspecific crosses for turfgrass improvement. *International Turfgrass Society Research Journal* 9: 157-161.

Brilman, L.A. 2003. Velvet bentgrass (*Agrostis canina* L.). Pp. 201-205 in M.D. Casler and R.R. Duncan, eds., *Turfgrass Biology, Genetics, and Breeding*. John Wiley & Sons, Hoboken, New Jersey.

Brilman, L.A., and W.A. Meyer. 2000. Velvet bentgrass: Rediscovering a misunderstood turfgrass. *Golf Course Management* 68(10): 70-75.

Brown, A.J., and E.A. James. 1998. Biodiversity and potential utilization of blown-grasses (*Agrostis* spp.) in lowland Victoria. In *Agronomy – Growing a Greener Future; Proceedings of the 9th Australian Agronomy Conference, Wagga Wagga, 20-23 July 1998* (eds. D.L. Michalk and J.E. Pratley). Australian Society of Agronomy. http://www.regional.org.au/au/asa/1998/1/049brown.htm

Bruun, H.H., and B. Fritzbøger. 2002. The past impact of livestock husbandry on dispersal of plant seeds in the landscape of Denmark. *Ambio* 31: 425-431.

Bullock, J.M. 2000. Gaps and seedling colonization. Pp. 375-395 in M. Fenner, ed., *Seeds: The Ecology of Regeneration in Plant Communities*, 2nd Ed. CABI Publishing, Wallingford, England, U.K.

Bullock, J.M., J. Silvertown and B. Clear Hill. 1996. Plant demographic responses to environmental variation: Distinguishing between effects on age structure and effects on age-specific vital rates. *Journal of Ecology* 84: 733-743.

Bullock, J.M., J. Franklin, M.J. Stevenson, J. Silvertown, S.J. Coulson, S.J. Gregory and R. Tofts. 2001. A plant trait analysis of responses to grazing in a long-term experiment. *Journal of Applied Ecology* 38: 253-267.

Burgess, N.D., C.E. Evans and G.J. Thomas. 1990. Vegetation change on the Ouse Washes wetland, England, 1972-88 and effects on their conservation importance. *Biological Conservation* 53: 173-189.

Bylterud, A. 1984. Gras som ugras: Utbredning og omfang i Norge [Grasses as weeds: Distribution and range in Norway]. *Nordisk Jordbrugsforskning* 66: 166.

Caceres, M.E., F. Pupilli, E. Piano and S. Arcioni. 2000. RFLP markers are an effective tool for the identification of creeping bentgrass (*Agrostis stolonifera* L.) cultivars. *Genetic Resources and Crop Evolution* 47: 455-459.

Cadwalladr, D.A., M. Owen, J.V. Morley and R.S. Cook. 1972. Wigeon (*Anas penelope* L.) conservation and salting pasture management at Bridgwater Bay National Nature Reserve, Somerset. *Journal of Applied Ecology* 9: 417-425 & plate 1.

Caldwell, F.A., and G.E. Crow. 1992. A floristic and vegetation analysis of a freshwater tidal marsh on the Merrimack River, West Newbury, Massachusetts. *Rhodora* 94: 63-97.

Callaway, J.C., and J.B. Zedler. 1998. Interactions between a salt marsh native perennial (*Salicornia virginica*) and an exotic annual (*Polypogon monspeliensis*) under varied salinity and hydroperiod. *Wetlands Ecology and Management* 5: 179-194.

Campbell, B.D., N.D. Mitchell and T.R.O. Field. 1999. Climate profiles of temperate C_3 and subtropical C_4 species in New Zealand pastures. *New Zealand Journal of Agricultural Research* 42: 223-233.

Camus, A. 1958. Graminées hybrides de la flore française (genre *Bromus* excepté). *Bulletin del Jardin Botanique de l'État Bruxelles* 28: 337-374.

Carlbom, C.G. 1967 [1966?]. A Biosystematic Study of Some North American Species of *Agrostis* L. and *Podagrostis* (Griseb.) Scribn. & Merr. Ph.D. Dissertation, Oregon State University, Corvallis. 223 pp.

Carlbom, C. 1969. Premeiotic reduction in *Agrostis* L., *Potentilla* L., and *Triticum* L. *Hereditas* 61: 421-423.

Carr, G.W., J.V. Yugovic and K.E. Robinson. 1992. *Environmental Weed Invasions in Victoria: Conservation and Management Implications*. Department of Conservation and Environment, and Ecological Horticulture, Melbourne. 78 pp.

Carrier, L. 1921. Rhode Island bent seed situation. *Bulletin of the Green Section of the United States Golf Association* 1: 162-164.

Carrier, L. 1923. Vegetative planting. *Bulletin of the Green Section of the United States Golf Association* 3: 102-113.

Carrier, L. 1924. The vegetative method of planting creeping bent. *Bulletin of the Green Section of the United States Golf Association* 4: 54-60.

Casler, M.D., and R.R Duncan. 2003. Origins of the turfgrasses. Pp. 5-23 in M.D. Casler and R.R Duncan, eds., *Turfgrass Biology, Genetics, and Breeding*. John Wiley & Sons, Hoboken, New Jersey.

Casler, M.D., Y. Rangel, J.C. Stier and G. Jung. 2003. RAPD marker diversity among creeping bentgrass clones. *Crop Science* 43: 688-693.

Cattani, D.J. 1999. Early plant development in 'Emerald' and 'UM67-10' creeping bentgrass. *Crop Science* 39: 754-762.

Cattani, D.J., and P.C. Struik. 2001. Tillering, internode development, and dry matter partitioning in creeping bentgrass. *Crop Science* 41: 111-118.

Cattani, D.J., P.R. Miller and S.R. Smith Jr. 1996. Relationship of shoot morphology between seedlings and established turf in creeping bentgrass. *Canadian Journal of Plant Science* 76: 283-289.

Cattani, D.J., S.R. Smith Jr., P.R. Miller, D.E. Feindel and R. Gjuric. 2004. Seed yield and yield components of creeping bentgrass cultivars. *Canadian Journal of Plant Science* 84: 117-124.

Chadwick, M.J., and J.K. Salt. 1969. Population differentiation within *Agrostis tenuis* Sibth. in response to colliery spoil substrate factors. *Nature* 224: 186.

Chai, B., and M.B. Sticklen. 1998. Applications of biotechnology in turfgrass genetic improvement. *Crop Science* 38: 1320-1338.

Chai, B., S.B. Maqbool, R.K. Hajela, D. Green, J.M. Vargas Jr., D. Warkentin, R. Sabzikar and M.B. Sticklen. 2002. Cloning of a chitinase-like cDNA (*hs2*), its transfer to creeping bentgrass (*Agrostis palustris* Huds.) and development of brown patch (*Rhizoctonia solani*) disease-resistant transgenic lines. *Plant Science* 163: 183-193.

Chai, M.-L., K.K. Senthil, S.-Y. Mo, Y.-S. Chung, S.-H. Cho, J.-S. Shin, M.-H. Park and D.-H. Kim. 2000. Embryogenic callus induction and *Agrobacterium*-mediated transformation in bentgrass (*Agrostis* spp.). *Journal of the Korean Society for Horticultural Science* 41: 450-454.

Chai M.-L., Wang B.-L., Kim J.-Y., Lee J.-M. and Kim D.-H. 2003. *Agrobacterium*-mediated transformation of herbicide resistance in creeping bentgrass and colonial bentgrass. *Journal of Zhejiang University Science* 4: 346-351.

Chai, M.L., K.K. Senthil and D.H. Kim. 2004. Transgenic plants of colonial bentgrass from embryogenic callus via *Agrobacterium*-mediated transformation. *Plant Cell, Tissue and Organ Culture* 77: 165-171.

Chakraborty, N., J. Bae, S. Warnke, T. Chang and G. Jung. 2005. Linkage map construction in allotetraploid creeping bentgrass (*Agrostis stolonifera* L.). *Theoretical and Applied Genetics* 111: 795-803.

Chandler, S.F. 2003. Commercialization of genetically modified ornamental plants. *Journal of Plant Biotechnology* 5: 69-77.

Chang, E.R., E.L. Zozaya, D.P.J. Kuijper and J.P. Bakker. 2005. Seed dispersal by small herbivores and tidal water: Are they important filters in the assembly of salt-marsh communities? *Functional Ecology* 19: 665-673.

Chastain, T.G., and W.C. Young III. 1998. Vegetative plant development and seed production in cool-season perennial grasses. *Seed Science Research* 8: 295-301.

Chelius, M.K., and E.W. Triplett. 1999. Rapid detection of arbuscular mycorrhizae in roots and soil of an intensively managed turfgrass system by PCR amplification of small subunit rDNA. *Mycorrhiza* 9: 61-64.

Chicouène, D. 1989. Note sur les *Agrostis* du Massif Armoricain: Identification, écologie, répartition. *Bulletin de la Société de Sciences Naturelles de l'Ouest de la France*, n.s. 11: 33-42.

Chorlton, K.H., I.D. Thomas, D.W. Bowen and M. Sevcikova. 1997. A forage grass and legume plant collecting expedition in Czechoslovakia 1992. *Genetic Resources and Crop Evolution* 44: 277-283.

Chorlton, K.H., I.D. Thomas, D.W. Bowen and V.P. Carnide. 2000. A forage grass and legume plant collecting expedition in Portugal. *Genetic Resources and Crop Evolution* 47: 157-162.

Christians, N.E., K.J. Karnok and T.J. Logan. 1981. Root activity in creeping bentgrass thatch. *Communications in Soil Science and Plant Analysis* 12: 765-774.

Christoffer, P.M. 2003. *Transgenic Glyphosate Resistant Creeping Bentgrass: Studies in Pollen-mediated Transgene Flow*. M.S. Thesis, Washington State University, Pullman. 84 pp.

Clark, D.L., and M.V. Wilson. 2001. Fire, mowing, and hand-removal of woody species in restoring a native wetland prairie in the Willamette Valley of Oregon. *Wetlands* 21: 135-144.

Clark, G.H. 1922. Turf grasses in Canada. *Bulletin of the Green Section of the United States Golf Association* 2: 284-286.

Clark, K.W., A. Hussain, K. Bamford and W. Bushuk. 1989. Identification of cultivars of *Agrostis* species by polyacrylamide gel electrophoresis of seed proteins. Pp. 121-125 in *Proceedings of the Sixth International Turfgrass Research Conference* (ed. H. Takatoh). International Turfgrass Society and Japanese Society of Turfgrass Science, Tokyo.

Clarkson, D.T. 1965. Calcium uptake by calcicole and calcifuge species in the genus *Agrostis*. *Journal of Ecology* 53: 427-435.

Clarkson, D.T. 1967. Phosphorus supply and growth rate in species of *Agrostis* L. *Journal of Ecology* 55: 111–118.

Clay, K., and C. Schardl. 2002. Evolutionary origins and ecological consequences of endophyte symbiosis with grasses. *American Naturalist* 160: S99-S127.

Clayton, W.D., and S.A. Renvoize. 1986. *Genera Graminum: Grasses of the World*. Kew Bulletin Additional Series No. 13. 389 pp.

CNPS Rare Plant Scientific Advisory Committee. 2001. *California Native Plant Society's Inventory of Rare and Endangered Plants of California*, 6th Ed. California Native Plant Society [CNPS] Press, Sacramento. 386 pp.

CNPS Rare Plant Scientific Advisory Committee. 2005. *California Native Plant Society's Inventory of Rare and Endangered Plants of California*, Online Ed. v6.05c. California Native Plant Society Press, Sacramento. http://www.cnps.org/inventory

Cody, W.J., K.L. MacInnes, J. Cayouette and S. Darbyshire. 2000. Alien and invasive native vascular plants along the Norman Wells Pipeline, District of Mackenzie, Northwest Territories. *Canadian Field-Naturalist* 114: 126-137.

Collet, C., H. Frochot and J.-M. Guehl. 1996. Growth dynamics and water uptake of two forest grasses differing in their growth strategy and potentially competing with forest seedlings. *Canadian Journal of Botany* 74: 1555-1561.

Conley, S.A. 1993. *Polypogon*, Beard grass. Pp. 1290, 1295 in J.C. Hickman, ed., *The Jepson Manual: Higher Plants of California*. University of California Press, Berkeley.

Conover, M.R. 1991. Herbivory by Canada geese: Diet selection and effect on lawns. *Ecological Applications* 1: 231-236.

Cooper, J.P., and D.M. Calder. 1964. The inductive requirements for flowering of some temperate grasses. *Journal of the British Grassland Society* 19: 6-14.

Cope, T.A. 1991. Problems with bents – identifying British *Agrostis*. *Wild Flower Magazine* 422: 22-24.

Copping, A. 1974. Identification of *Agrostis* species in Inverness-shire. *Inverness-shire Surv. 1970-1974 Newsletter* No. 3: 20-25.

Cornish, M.W. 1954. The origin and structure of the grassland types of the central North Downs. *Journal of Ecology* 42: 359-374.

Cosyns, E., S. Claerbout, I. Lamoot and M. Hoffmann. 2005a. Endozoochorous seed dispersal by cattle and horse in a spatially heterogeneous landscape. *Plant Ecology* 178: 149-162.

Cosyns, E., A. Delporte, L. Lens and M. Hoffmann. 2005b. Germination success of temperate grassland species after passage through ungulate and rabbit guts. *Journal of Ecology* 93: 353-361 + Appendices 1-3 (3 pp.).

Cotter-Howells, J.D., and S. Caporn. 1996. Remediation of contaminated land by formation of heavy metal phosphates. *Applied Geochemistry* 11: 335-342.

Courtney, A.D. 1981. A comparative study of management factors likely to influence rhizome production by *Agropyron repens* and *Agrostis gigantea* in perennial ryegrass swards. Pp. 469-475 in *Proceedings of the 1980 British Crop Protection Conference – Weeds (15th British Weed Control Conference), 17-20 November 1980, Brighton, England* (eds. C. Wheeler and J. Holroyd). British Crop Protection Council, London, England, U.K.

Couvreur, M., B. Christiaen, K. Verheyen and M. Hermy. 2004. Large herbivores as mobile links between isolated nature reserves through adhesive seed dispersal. *Applied Vegetation Science* 7: 229-236.

Crick, J.C., and J.P. Grime. 1987. Morphological plasticity and mineral nutrient capture in two herbaceous species of contrasted ecology. *New Phytologist* 107: 403-414.

Croce, P., M. Mocioni and J.B. Beard. 1999. *Agrostis* cultivar characterizations for closely mowed putting greens in a Mediterranean climate. Pp. 668-678 in *Science and Golf III: Proceedings of the World Scientific Congress of Golf, July 1998, St. Andrews, Scotland* (eds. M.R. Farrally and A.J. Cochran). Human Kinetics Publishers, Champaign, Illinois.

Cronon, W. 1983. *Changes in the Land: Indians, Colonists, and the Ecology of New England*. Hill and Wang, New York. 241 pp.

Cronquist, A., A.H. Holmgren, N.H. Holmgren, J.L. Reveal and P.K. Holmgren. 1977. *Intermountain Flora: Vascular Plants of the Intermountain West, Vol. 6, The Monocotyledons*. *Agrostis* L. (pp. 273-281). Columbia University Press, New York.

Croxton, P.J., C. Carvell, J.O. Mountford and T.H. Sparks. 2002. A comparison of green lanes and field margins as bumblebee habitat in an arable landscape. *Biological Conservation* 107: 365-374.

DaCosta, M., and B. Huang. 2003. Water use and requirements for bentgrasses under fairway conditions. Page 38 in *Proceedings of the Twelfth Annual Rutgers Turfgrass Symposium, Cook College, January 9-10, 2003* (eds. J. Murphy, D. Corrington and B. Fitzgerald). Rutgers University, New Brunswick, New Jersey.

Daehler, C.C. 2005. Upper-montane plant invasions in the Hawaiian Islands: Patterns and opportunities. *Perspectives in Plant Ecology, Evolution and Systematics* 7: 203-216.

Dahmani-Muller, H., F. van Oort, B. Gélie and M. Balabane. 2000. Strategies of heavy metal uptake by three plant species growing near a metal smelter. *Environmental Pollution* 109: 231–238.

Dai, W.D., S. Bonos, Z. Guo, W.A. Meyer, P.R. Day and F.C. Belanger. 2002. Expression of pokeweed antiviral proteins in creeping bentgrass. *Plant Cell Reports* 21: 497-502.

Dalton, S.J., A.J.E. Bettany, E. Timms and P. Morris. 1998. Transgenic plants of *Lolium multiflorum*, *Lolium perenne*, *Festuca arundinacea* and *Agrostis stolonifera* by silicon carbide fibre-mediated transformation of cell suspension cultures. *Plant Science* 132: 31-43.

Darbyshire, S.J. 2003. *Inventory of Canadian Agricultural Weeds*. Research Branch, Agriculture and Agri-Food Canada, Ottawa. 396 pp. (WWW electronic resource)

Davies, M.S., and A.K. Singh. 1983. Population differentiation in *Festuca rubra* L. and *Agrostis stolonifera* L. in response to soil waterlogging. *New Phytologist* 94: 573-583.

Davies, W.E. 1953. The breeding affinities of some British species of *Agrostis*. *British Agricultural Bulletin* 5: 313-315.

Davis, E.O., G.E. Curran, W.T. Hetherington, D.A. Norris, G.A.Wise, I.J. Roth, A.A. Seawright and W.L. Bryden. 1995. Clinical, pathological and epidemiological aspects of floodplain staggers, a corynetoxicosis of livestock grazing *Agrostis avenacea*. *Australian Veterinary Journal* 72: 187-190.

Davis, L.T., and P.L. Guy. 2001. Introduced plant viruses and the invasion of a native grass flora. *Biological Invasions* 3: 89-95.

Davis, R.J. 1952. *Flora of Idaho*. Brigham Young University Press, Provo, Utah. 836 pp.

Day, P.R., and L. Lee. 1997. Herbicide-resistant turfgrasses: Potential and concerns. Vol. 51: 173-176 in *Proceedings of the 51st Annual Meeting of the Northeastern Weed Science Society, Newport, Rhode Island, January 6-9, 1997* (ed. S. Glenn).

Dayan, F.E., J.G. Romagni and S.O. Duke. 2000. Investigating the mode of action of natural phytotoxins. *Journal of Chemical Ecology* 26: 2079-2094.

de Coninck, Fréderíc, [and J.C. Bay]. 1816. Fiorin Graes eller *Agrostis stolonifera*. N. Christensen, Kjobenhavn. 30 pp.

DeFrance, J.A., and A.W. Burger. 1966. Redtop and the bentgrasses. Pp. 238-242 in H.D. Hughes, M.E. Heath and D.S. Metcalfe, eds., *Forages: The Science of Grassland Agriculture*, Revised 2nd Ed. (3rd printing). Iowa State University Press, Ames.

De Koe, T. 1994. *Agrostis castellana* and *Agrostis delicatula* on heavy metal and arsenic enriched sites in NE Portugal. *Science of the Total Environment* 145: 103-109.

De Koe, T., and N.M.M. Jaques. 1993. Arsenate tolerance in *Agrostis castellana* and *Agrostis delicatula*. *Plant and Soil* 151: 185-191.

De Koe, T., K. Geldmeyer and N.M.M. Jaques. 1992. Measuring maximum root growth instead of longest root elongation in metal-tolerance tests for grasses (*Agrostis capillaris, Agrostis delicatula* and *Agrostis castellana*). *Plant and Soil* 144: 305-308.

Díaz-Villa, M.D., T. Marañón, J. Arroyo and B. Garrido. 2003. Soil seed bank and floristic diversity in a forest-grassland mosaic in southern Spain. *Journal of Vegetation Science* 14: 701-709 + Appendices 1 & 2 (4 pp.).

Dong, M., and M.G. Pierdominici. 1995. Morphology and growth of stolons and rhizomes in three clonal grasses, as affected by different light supply. *Vegetatio* 116: 25-32.

Donohue, K. 2003. Setting the stage: Phenotypic plasticity as habitat selection. *International Journal of Plant Sciences* 164(3S): S79-S92.

Dore, W.G., and J. McNeill. 1980. *Grasses of Ontario*. *Agrostis* L. (pp. 288-298 & plate 40). Agriculture Canada Monograph 26.

Dostál, P. 2005. Effect of three mound-building ant species on the formation of soil seed bank in mountain grassland. *Flora* 200: 148-158.

Dostál, P., M. Březnová, V. Kozlíčková, T. Herben and P. Kovář. 2005. Ant-induced soil modification and its effect on plant below-ground biomass. *Pedobiologia* 49: 127-137.

Dougall, T.A.G., and J.C. Dodd. 1997. A study of species richness and diversity in seed banks and its use for the environmental mitigation of a proposed holiday village development in a coniferized woodland in south-east England. *Biodiversity and Conservation* 6: 1413-1428.

Dudley, T. 1998. Exotic plant invasions in California riparian areas and wetlands. *Fremontia* 26(4): 24-29.

Duich, J.M. 1985. The bent grasses. *Weeds, Trees and Turf* 24(1): 72-78, 104.

Dumortier, M., A. Verlinden, H. Beeckman and K. van der Mijnsbrugge. 1996. Effects of harvesting dates and frequencies on above- and below-ground dynamics in Belgian wet grasslands. *Écoscience* 3: 190-198.

Durrett, R., and S. Levin. 1998. Spatial aspects of interspecific competition. *Theoretical Population Biology* 53: 30-43.

Duwensee, H.A. 1993. Morphologie von *Agrostis stolonifera* (Poaceae) auf Schwermetallboden. *Phyton; Anales Rei Botanicae* 33: 27-31.

Edgar, E. 1995. New Zealand species of *Deyeuxia* P. Beauv. and *Lachnagrostis* Trin. (Gramineae: Aveneae). *New Zealand Journal of Botany* 33: 1-33.

Edgar, E., and H.E. Connor. 2000. *Flora of New Zealand*, Vol. 5, Gramineae. *Agrostis* L. (pp. 225-242). Manaaki Whenua Press, Lincoln, New Zealand.

Edgar, E., and M.B. Forde. 1991. *Agrostis* L. in New Zealand. *New Zealand Journal of Botany* 29: 139-161.

Edler, G.C. 1930. Bent seed production in Germany. *Bulletin of the United States Golf Association Green Section* 10: 205.

Edwards, G.R., and M.J. Crawley. 1999. Herbivores, seed banks and seedling recruitment in mesic grassland. *Journal of Ecology* 87: 423-435.

Eertman, R.H.M., B.A. Kornman, E. Stikvoort and H. Verbeek. 2002. Restoration of the Sieperda tidal marsh in the Scheldt Estuary, The Netherlands. *Restoration Ecology* 10: 438-449.

Eggens, J.L. 1972. Control native creeping bentgrass in lawns. *Canadian Nurseryman* 9(6): 14, 18.

Ellstrand, N.C., and C.A. Hoffman. 1990. Hybridization as an avenue of escape for engineered genes — strategies for risk reduction. *BioScience* 40: 438-442.

Elmarsdottir, A., A.L. Aradottir and M.J. Trlica. 2003. Microsite availability and establishment of native species on degraded and reclaimed sites. *Journal of Applied Ecology* 40: 815-823.

Engelke, M. 1993. Bentgrass breeding — Texas style. *USGA Green Section Record* 31(6): 16-18.

Engelke, M.C., V.G. Lehman, W.R. Kneebone, P.F. Colbaugh, J.A. Reinert and W.E. Knoop. 1995. Registration of 'Crenshaw' creeping bentgrass. *Crop Science* 35: 590.

Enomoto, T. 2000. *Weeds of Japan*. Research Institute for Bioresources, Okayama University, Kurashiki, Japan. http://www.rib.okayama-u.ac.jp/wild/zassou/z_table.htm

Eriksson, O. 1989. Seedling dynamics and life histories in clonal plants. *Oikos* 55: 231-238.

Esler, A.E. 1988. The naturalisation of plants in urban Auckland, New Zealand. 5. Success of the alien species. *New Zealand Journal of Botany* 26: 565-584.

Faeth, S.H. 2002. Are endophytic fungi defensive plant mutualists? *Oikos* 98: 25-36.

Farrow, S., T. McNeilly and P.D. Putwain. 1981. The dynamics of natural selection for copper tolerance in *Agrostis canina* L. subsp. *montana* Hartm. Pp. 289-295 in *Proceedings of the 3rd International Conference on Heavy Metals in the Environment, Amsterdam, 14-18 September 1981*. CEP Consultants, Edinburgh, Scotland, U.K.

Fassett, N.C. 1951. *Grasses of Wisconsin*. University of Wisconsin Press, Madison. 173 pp.

Faville, M.J., K.D. Adam and M.E. Wedderburn. 1995. Allozyme variation within and between three populations of browntop (*Agrostis capillaris*). *New Zealand Journal of Agricultural Research* 38: 65-70.

Fei, S., and E. Nelson. 2003. Estimation of pollen viability, shedding pattern, and longevity of creeping bentgrass on artificial media. *Crop Science* 43: 2177-2181.

Fei, S., and E. Nelson. 2004. Greenhouse evaluation of fitness-related reproductive traits in Roundup®-tolerant transgenic creeping bentgrass (*Agrostis stolonifera* L.). *In Vitro Cellular & Developmental Biology – Plant* 40: 266-273.

Ferguson, M.H. 1948. West Coast trip. *USGA Journal Timely Turf Topics* 1(4): 12-15.

Ferguson, M.H. 1964. Bentgrass for the South — varieties. *USGA Green Section Record* 2(3): 6-9.

Ferris, R., and E. Simmons. 2000. *Plant Communities and Soil Seedbanks in Broadleaved-Conifer Mixtures on Ancient Woodland Sites in Lowland Britain*. Forestry Commission Information Note (FCIN32), Edinburgh, Scotland, U.K. 8 pp.

Fisher, R., and C.E. Wright. 1980. The breeding of lines of *Agrostis tenuis* Sibth. and *Festuca rubra* L. tolerant of grass-killing herbicides. Pp. 11-18 in *Proceedings of the Third International Turfgrass Conference: Sponsored by the International Turfgrass Society [ITS], July 11-13, 1977, Munich, West Germany* (ed. J.B. Beard). ASA, CSSA, SSSA and ITS, Madison, Wisconsin.

Fitts, O.B. 1925a. A preliminary study of the root growth of fine grasses under turf conditions. *Bulletin of the Green Section of the United States Golf Association* 5: 58-62.

Fitts, O.B. 1925b. Converting established turf to creeping bent by broadcasting stolons and topdressing. *Bulletin of the Green Section of the United States Golf Association* 5: 223-224.

Flores-M., M., D. Alomar-C. and O. Balocchi-L. 2000. Efecto del período de rezago sobre la calidad de cinco gramíneas forrajeras y su predicción por NIRS. *Agro Sur (Valdivia)* 28(1): 41-55.

FNA. 2005. Grass Manual and Flora of North America [FNA] Grass Volumes: Publication Plans: Names and Mapping Synonyms. Intermountain Herbarium, Utah State University, Logan. http://herbarium.usu.edu/treatments/accepted_names_and_synonyms.htm [accessed 10/25/2005].

Forde, M.B. 1991. Assessment of the extent and taxonomic significance of hybridism in naturalised bent grasses. *New Zealand Journal of Botany* 29: 158-161.

Fouillade, A. 1911. Sur les *Agrostis alba*, *castellana* et *vulgaris*. *Bulletin de la Société Botanique de Deux-Sèvres* 1910-1911: 72-79.

Fouillade, A. 1933 [1932]. Sur les *Agrostis alba*, *vulgaris*, *castellana* et leurs hybrides. *Bulletin de la Société Botanique de France* 79: 789-804.

Fowler, C. 2004. Accessing genetic resources: International law establishes multilateral system. *Genetic Resources and Crop Evolution* 51: 609-620.

Frame, J. 1990. Herbage productivity of a range of grass species in association with white clover. *Grass and Forage Science* 45: 57-64.

Franklin, J.F., and C.T. Dyrness. 1973. *Natural Vegetation of Oregon and Washington*. USDA Forest Service General Technical Report PNW-8. 417 pp.

Fransen, S.C., and M. Chaney. 2002. *Pasture and Hayland Renovation for Western Washington and Oregon*. Washington State University Cooperative Extension EB1870. 20 pp.

Freeman, G.W., and F.A. Yoder Jr. 1994. Esterase isoenzyme electrophoresis as a method of separating colonial and creeping bentgrass mixtures. Pp. 27-28 in *Third Annual Rutgers Turfgrass Symposium, Cook College, January 21-22, 1994*. Rutgers University, New Brunswick, New Jersey.

Frenot, Y., J.C. Gloaguen, L. Massé and M. Lebouvier. 2001. Human activities, ecosystem disturbance and plant invasions in subantarctic Crozet, Kerguelen and Amsterdam islands. *Biological Conservation* 101: 33-50.

Frenot, Y., S.L. Chown, J. Whinam, P.M. Selkirk, P. Convey, M. Skotnicki and D.M. Bergstrom. 2005. Biological invasions in the Antarctic: Extent, impacts and implications. *Biological Review*s 80: 45-72.

Frey, L. 1997. Karyology of the genus *Agrostis* (Poaceae) — a review. *Fragmenta Floristica et Geobotanica* 42: 361-400.

Fryčková, K. 1996. *Agrostis canina* agg. v České Republice. M.S. thesis, Department of Botany, Masaryk University, Brno, Czech Republic.

Fu, D., Y. Xiao, S. Muthukrishnan and G.H. Liang. 2005a. *In vivo* performance of a dual genetic marker, *manA-gfp*, in transgenic bentgrass. *Genome* 48: 722-730.

Fu, D., N.A. Tisserat, Y. Xiao, D. Settle, S. Muthukrishnan and G.H. Liang. 2005b. Overexpression of rice TLPD34 enhances dollar-spot resistance in transgenic bentgrass. *Plant Science* 168: 671-680.

Funk, C.R. 1998. Opportunities for the genetic improvement of underutilized plants in turf. Pp. 23-26 in *Proceedings of the Seventh Annual Rutgers Turfgrass Symposium, Cook College, January 15-16, 1998* (ed. P.M. Shrewsbury). Rutgers University, New Brunswick, New Jersey.

Funtova, V., and L. Malyshev. 2001. Differentiation of populations of *Agrostis tenuis* Sibth. and *Dactylis glomerata* L. in the flood meadow habitats of the Luga River. *Statistica (Bologna)* 61: 741-746.

Fustec, J., J. Guilleux, J. Le Corff and J.-P. Maitre. 2005. Comparison of early development of three grasses: *Lolium perenne*, *Agrostis stolonifera* and *Poa pratensis*. *Annals of Botany* 96: 269-278.

Gardner, D.S., T.K. Danneberger, E. Nelson, W. Meyer and K. Plumley. 2003. Relative fitness of glyphosate-resistant creeping bentgrass lines in Kentucky bluegrass. *HortScience* 38: 455-459.

Gardner, D.S., T.K. Danneberger and E.K. Nelson. 2004. Lateral spread of glyphosate-resistant transgenic creeping bentgrass (*Agrostis stolonifera*) lines in established turfgrass swards. *Weed Technology* 18: 773-778.

Gartside, D.W., and T.S. McNeilly. 1974. Genetic studies in heavy metal tolerant plants. II. Zinc tolerance in *Agrostis tenuis*. *Heredity* 33: 303-308.

Gaut, B.S. 2002. Evolutionary dynamics of grass genomes. *New Phytologist* 154: 15-28.

Gelbard, J.L., and S. Harrison. 2003. Roadless habitats as refuges for native grasslands: Interactions with soil, aspect, and grazing. *Ecological Applications* 13: 404-415.

Gepts, P. 2002. A comparison between crop domestication, classical plant breeding, and genetic engineering. *Crop Science* 42: 1780-1790.

Gilbert, J.C., D.J.G. Gowing and R.J. Bullock. 2003. Influence of seed mixture and hydrological regime on the establishment of a diverse grassland sward at a site with high phosphorus availability. *Restoration Ecology* 11: 424-435.

Gill, R.M.A., and V. Beardall. 2001. The impact of deer on woodlands: The effects of browsing and seed dispersal on vegetation structure and composition. *Forestry* 74: 209-218.

Gipiškis, V. 2000. Effect of the interaction between biological properties of herbage species and factors of cultivation techniques on the formation of swards in the meadows of the Lower Nemunas at various levels of flooding. Lithuanian Institute of Agriculture, *Agriculture. Scientific Articles (Dotnuva)* 69: 148-163.

Giraldo-Cañas, D. 2004. El género *Polypogon* (Poaceae: Pooideae) en Colombia. *Caldasia* 26: 417-422.

Gleason, H.A. 1952. *The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada*. 3 vols. New York Botanical Garden, Bronx.

Gleason, H.A., and A. Cronquist. 1963. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*. D. Van Nostrand Co., Princeton, New Jersey. 810 pp.

Gleason, H.A., and A. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*, 2nd Ed. New York Botanical Garden, Bronx. 910 pp.

Glimskär, A. 2000. Estimates of root system topology of five plant species grown at steady-state nutrition. *Plant and Soil* 227: 249-256.

Glimskär, A., and T. Ericsson. 1999. Relative nitrogen limitation at steady-state nutrition as a determinant of plasticity in five grassland plant species. *Annals of Botany* 84: 413-420.

Godfree, R., B. Lepschi and D. Mallinson. 2004. Ecological filtering of exotic plants in an Australian sub-alpine environment. *Journal of Vegetation Science* 15: 227-238 + Appendices 1 & 2 (4 pp.).

Godfrey, R.K., and J.W. Wooten. 1979. *Aquatic and Wetland Plants of Southeastern United States: Monocotyledons*. University of Georgia Press, Athens. 712 pp.

Goldsmith, F.B. 1978. Interaction (competition) studies as a step towards the synthesis of sea-cliff vegetation. *Journal of Ecology* 66: 921-931.

Golembiewski, R.C., T.K. Danneberger and P.M. Sweeney. 1997a. Potential of RAPD markers for use in the identification of creeping bentgrass cultivars. *Crop Science* 37: 212-214.

Golembiewski, R.C., T.K. Danneberger and P.M. Sweeney. 1997b. RAPD analysis of creeping bent seed and leaf tissue. *International Turfgrass Society Research Journal* 8: 291-296.

Goodson, J.M., A.M. Gurnell, P.G. Angold and I.P. Morrissey. 2003. Evidence for hydrochory and the deposition of viable seeds within winter flow-deposited sediments: The River Dove, Derbyshire, U.K. *River Research and Applications* 19: 317–334.

Goverde, M., and A. Erhardt. 2003. Effects of elevated CO_2 on development and larval food-plant preference in the butterfly *Coenonympha pamphilus* (Lepidoptera, Satyridae). *Global Change Biology* 9: 74-83.

Goverde, M., J.A. Arnone III and A. Erhardt. 2002. Species-specific reactions to elevated CO_2 and nutrient availability in four species. *Basic and Applied Ecology* 3: 221-227.

Gray, A.J. 1972. The ecology of Morecambe Bay. V. The salt marshes of Morecambe Bay. *Journal of Applied Ecology* 9: 207-220.

Gray, A.J., and R. Scott. 1977. The ecology of Morecambe Bay. VII. The distribution of *Puccinellia maritima*, *Festuca rubra* and *Agrostis stolonifera* in the salt marshes. *Journal of Applied Ecology* 14: 229-241.

Greene, E.L. 1909/1983, 1983. *Landmarks of Botanical History*, Parts 1 and 2 (ed. F.N. Egerton). Stanford University Press, Stanford, California. 1139 pp.

Gregory, R.P.G., and A.D. Bradshaw. 1965. Heavy metal tolerance in *Agrostis tenuis* Sibth. and other grasses. *New Phytologist* 64: 131-143.

Greipsson, S., and H. El-Mayas. 1999. Large-scale reclamation of barren lands in Iceland by aerial seeding. *Land Degradation and Development* 10: 185-193.

Gremmen, N.J.M., S.L. Chown and D.J. Marshall.1998. Impact of the introduced grass *Agrostis stolonifera* on vegetation and soil fauna communities at Marion Island, sub-Antarctic. *Biological Conservation* 85: 223-231.

Griffin, H.M. 1965. Bentgrass for fairways. *USGA Green Section Record* 2(6): 9-10.

Griffioen, W.A.J., and W.H.O. Ernst. 1989. The role of VA mycorrhiza in the heavy metal tolerance of *Agrostis capillaris* L. *Agriculture, Ecosystems and Environment* 29: 173-177.

Griffioen, W.A.J., J.H. Ietswaart and W.H.O. Ernst. 1994. Mycorrhizal infection of an *Agrostis capillaris* population on a copper-contaminated soil. *Plant and Soil* 158: 83-89.

Grime, J.P. 1977. Evidence for the existence of three primary strategies in plants and its relevance to ecological and evolutionary theory. *American Naturalist* 111: 1169-1194.

Grime, J.P. 1988. The C-S-R model of primary plant strategies — origins, implications and tests. Pp. 371-393 in L.D. Gottlieb and S.K. Jain, eds., *Plant Evolutionary Biology*. Chapman & Hall, London, England, U.K.

Grime, J.P. 2001. *Plant Strategies, Vegetation Processes, and Ecosystem Properties*, 2nd Ed. John Wiley & Sons, New York. 456 pp.

Grime, J.P., and R. Hunt. 1975. Relative growth-rate: Its range and adaptive significance in a local flora. *Journal of Ecology* 63: 393-422.

Grime, J.P., and J.M.L. Mackey. 2002. The role of plasticity in resource capture by plants. *Evolutionary Ecology* 16: 299-307.

Grime, J.P., J.G. Hodgson and R. Hunt. 1988. *Comparative Plant Ecology: A Functional Approach to Common British Species*. (*Agrostis* spp., pp. 58-65.) Unwin Hyman, London, England, U.K.

Groot Bruinderink, G.W.T.A. 1989. The impact of wild geese visiting improved grasslands in The Netherlands. *Journal of Applied Ecology* 26: 131-146.

Grootjans, A.P., G.J.R. Allersma and C. Kik. 1987. Hybridization of the habitat in disturbed hay meadows. Pp. 67-70 in J. van Andel, J.P. Bakker and R.W. Snaydon, eds., *Disturbance in Grasslands: Causes, Effects and Processes*. Geobotany Vol. 10. W. Junk Publishers, Dordrecht, The Netherlands.

Guo, Z., S. Bonos, W.A. Meyer, P.R. Day and F.C. Belanger. 2003. Transgenic creeping bentgrass with delayed dollar spot symptoms. *Molecular Breeding* 11: 95-101.

Habeck, R.J. 1961. The original vegetation of the mid-Willamette Valley. *Northwest Science* 35: 65-77.

Häfliger, E., and H. Scholz. 1981. *Grass Weeds 2*. Pp. 6-9: *Agrostis canina* L., *Agrostis gigantea* Roth, *Agrostis stolonifera* L., *Agrostis tenuis* Sibth. Documenta Ciba-Geigy, Basle, Switzerland.

Haggar, R.J. 1976. The seasonal productivity, quality and response to nitrogen of four indigenous grasses compared to *Lolium perenne*. *Journal of the British Grassland Society* 31: 197-207.

Håkansson, S., and B. Wallgren. 1976. *Agropyron repens* (L.) Beauv., *Holcus mollis* L. and *Agrostis gigantea* Roth as weeds — some properties. *Swedish Journal of Agricultural Research* 6: 109-120.

Hald, A.B. 2002. Impact of agricultural fields on vegetation of stream border ecotones in Denmark. *Agriculture, Ecosystems and Environment* 89: 127-135.

Hall, J.L. 2002. Cellular mechanisms for heavy metal detoxification and tolerance. *Journal of Experimental Botany* 53: 1-11.

Hammer, K., and M. Spahillari. 1999. Crops of European origin. Pp. 163-175 in *Alternative Crops for Sustainable Agriculture. Proceedings of a Workshop Held at BioCity, Turku, Finland, 13-15 June 1999. Research Progress COST 814.* (eds. T. Mela, J. Christiansen, M. Kontturi, K. Pahkala, A. Partala, M. Sahramaa, H. Sankari, M. Topi-Hulmi and K. Pithan). Office of Official Publications of the European Communities, EUR-OP, Luxembourg.

Han, N., D. Chen, H.-W. Bian, M.-J. Deng and M.-Y. Zhu. 2005. Production of transgenic creeping bentgrass *Agrostis stolonifera* var. *palustris* plants by *Agrobacterium tumefaciens*-mediated transformation using hygromycin selection. *Plant Cell, Tissue and Organ Culture* 81: 131-138.

Hanslin, H.M., and T. Eggen. 2005. Salinity tolerance during germination of seashore halophytes and salt-tolerant grass cultivars. *Seed Science Research* 15: 43-50.

Hares, R.J., and N.I. Ward. 1999. Comparison of the heavy-metal content of motorway stormwater following discharge into wet biofiltration and dry detention ponds along the London Orbital (M25) Motorway. *Science of the Total Environment* 235: 169-178.

Harkot, W., and Z. Czarnecki. 1999. Grasses in the lawns of Lublin (Poland) within areas contaminated by road traffic. *Fragmenta Floristica et Geobotanica* 44: 149-154.

Harriman, B., and D. Suttner. 2003. Turf benefits of biotechnology on the horizon. *Grounds Maintenance* 38(8): 12-24.

Harris, P., and W.J. Whittington. 1983. Effects of temperature, levels of nitrate supply and duration of light and growth on nitrate reductase activity in *Agrostis tenuis* and *Agrostis stolonifera*. *New Phytologist* 93: 193-201.

Harris, W. 1974. Why browntop is bent on creeping. *Proceedings of the New Zealand Grassland Association* 35: 101-109.

Harrison, S., C. Hohn and S. Ratay. 2002. Distribution of exotic plants along roads in a peninsular nature reserve. *Biological Invasions* 4: 425–430.

Hart, S.E., F. Yelverton, E.K. Nelson, D.W. Lycan and G.M. Henry. 2005. Response of glyphosate-resistant and glyphosate-susceptible bentgrass (*Agrostis* spp.) to postemergence herbicides. *Weed Technology* 19: 549-559.

Hartman, C.L., L. Lee, P.R. Day and N.E. Tumer. 1994. Herbicide-resistant turfgrass (*Agrostis palustris* Huds.) by biolistic transformation. *Bio/Technology* 12: 919-923.

Hartvig, P. 1991. *Agrostis* L. Pp. 811-817 in A. Strid and K. Tan, eds., *Mountain Flora of Greece*, Vol. 2. Edinburgh University Press, Edinburgh, Scotland, U.K.

Harvey, M.J. 1993. *Agrostis*, Bent grass. Pp. 1227-1231, 1237, 1360 in J.C. Hickman, ed., *The Jepson Manual: Higher Plants of California*. University of California Press, Berkeley.

Harvey, M.J. 2001. *Agrostis*. Pp. 58-69 in G.W. Douglas, D. Meidinger and J. Pojar, eds. *Illustrated Flora of British Columbia, Vol. 7, Monocotyledons (Orchidaceae through Zosteraceae)*. British Columbia Ministry of Sustainable Resource Management and Ministry of Forests, Victoria.

Harvey, M.J. 2004. *Agrostis* L., Bent. (8/04 ms., 13 pp.) for Flora of North America Editorial Committee, M.E. Barkworth, K.M. Capels, S. Long and M.B. Piep, eds., *Flora of North America North of Mexico, Vol. 24, Magnoliophyta: Commelinidae (in part): Poaceae (Part 1)* with publication planned in 2007. Oxford University Press, New York.

Heide, O.M. 1994. Control of flowering and reproduction in temperate grasses. *New Phytologist* 128: 347-362.

Heim, D.R., L.A. Bjelk, J. James, M.A. Schneegurt and I.M. Larrinua. 1993. Mechansim of isoxaben tolerance in *Agrostis palustris* var. Penncross. *Journal of Experimental Botany* 44: 1185-1189.

Heinken, T., and D. Raudnitschka. 2002. Trägt Schalenwild durch Epizoochorie zur Ausbreitung von Gefäßpflanzen in mitteleuropäischen Wäldern bei? Eine Fallstudie aus Nordostdeutschland. *Forstwissenschaftliches Centralblatt* 121: 179-194.

Helgadóttir, Á., and R.W. Snaydon. 1985. Competitive interactions between populations of *Poa pratensis* and *Agrostis tenuis* from ecologically contrasting environments. *Journal of Applied Ecology* 22: 525-537.

Helgadóttir, Á., and R.W. Snaydon. 1986. Patterns of genetic variation among populations of *Poa pratensis* and *Agrostis capillaris* from Britain and Iceland. *Journal of Applied Ecology* 23: 703-719.

Hendry, G.A.F., K. Thompson, C.J. Moss, E. Edwards and P.C. Thorpe. 1994. Seed persistence: A correlation between seed longevity in the soil and *orth*-dihydroxyphenol concentration. *Functional Ecology* 8: 658-664.

Henry, H.H. 1928. Changes in the bent grass seed market as viewed by the seed analyst. *Bulletin of the United States Golf Association Green Section* 8: 226-231.

Herbst, D.R., and W.D. Clayton. 1998. Notes on the grasses of Hawai ʻi: New records, name changes, and corrections. *Bishop Museum Occasional Papers* 55: 17-38.

Hertstein, U., and H.-J. Jäger. 1986. Tolerances of different populations of three grass species to cadmium and other metals. *Environmental and Experimental Botany* 26: 309-319.

Hess, H.E., E. Landolt and R. Hirzel. 1967. *Flora der Schweiz und Angrenzender Gebiete*, Vol. 1: Pteridophyta bis Caryophyllaceae. Birkhäuser Verlag, Basel.

Hill, M.O., D.F. Evans and S.A. Bell. 1992. Long-term effects of excluding sheep from hill pastures in North Wales. *Journal of Ecology* 80: 1-13.

Hill, M.O., D.B. Roy and K. Thompson. 2002. Hemeroby, urbanity and ruderality: Bioindicators of disturbance and human impact. *Journal of Applied Ecology* 39: 708-720.

Hill, R.D., D.J. Missen and R.J. Taylor. 1996. Use of glyphosate to prevent development of reproductive tillers and extend vegetative growth of bent grass (*Agrostis castellana*). *Australian Journal of Experimental Agriculture* 36: 661-664.

Hillman, F.H. 1918. The seeds of redtop and other bent grasses, Part II in C.V. Piper and F.H. Hillman, *The Agricultural Species of Bent Grasses*. USDA Bulletin No. 692: 15-27.

Hillman, F.H. 1921. South German mixed bent seed described. *Bulletin of the Green Section of the United States Golf Association* 1: 37-39.

Hillman, F.H. 1930. Identifying turf-grass seed. *Bulletin of the United States Golf Association Green Section* 10: 39-43.

Hinds, H.R. 1986. *The Flora of New Brunswick*. Primrose Press, Fredericton. 460 pp.

Hitchcock, A.S. 1905. North American Species of *Agrostis*. Bulletin U.S. Bureau of Plant Industry No. 68. 68 pp., 37 plates.

Hitchcock, A.S. 1935. *Manual of the Grasses of the United States*. USDA Miscellaneous Publication No. 200. 1040 pp.

Hitchcock, A.S. 1951 [1950]. *Manual of the Grasses of the United States*, 2nd Ed., rev. by A. Chase. USDA Miscellaneous Publication No. 200. 1051 pp.

Hodson, M.J., M.M. Smith, S.J. Wainwright and H. Öpik. 1985. The effects of the interaction between salinity and nitrogen limitation in *Agrostis stolonifera* L. *Vegetatio* 61: 255-263.

Hoeltzener, C., and J.P. Maitre. 2004. Tillering patterns in turfgrass species with distinct clonal tactics. *Acta Horticulturae* 661: 241-246.

Hogan, G.D., and W.E. Rauser. 1979. Tolerance and toxicity of cobalt, copper, nickel and zinc in clones of *Agrostis gigantea* Roth. *New Phytologist* 83: 665-670.

Hogan, G.D., and W.E. Rauser. 1981. Role of copper binding, absorption, and translocation in copper tolerance of *Agrostis gigantea* Roth. *Journal of Experimental Botany* 32: 27-36.

Hogan, G.D., G.M. Courtin and W.E. Rauser. 1977a. Copper tolerance in clones of *Agrostis gigantea* from a mine waste site. *Canadian Journal of Botany* 55: 1043-1050.

Hogan, G.D., G.M. Courtin and W.E. Rauser. 1977b. The effects of soil factors on the distribution of *Agrostis gigantea* on a mine waste site. *Canadian Journal of Botany* 55: 1038-1042.

Hollman, A.B., J.C. Stier, M.D. Casler, G. Jung and L.A. Brilman. 2005. Identification of putative velvet bentgrass clones using RAPD markers. *Crop Science* 45: 923-930.

Holm, LeR.G., J.V. Pancho, J.P. Herberger and D.L. Plucknett. 1979/1991. *A Geographical Atlas of World Weeds*. John Wiley & Sons, New York / Krieger Publishing Company, Malabar, Florida. 391 pp.

Holm, LeR., J. Doll, E. Holm, J. Pancho and J. Herberger. 1997. *World Weeds: Natural Histories and Distribution*. John Wiley & Sons, New York. 1129 pp.

Holt, E.C., and K.T. Payne. 1952. Variation in spreading rate and growth characteristics of creeping bentgrass seedlings. *Agronomy Journal* 44: 88-90.

Hölzel, N., and A. Otte. 2004. Assessing soil seed-bank persistence in flood-meadows: The search for reliable traits. *Journal of Vegetation Science* 15: 93-100 + Appendix 1 (3 pp.).

Howe, C.D., and R.W. Snaydon. 1986. Factors affecting the performance of seedlings and ramets of invading grasses in an established ryegrass sward. *Journal of Applied Ecology* 23: 139-146.

Hu F.-R. 2005. [Obtaining insect-resistant transgenic plants of creeping bentgrass (*Agrostis stolonifera* L.) mediated by *Agrobacterium tumefaciens*.] *Journal of Agricultural Biotechnology* 13: 262-263.

Huang, B., and X. Liu. 2003. Summer root decline: Production and mortality for four cultivars of creeping bentgrass. *Crop Science* 43: 258-265.

Hubbard, C.E. 1984. *Grasses: A Guide to Their Structure, Identification, Uses, and Distribution in the British Isles*, 3rd Ed., rev. by J.C.E. Hubbard. Penguin Books, Harmondsworth, England, U.K. 476 pp.

Huff, D., and P. Landschoot. 2000. Comparing the new bents. *Grounds Maintenance* 35(1): 14-22.

Hulse, D.W., A. Branscomb and S.G. Payne. 2004. Envisioning alternatives: Using citizen guidance to map future land and water use. *Ecological Applications* 14: 325-341.

Hultén, E., and M. Fries. 1986. *Atlas of North European Vascular Plants, North of the Tropic of Cancer*. Vols. 1-3. Koeltz Scientific Books, Königstein, Germany. 1172 pp.

Humphreys, M.O., and M.K. Nicholls. 1984. Relationships between tolerance to heavy metals in *Agrostis capillaris* L. (*Agrostis tenuis* Sibth.). *New Phytologist* 98: 177-190.

Hunt, R., A.O. Nicholls and S.A. Pathy. 1987. Growth and root-shoot partitioning in eighteen British grasses. *Oikos* 50: 53-59.

Hunter, B.A., M.S. Johnson and D.J. Thompson. 1987. Ecotoxicology of copper and cadmium in a contaminated grassland ecosystem, III. Small mammals. *Journal of Applied Ecology* 24: 601-614.

Hurley, R. 1973. Velvet bentgrass — the putter's delight. *Weeds, Trees and Turf* 12(1): 20, 35.

Hurley, R.H., and J.A. Murphy. 1996. Creeping bentgrass: The legacy and the promise. *Golf Course Management* 64(7): 49-55.

Hurley, R.H., V.G. Lehman, J.A. Murphy and C.R. Funk. 1994. Registration of 'Southshore' creeping bentgrass. *Crop Science* 34: 1124-1125.

Hussey, B.M.J., G.J. Keighery, R.D. Cousens, J. Dodd and S.G. Lloyd. 1997. *Western Weeds: A Guide to the Weeds of Western Australia*. Plant Protection Society of Western Australia, Victoria Park. 254 pp.

Hutchings, M.J., and K.D. Booth. 1996. Studies on the feasibility of re-creating chalk grassland vegetation on ex-arable land. I. The potential roles of the seed bank and the seed rain. *Journal of Applied Ecology* 33: 1171-1181.

Hyslop, G.R. 1930. Oregon bent grass seed certification. *Bulletin of the United States Golf Association Green Section* 10: 195-200.

Inderjit, and K.M.M. Dakshini. 1995. Allelopathic potential of an annual weed, *Polypogon monspeliensis*, in crops in India. *Plant and Soil* 173: 251-257.

Jacobs, S.W.L. 2001. The genus *Lachnagrostis* (Gramineae) in Australia. *Telopea* 9: 439-448; *cf. Telopea* 9: 837-838, 2002 and *Telopea* 10: 840, 2004.

Jain, S.K., and A.D. Bradshaw. 1966. Evolutionary divergence among adjacent plant populations. I. The evidence and its theoretical analysis. *Heredity* 21: 407-441.

Jalloq, M.C. 1975. The invasion of molehills by weeds as a possible factor in the degeneration of reseeded pasture, I. The buried viable seed population of molehills from four reseeded pastures in West Wales. *Journal of Applied Ecology* 12: 643-657.

James, T.K., and G.C. Atkinson. 1979. Control of browntop in lucerne on pumice soils. Pp. 58-61 in *Proceedings 32nd New Zealand Weed and Pest Control Conference*.

Jansen, P. 1951. *Flora Neerlandica. Flora van Nederland*: Gramineae. Koninklijke Nederlandse Botanische Vereniging, Amsterdam.

Jansen, P., and W.H. Wachter. 1940. Grassen om het IJsselmeer. V. *Agrostis*. *Nederlandsch Kruidkundig Archief* 50: 105-114.

Johannessen, C.L., W.A. Davenport, A. Millet and S. McWilliams. 1971. The vegetation of the Willamette Valley. *Annals of the Association of American Geographers* 61: 286-302.

Johnson, P.G., and T.P. Riordan. 1999. A review of issues pertaining to transgenic turfgrasses. *HortScience* 34: 594-598.

Jonassen, G.H. 1980. Virkning av liten plantetetthet på frøavling av engsvingel, hundegras, rødsvingel og engkvein [Effect of low planting density on seed yield of meadow fescue, cocksfoot, red fescue and common bentgrass]. *Forskning og Forsok i Landbruket* 31: 187-196.

Jones, A.G., S.L. Chown, P.G. Ryan, N.J.M. Gremmen and K.J. Gaston. 2003. A review of conservation threats on Gough Island: A case study for terrestrial conservation in the Southern Oceans. *Biological Conservation* 113: 75-87.

Jones, K. 1953. The cytology of some British species of *Agrostis* and their hybrids. *British Agricultural Bulletin* 5: 316.

Jones, K. 1956a. Species differentiation in *Agrostis*, I. Cytological relationships in *Agrostis canina*. *Journal of Genetics* 54: 370-376 & plate 17.

Jones, K. 1956b. Species differentiation in *Agrostis*, II. The significance of chromosome pairing in the tetraploid hybrids of *Agrostis canina* subsp. *montana* Hartm., *A. tenuis* Sibth. and *A. stolonifera* L. *Journal of Genetics* 54: 377-393 & plate 18.

Jones, K. 1956c. Species differentiation in *Agrostis*, III. *Agrostis gigantea* Roth and its hybrids with *A. tenuis* Sibth. and *A. stolonifera* L. *Journal of Genetics* 54: 394-399.

Jones, P.B.C. 2005. Approval for genetically engineered bentgrass creeps through agency turfs. *ISB News Report* January 2005: 8-9.

Jones, R.G.W., M. Sutcliffe and C. Marshall. 1971 [1970]. Physiological and biochemical basis for heavy metal tolerance in clones of *Agrostis tenuis*. *6th Colloquium on Plant Analysis and Fertilizer Problems, Tel Aviv, 1970. Recent Advances in Plant Nutrition* 2: 575-581.

Jónsdóttir, G.Á. 1991a. Effects of density and weather on tiller dynamics in *Agrostis stolonifera*, *Festuca rubra* and *Poa irrigata*. *Acta Botanica Neerlandica* 40: 311-318.

Jónsdóttir, G.Á. 1991b. Tiller demography in seashore populations of *Agrostis stolonifera*, *Festuca rubra* and *Poa irrigata*. *Journal of Vegetation Science* 2: 89-94.

Jordan, M. 12/2001. [Letter to J.L. White, USDA/APHIS, on potential commercial release of *Agrostis stolonifera* and *Poa pratensis* genetically altered for resistance to herbicides.] Stewardship Ecologist, The Nature Conservancy, Long Island and South Fork/Shelter Island Chapters, Cold Spring Harbor, New York. 1 + 5 pp.

Jowett, D. 1958. Populations of *Agrostis* spp. tolerant of heavy metals. *Nature* 182: 816-817.

Jowett, D. 1964. Population studies on lead-tolerant *Agrostis tenuis*. *Evolution* 18: 70-80.

Juhl, K. 1952. An-euploidie und Systematik bei *Agrostis stolonifera* L. und *Festuca rubra* L. aus Schleswig-Holstein. *Berichte der Deutschen Botanischen Gesellschaft* 65: 331-338.

Jutila b. Erkkilä, H.M. 1998a. Effect of different treatments on the seed bank of grazed and ungrazed Baltic seashore meadows. *Canadian Journal of Botany* 76: 1188-1197.

Jutila b. Erkkilä, H.M. 1998b. Vascular plant species richness in the grazed and ungrazed shore meadow areas of the Bothnian Sea, SW Finland. *Journal of Vegetation Science* 9: 395-408.

Jutila, H. 1999. Effect of grazing on the vegetation of shore meadows along the Bothnian Sea, Finland. *Plant Ecology* 140: 77-88.

Kaligarič, M. 2001. Vegetation patterns and responses to elevated CO_2 from natural CO_2 springs at Strmec (Radenci, Slovenia). *Acta Biologica Slovenica* 44: 31-38.

Karataglis, S.S. 1980a. Differential tolerance of *Agrostis tenuis* Sibth. populations growing at two mine soils to Cu, Zn, and Pb. *Phyton; Annales Rei Botanicae* 20: 15-22.

Karataglis, S.S. 1980b. Gene flow in *Agrostis tenius* (Poaceae). *Plant Systematics and Evolution* 134: 23-31.

Karataglis, S.S. 1980c. Selective adaptation to copper of populations of *Agrostis tenuis* and *Festuca rubra* (Poaceae). *Plant Systematics and Evolution* 134: 215-228.

Karataglis, S.S. 1980d. Variability between and within *Agrostis tenuis* Sibth. populations regarding heavy metal tolerance. *Phyton; Anales Rei Botanicae* 20: 23-32.

Karataglis, S.S. 1980e. Zinc and copper effects on metal-tolerant and non-tolerant clones of *Agrostis tenius* (Poaceae). *Plant Systematics and Evolution* 134: 173-182.

Karataglis, S.S. 1982. Combined tolerance to copper, zinc and lead by populations of *Agrostis tenuis*. *Oikos* 38: 234-241.

Karataglis, S.S. 1986. Gene flow in parapatric plant populations of *Agrostis tenuis* Sibth. and *Festuca rubra* L. *Acta Societatis Botanicorum Poloniae* 55: 517-527.

Karataglis, S.S., T. McNeilly and A.D. Bradshaw. 1985. Lead and zinc tolerance of *Agrostis capillaris* L. and *Festuca rubra* L. across a mine – pasture boundary at Minera, North Wales. *Phyton; Anales Rei Botanicae* 26: 65-72.

Karlsen, Å.K. 1988. Agronomic value of some north Norwegian populations of *Agrostis capillaris* L. *Norwegian Journal of Agricultural Sciences* 2: 75-79.

Kartesz, J.T. 2006. *Synthesis of the North American Flora*, Version 2.1.2309.19292 (4/28/06 ms.), CD-ROM. Biota of North America Program, Chapel Hill, North Carolina.

Keeler, K.H. 1985. Implications of weed genetics and ecology for the deliberate release of genetically engineered crop plants. *Recombinant DNA Technical Bulletin* 8: 165-172.

Keeler, K.H. 1989. Can genetically engineered crops become weeds? *Bio/Technology* 7: 1134-1139.

Kendrick, D.L., and T.K. Danneberger. 2002. Lack of competitive success of an intraseeded creeping bentgrass cultivar into an established putting green. *Crop Science* 42: 1615-1620.

Kennedy, M.P., J.M. Milne and K.J. Murphy. 2003. Experimental growth responses to groundwater level variation and competition in five British wetland plant species. *Wetlands Ecology and Management* 11: 383-396.

Kerguélen, M. 1975. Les Gramineae (Poaceae) de la Flore Française. Essai de Mise au Point Taxonomique et Nomenclaturale. Lejeunia n.s. 75: 1-343.

Kershaw, K.A. 1958. An investigation of the structure of a grassland community. I. The pattern of *Agrostis tenuis*. *Journal of Ecology* 46: 571-592.

Kharkevich, S.S., N.S. Probatova and V.S. Novikov. 2003 [1985]. *Vascular Plants of the Russian Far East [Sosudistye Rasteniya Sovetskogo Dalnego Vostoka]*, Vol. 1, Lycopodiophyta, Juncaceae, Poaceae (Gramineae) (ed. N.N. Tzvelev). *Agrostis* L. (pp. 243-260). Science Publishers, Enfield, New Hampshire (USA) and Plymouth, England, U.K. [Nauka Publishers, Leningrad].

Kik, C. 1987. Population responses in *Agrostis stolonifera* to selective forces in inland and coastal habitats. Pp. 229-236 in J. van Andel, J.P. Bakker and R.W. Snaydon, eds., *Disturbance in Grasslands: Causes, Effects and Processes*. Geobotany Vol. 10. W. Junk Publishers, Dordrecht, The Netherlands.

Kik, C. 1989. Ecological genetics of salt resistance in the clonal perennial, *Agrostis stolonifera* L. *New Phytologist* 113: 453-458.

Kik, C., J. van Andel and W. Joenje. 1990a. Life-history variation in ecologically contrasting populations of *Agrostis stolonifera*. *Journal of Ecology* 78: 962-973.

Kik, C., J. van Andel, W. van Delden, W. Joenje and R. Bijlsma. 1990b. Colonization and differentiation in the clonal perennial *Agrostis stolonifera*. *Journal of Ecology* 78: 949-961.

Kik, C., M. Jongman and J. van Andel. 1991. Variation of relative growth rate and survival in ecologically contrasting populations of *Agrostis stolonifera*. *Plant Species Biology* 6: 47-54.

Kik, C., T.E. Linders and R. Bijlsma. 1992. The distribution of cytotypes in ecologically contrasting populations of the clonal perennial *Agrostis stolonifera*. *Evolutionary Trends in Plants* 6: 93-98.

Kik, C., T.E. Linders and R. Bijlsma. 1993. Ploidy level and somatic chromosome number variation in *Agrostis stolonifera*. *Acta Botanica Neerlandica* 42: 73-80.

Kim, D.-H., M.-L. Chai, S. Kalalselvi, J.-M. Lee, M.-H. Park and J.-Y. Kim. 2001. Factors affecting the transformation of bentgrass (*Agrostis* spp.) based on *Agrobacterium tumefaciens*. *Journal of the Korean Society for Horticultural Science* 42: 243-248.

Klötzli, F., and A.P. Grootjans. 2001. Restoration of natural and semi-natural wetland systems in Central Europe: Progress and predictability of developments. *Restoration Ecology* 9: 209-219.

Koch, I., L. Wang, C.A. Ollson, W.R. Cullen and K.J. Reimer. 2000. The predominance of inorganic arsenic species in plants from Yellowknife, Northwest Territories, Canada. *Environmental Science and Technology* 34: 22-26.

Kohler, A., V. Sipos, E. Sonntag, K. Penksza, D. Pozzi, U. Veit and S. Bjork. 2000. Macrophyte distribution and habitat quality in the eutrophic Bjorka-Kavlinge River (Skåne, South Sweden) [Makrophyten-verbreitung und Standortqualitat im eutrophen Bjorka-Kavlinge-Fluss (Skåne, Sudschweden)]. *Limnologica* 30: 281-298.

Kovář, P., and M. Kovářová. 1998. Ant herbivory — a significant factor in population dynamics of *Veronica* and other temperate plant species? *Thaiszia – Journal of Botany* 8: 141-146.

Kovář, P., M. Kovářová, P. Dostál and T. Herben. 2001. Vegetation of ant-hills in a mountain grassland: Effects of mound history and of dominant ant species. *Plant Ecology* 156: 215-227.

Koyama, T. 1987. *Grasses of Japan and its Neighboring Regions: An Identification Manual*. Kodansha, Tokyo. 570 pp.

Krans, J.V., and G.V. Johnson. 1974. Some effects of subirrigation on bentgrass during heat stress in the field. *Agronomy Journal* 66: 526-530.

Krans, J.V., V.T. Henning and K.C. Torres. 1982. Callus induction, maintenance and plantlet regeneration in creeping bentgrass. *Crop Science* 22: 1193-1197.

Kratochwil, A., S. Fock, D. Remy and A. Schwabe. 2002. Responses of flower phenology and seed production under cattle-grazing impact in sandy grasslands. *Phytocoenologia* 32: 531-552.

Kubik, C., S. Bonos, R. Wu and W. Meyer. 2003. Creeping bentgrass (*Agrostis stolonifera* L.) cultivar identification using simple sequence repeats. P74, *Molecular Breeding of Forage and Turf: Third International Symposium, May 18-22, 2003, Dallas, Texas, USA*.

Kuhn, N., and J. Zedler. 1997. Differential effects of salinity and soil saturation on native and exotic plants of a coastal salt marsh. *Estuaries* 20: 391-403.

Kuo, Y.J., M.A.L. Smith and L.A. Spomer. 1994. Merging callus level and whole plant micro-culture to select salt-tolerant 'Seaside' creeping bentgrass. *Journal of Plant Nutrition* 17: 549-560.

Kurchenko, E.I. 1975. [Ontogenesis and developmental stages of bentgrass (*Agrostis stolonifera* L.) swards.] *Biulleten' Moskovskogo Obshchestva Ispytatelei Prirody, Otdel' Biologicheskii* 80: 92-103.

Kurchenko, E.I. 1979a. [Ontogeny and seasonally different characteristics of the caenotic population structure of velvet bent (*Agrostis canina* L.).] *Biulleten' Moskovskogo Obshchestva Ispytatelei Prirody, Otdel' Biologicheskii* 84: 44-54.

Kurchenko, E.I. 1979b. O populyatsionno-ontogeneticheskem podkhode k izucheniyu polevits (rod Agrostis L.) [A populational-ontogenetic approach to study bents (genus Agrostis L.)]. *Biulleten' Moskovskogo Obshchestva Ispytatelei Prirody, Otdel' Biologicheskii* 84: 93-105.

Kurchenko, E.I. 1979c. [Taxonomy of the bent grass species *Agrostis syreistschikowii* Smirn., *Agrostis marschalliana* Sered. and *Agrostis trinii* Turcz.] *Biulleten' Moskovskogo Obshchestva Ispytatelei Prirody, Otdel' Biologicheskii* 84: 110-119.

Kurchenko, E.I. 2002. [Critical notes on bents of *Agrostis stolonifera* group: The new species *A. diluta* (Poaceae).] *Botanicheskii Zhurnal* 87(5): 115-121.

Kurchenko, E.I., and I.IU. Ianova. 1976. [The anatomy of *Agrostis trinii* Turcz.] *Biulleten' Moskovskogo Obshchestva Ispytatelei Prirody, Otdel' Biologicheskii* 81: 156-159.

Lambinon, J., F. Verloove and B. Toussaint. 2004. *Agrostis ×fouilladeana* Lambinon & Verloove, nothospec. nov., en Belgique et dans le nord de la France. *Société pour l'Échange des Plantes Vasculaires de l'Europe et du Bassin Méditerranéen: Bulletin* 29: 105-109.

Lanchier, N., and C. Neuhauser. 2005. Voter model and biased voter model in heterogeneous environments. *Journal of Applied Probability* (submitted). http://www.univ-rouen.fr/LMRS/Persopage/Lanchier/files/06-VMH.pdf.

Lasat, M.M. 2002. Phytoextraction of toxic metals: A review of biological mechanisms. *Journal of Environmental Quality* 31: 109-120.

Laser, H., and W. Opitz von Boberfeld. 2004. Effect of legume proportion and physiological age on forage quality and the suitability of *Agrostis capillaris* L. and *Festuca rubra* L. for silage making. *Plant, Soil and Environment* 50: 315-323.

Lee, L. 1996. Turfgrass biotechnology. *Plant Science* 115: 1-8.

Lee, L., and P. Day. 1998. Herbicide-resistant transgenic creeping bentgrass. Pp. 195-202 in M.B. Sticklen and M.P. Kenna, eds., *Turfgrass Biotechnology: Cell and Molecular Genetic Approaches to Turfgrass Improvement*. Ann Arbor Press, Chelsea, Michigan.

Lee, L., C. Hartman, C. Laramore, N. Tumer and P. Day. 1995. Herbicide-resistant creeping bentgrass. *USGA Green Section Record* 33(2): 16-18.

Lee, L., C.L. Laramore, P.R. Day and N.E. Tumer. 1996. Transformation and regeneration of creeping bentgrass (*Agrostis palustris* Huds.) protoplasts. *Crop Science* 36: 401-406.

Lee, L., C. Laramore, C.L. Hartman, L. Yang, C.R. Funk, J. Grande, J.A. Murphy, S.A. Johnston, B.A. Majek, N.E. Tumer and P.R. Day. 1997. Field evaluation of herbicide resistance in transgenic *Agrostis stolonifera* L. and inheritance in the progeny. *International Turfgrass Society Research Journal* 8: 337-344.

Lehman, V.G., and M.C. Engelke. 1991. Heritability estimates of creeping bentgrass root systems grown in flexible tubes. *Crop Science* 31: 1680-1684.

LeLacheur, G. 1930. Canadian certified bent seed. *Bulletin of the United States Golf Association Green Section* 10: 212-213.

Lenssen, J.P.M., H.M. van de Steeg and H. de Kroon. 2004. Does disturbance favour weak competitors? Mechanisms of changing plant abundance after flooding. *Journal of Vegetation Science* 15: 305-314.

Lenssen, J.P.M., C. Hershock, T. Speek, H.J. During and H. de Kroon. 2005. Experimental ramet aggregation in the clonal plant *Agrostis stolonifera* reduces its competitive ability. *Ecology* 86: 1358-1365.

Lepp, N.W., J. Hartley, M. Toti and N.M. Dickinson. 1997. Patterns of soil copper contamination and temporal changes in vegetation in the vicinity of a copper rod rolling factory. *Environmental Pollution* 95: 363-369.

Lesica, P., and F.W. Allendorf. 1999. Ecological genetics and the restoration of plant communities: Mix or match? *Restoration Ecology* 7: 42-50.

Levin, D.A. 2001. The recurrent origin of plant races and species. *Systematic Botany* 26: 197-204.

Levine, J.M. 2000. Species diversity and biological invasions: Relating local process to community pattern. *Science* 288: 852-854.

Levine, J.M. 2001. Local interactions, dispersal, and native and exotic plant diversity along a California stream. *Oikos* 95: 397-408.

Levine, J.M. 2003. A patch modeling approach to the community-level consequences of directional dispersal. *Ecology* 84: 1215-1224.

Levy, A.A., and M. Feldman. 2002. The impact of polyploidy on grass genome evolution. *Plant Physiology* 130: 1587–1593.

Levy, E.B. 1924. The *Agrostis* species — red-top, brown-top, and creeping bent. *New Zealand Journal of Agriculture* 28: 73-91.

Levy, E.B., and S.H. Saxby. 1931. Strain investigation of grasses and clovers. 5. Brown-top (*Agrostis tenuis*). *New Zealand Journal of Agriculture* 43: 1-10.

Leyer, I. 2005. Predicting plant species' responses to river regulation: The role of water-level fluctuations. *Journal of Applied Ecology* 42: 239-250 + Appendix.

Li, H.M., D. Rotter, S.A. Bonos, W.A. Meyer and F.C. Belanger. 2005. Identification of a gene in the process of being lost from the genus *Agrostis*. *Plant Physiology* 138: 2386-2395 + Supplemental Figure.

Litrenta, J. 2003. Transgenics: The bright future of turfgrass. *Grounds Maintenance* 38(8): 12-24.

Liu, C.-A., H. Zhong, J. Vargas Jr., D. Penner and M. Sticklen. 1998. Prevention of fungal diseases in transgenic, bialaphos- and glufosinate-resistant creeping bentgrass (*Agrostis palustris*). *Weed Science* 46: 139-146.

Lonchamp, J.-P. 2000. *HYPPA (Hypermédia pour la Protection des Plantes - Adventices)*. Unité de Malherbologie et Agronomie, INRA (Institut National de la Recherche Agronomique), Dijon, France. http://www.inra.fr/Internet/Centres/Dijon/malherbo/hyppa/hyppa-a/noms_sca.htm

Loonen, M., and M. van Eerden. 1989. The significance of water as a key trigger enabling wigeon *Anas penelope* to feed on grass leaves of *Agrostis stolonifera* in a wet meadow system in Lake Lauwersmeer, The Netherlands. Page 20 in *Eighth International Waterfowl Feeding Ecology Symposium*, Ribe, Denmark.

López-C., I., O. Balocchi-L., P. Lailhacar and C. Oyarzún-S. 1997. Caracterización de sitios de crecimiento de seis especies pratenses nativas y naturalizadas del Dominio Húmedo de Chile. *Agro Sur (Valdivia)* 25: 62-80.

López-C., I., O. Balocchi-L. and P. Niklitschek-S. 1999. Caracterización fenológica y productiva de *Agrostis capillaris* y *Holcus lanatus* en el Dominio Húmedo de Chile. *Agro Sur (Valdivia)* 27(2): 59-81.

Löser, C., A. Zehnsdorf, P. Hoffmann and H. Seidel. 1999. Conditioning of heavy metal-polluted river sediments by helophytes. *International Journal of Phytoremediation* 1: 339-359.

Loucougaray, G., A. Bonis and J.-B. Bouzillé. 2004. Effects of grazing by horses and/or cattle on the diversity of coastal grasslands in western France. *Biological Conservation* 116: 59-71.

Luo, H., Q. Hu, K. Nelson, C. Longo, A.P. Kausch, J.M. Chandlee, J.K. Wipff and C.R. Fricker. 2004. *Agrobacterium tumefaciens*-mediated creeping bentgrass (*Agrostis stolonifera* L.) transformation using phosphinothricin selection results in a high frequency of single-copy transgene integration. *Plant Cell Reports* 22: 645-652.

Luo, H., A.P. Kausch, Q. Hu, K. Nelson, J.K. Wipff, C.C.R. Fricker, T.P Owen, M.A. Moreno, J.-Y. Lee and T.K. Hodges. 2005. Controlling transgene escape in GM creeping bentgrass. *Molecular Breeding* 16: 185-188.

Lush, W.M. 1990. Turf growth and performance evaluation based on turf biomass and tiller density. *Agronomy Journal* 82: 505-511.

Mabberley, D.J. 1998. *The Plant-Book: A Portable Dictionary of the Higher Plants*, 2nd Ed., rev. printing. Cambridge University Press, Cambridge, England, U.K. 858 pp.

Macnair, M.R. 1987. Heavy metal tolerance in plants: A model evolutionary system. *Trends in Ecology and Evolution* 2: 354-359.

Macnair, M.R. 1990. The genetics of tolerance in natural populations. Pp. 235-254 in A.J. Shaw, ed., *Heavy Metal Tolerance in Plants: Evolutionary Aspects*. CRC Press, Boca Raton, Florida.

Macnair, M.R. 1993. The genetics of metal tolerance in vascular plants. *New Phytologist* 124: 541-559.

Macnair, M.R., G.H. Tilstone and S.E. Smith. 2000. The genetics of metal tolerance and accumulation in higher plants. Pp. 235-250 in N. Terry and G. Bañuelos, eds., *Phytoremediation of Contaminated Soil and Water*. Lewis Publishers, Boca Raton, Florida.

Madison, J.H. 1961. Turfgrass ecology: Effects of mowing, irrigation, and nitrogen treatments of *Agrostis palustris* Huds., 'Seaside' and *Agrostis tenuis* Sibth., 'Highland' on population, yield, rooting and cover. *Agronomy Journal* 54: 407-412.

Mahmood, K., K.A. Malik, M.A.K. Lodhi and K.H. Sheikh. 1996. Seed germination and salinity tolerance in plant species growing on saline wastelands. *Biologia Plantarum* 38: 309-315.

Malcová, R., M. Vosátka and M. Gryndler. 2003. Effects of inoculation with *Glomus intraradices* on lead uptake by *Zea mays* L. and *Agrostis capillaris* L. *Applied Soil Ecology* 23: 55-67.

Malinowski, D.P., and D.P. Belesky. 2000. Adaptations of endophyte-infected cool-season grasses to environmental stresses: Mechanisms of drought and mineral stress tolerance. *Crop Science* 40: 923-940.

Malte, M.O. 1928. The commercial bent grasses (*Agrostis*) in Canada. National Museum of Canada Bulletin 50, Annual Report 1926: 105-126.

Malyschev, L.I., and G.A. Peschkova. 1990. *Flora Sibiri.* Poaceae (Gramineae), 2. Nauka Publishers, Novosibirsk. 359 pp.

Maqbool, S.B., A. Ahmad and M.B. Sticklen. 2002. Past, present, and future of turfgrass biotechnology. Vol. 31: 83-86 in *Proceedings of the 72nd Annual Michigan Turfgrass Conference, 21-24 January 2002, Lansing, Michigan* (eds. K. Frank, J. Schonfelder and R. Calhoun).

Marcum, K.B. 2001. Salinity tolerance of 35 bentgrass cultivars. *HortScience* 36: 374-376.

Marrs, R.H., and J. Proctor. 1976. The response of serpentine and non-serpentine *Agrostis stolonifera* to magnesium and calcium. *Journal of Ecology* 64: 953-964.

Marshall, C., and G. Anderson-Taylor. 1992. Mineral nutritional inter-relations amongst stolons and tiller ramets in *Agrostis stolonifera* L. *New Phytologist* 122: 339-347.

Marshall, E.J.P. 1990. Interference between sown grasses and the growth of rhizome of *Elymus repens* (couch grass). *Agriculture, Ecosystems and Environment* 33: 11-22.

Masarovičová, E., and M. Holubová. 1998. Effect of copper on growth and chlorophyll content of some herbs. *Rostlinná Výroba* 44: 261-265.

Master, L.L., B.A. Stein, L.S. Kutner and G.A. Hammerson. 2000. Vanishing assets: Conservation status of U.S. species. Pp. 93-118 *in* B.A. Stein, L.S. Kutner and J.S. Adams, eds., *Precious Heritage: The Status of Biodiversity in the United States*. Oxford University Press, New York.

Mathys, W. 1973. Vergleichende Untersuchungen der Zinkaufnahme von resistenten und sensitiven Populationen von *Agrostis tenuis* Sibth. *Flora* 162: 492-499.

Matthei, O., with C. Marticorena, R. Rodríguez and M. Quezada. 1993. *Manual de las Malezas que Crecen en Chile*. Pp. 403-404: *Agrostis capillaris* L., *Agrostis stolonifera* L. Alfabeta Impresores, Santiago.

Matus, G., R. Verhagen, R.M. Bekker and A.P. Grootjans. 2003. Restoration of the *Cirsio dissecti-Molinietum* in The Netherlands: Can we rely on soil seed banks? *Applied Vegetation Science* 6: 73-84.

Mazer, G., D. Booth and K. Ewing. 2001. Limitations to vegetation establishment and growth in biofiltration swales. *Ecological Engineering* 17: 429-443.

McCartney, D.M. 2003. Auditing non-hazardous wastes from golf course operations: Moving from a waste to a sustainability framework. *Resources, Conservation and Recycling* 37: 283-300.

McCarty, L.B., and A.E. Dudeck. 1993. Salinity effects on bentgrass germination. *HortScience* 28: 15-17.

McCollin, D., L. Moore and T. Sparks. 2000. The fora of a cultural landscape: Environmental determinants of change revealed using archival sources. *Biological Conservation* 92: 249-263.

McCown, B.H. 2003. Biotechnology in horticulture: 100 years of application. *HortScience* 38: 1026-1030.

McKay, A.C., K.M. Ophel, T.B. Reardon and J.M. Gooden. 1993. Livestock deaths associated with *Clavibacter toxicus* / *Anguina* sp. infection in seedheads of *Agrostis avenacea* and *Polypogon monspeliensis*. *Plant Disease* 77: 635-641.

McKersie, B.D., and S.R. Bowley. 2001. Stress tolerance of transgenic plants overexpressing superoxide dismutase. P2.15 in *Plant and Cell Biology Abstracts, Society for Experimental Biology Annual Meeting, 2-6 April 2001, University of Kent (Canterbury)*.

McLaughlin, B.E., and A.A. Crowder. 1988. The distribution of *Agrostis gigantea* and *Poa pratensis* in relation to some environmental factors on a mine-tailings area at Copper Cliff, Ontario. *Canadian Journal of Botany* 66: 2317-2322.

McNeill, J., and W.G. Dore. 1976. Taxonomic and nomenclatural notes on Ontario, Canada grasses. *Naturaliste Canadien* 103: 553-567.

McNeilly, T. 1968. Evolution in closely adjacent plant populations. III. *Agrostis tenuis* on a small copper mine. *Heredity* 23: 99-108.

McNeilly, T., and J. Antonovics. 1968. Evolution in closely adjacent plant populations. IV. Barriers to gene flow. *Heredity* 23: 205-218.

McNeilly, T., and A.D. Bradshaw. 1968. Evolutionary processes in populations of copper-tolerant *Agrostis tenuis* Sibth. *Evolution* 22: 108-118.

McNeilly, T., M. Ashraf and C. Veltkamp. 1987. Leaf micromorphology of sea cliff and inland plants of *Agrostis stolonifera* L., *Dactylis glomerata* L. and *Holcus lanatus* L. *New Phytologist* 106: 261-269.

Meagher, T.R., F.C. Belanger and P.R. Day. 2003. Using empirical data to model transgene dispersal. *Philosophical Transactions of the Royal Society of London Series B, Biological Sciences* 358: 1157-1162.

Meerts, P., and C. Grommesch. 2001. Soil seed banks in a heavy-metal polluted grassland at Prayon (Belgium). *Plant Ecology* 155: 35-45.

Meerts, P., and C. Lefèbvre. 1989. Observations génécologiques sur une population hybridée d'*Agrostis capillaris* L. et *A. stolonifera* L. *Bulletin de la Société Royale de Botanique de Belgique* 122: 161-169.

Meharg, A.A., and M.R. Macnair 1991. The mechanisms of arsenate tolerance in *Deschampsia cespitosa* (L.) Beauv. and *Agrostis capillaris* L. *New Phytologist* 119: 291–297.

Memon, A.R., D. Aktopraklıgil, A. Özdemir and A. Vertıı. 2001. Heavy metal accumulation and detoxification mechanisms in plants. *Turkish Journal of Botany* 25: 111-121.

Merritt, D.M., and E.E. Wohl. 2006. Plant dispersal along rivers fragmented by dams. *River Research and Applications* 22: 1-26.

Metcalf, M.M. 1922. Stolon-planting versus seeding for putting greens. *Bulletin of the Green Section of the United States Golf Association* 2: 292.

Misra, A., and G. Tyler. 2000a. Effect of wet and dry cycles in calcareous soil on mineral nutrient uptake of two grasses, *Agrostis stolonifera* L. and *Festuca ovina* L. *Plant and Soil* 224: 297-303.

Misra, A., and G. Tyler. 2000b. Effects of soil moisture on soil solution chemistry, biomass production and shoot nutrients in *Festuca ovina* L. and *Agrostis stolonifera* L. on a calcareous soil. *Communications in Soil Science and Plant Analysis* 31: 2727-2738.

Mitlacher, K., P. Poschlod, E. Rosén and J.P. Bakker. 2002. Restoration of wooded meadows — a comparative analysis along a chronosequence on Öland (Sweden). *Applied Vegetation Science* 5: 63-73 + Appendix 1.

Moncrief, J.B. 1964. Bent moves south. *USGA Green Section Record* 2(3): 1-6.

Monteith Jr., J. 1930. Classification of redtop and the common bent grasses. *Bulletin of the United States Golf Association Green Section* 10: 44-51.

Monteith Jr., J. 1941. Turf seed of higher quality. *Turf Culture* 2: 129-141.

Morris, K. 2003. Bentgrasses and bermudagrasses for today's putting greens. *USGA Turfgrass and Environmental Research Online* 2(1): cover + 1-7.

Morrison, J.A. 2002. Wetland vegetation before and after experimental purple loosestrife removal. *Wetlands* 22: 159-169.

Mouissie, A.M., W. Lengkeek and R. van Diggelen. 2005. Estimating adhesive seed-dispersal distances: Field experiments and correlated random walks. *Functional Ecology* 19: 478-486.

Mountford, E.P., and G.F. Peterken. 2003. Long-term change and implications for the management of wood-pastures: Experience over 40 years from Denny Wood, New Forest. *Forestry* 76: 19-43.

Mueller-Warrant, G.W., L.R. Schweitzer, R.L. Cook and A.E. Garay. 2003. Geographic distribution of prominent weeds of grass seed production. 6 pp. in *2002 Seed Production Research at Oregon State University, USDA-ARS Cooperating* (ed. W.C. Young III). Oregon State University, Department of Crop and Soil Sciences Ext/CrS 122, 5/03.

Munz, P.A. 1968. *Supplement to "A California Flora"*. University of California Press, Berkeley. 224 pp.

Murbeck, S. 1898. Studier öfver kritiska kärlväxtformer. II De nordeuropeiska formerna af slägtet *Agrostis*. *Botaniska Notiser* 1898: 1-14.

Murphy, J.A., M.G. Hendricks, P.E. Rieke, A.J.M. Smucker and B.E. Branham. 1994. Turfgrass root systems evaluated using the minirhizotron and video recording methods. *Agronomy Journal* 86: 247-250.

Murphy, J.A., H. Samaranayake, T.J. Lawson, J. Den Haan, W. Meyer and S. Bonos. 2003. Assessing cool-season turfgrasses for performance under simulated traffic stress. Page 24 in *Proceedings of the Twelfth Annual Rutgers Turfgrass Symposium, Cook College, January 9-10, 2003* (eds. J. Murphy, D. Corrington and B. Fitzgerald). Rutgers University, New Brunswick, New Jersey.

Musil, A.F. 1942. Diagnostic characters of seed of the commercial species of *Agrostis* and certain species occurring incidentally with them. *Proceedings of the Association of Official Seed Analysts* 1942: 139-151.

Musil, A.F. 1963. *Identification of Crop and Weed Seeds*. USDA Agriculture Handbook No. 219. 171 pp. + 43 plates.

Mutikainen, P., V. Salonen, S. Puustinen and T. Koskela. 2000. Local adaptation, resistance, and virulence in a hemiparasitic plant - host plant interaction. *Evolution* 54: 433–440.

MW. 2003. *Merriam-Webster's Collegiate Dictionary*, 11th Ed. Merriam-Webster [MW], Springfield, Massachusetts. 1623 pp.

Myers, J.A., M. Vellend, S. Gardescu and P.L. Marks. 2004. Seed dispersal by white-tailed deer: Implications for long-distance dispersal, invasion, and migration of plants in eastern North America. *Oecologia* 139: 35-44.

Nelson, J.C. 1919. The grasses of Salem, Oregon, and vicinity. *Torreya* 19: 216-227.

Nicholls, M.K., and T.S. McNeilly. 1979. Sensitivity of rooting and tolerance to copper in *Agrostis tenuis* Sibth. *New Phytologist* 83: 653-664.

Nicholls, M.K., and T. McNeilly. 1982. The possible polyphyletic origin of copper tolerance in *Agrostis tenuis* (Gramineae). *Plant Systematics and Evolution* 140: 109-117.

Nicholls, M.K., and T. McNeilly. 1985. The performance of *Agrostis capillaris* L. genotypes, differing in copper tolerance, in ryegrass swards on normal soil. *New Phytologist* 101: 207-217.

Niemelä, M., and A. Markkola. 2003. Interactions between two clonal grasses and their hemiparasite. Page 54 in *7th Clonal Plant Workshop: Reproductive Strategies, Biotic Interactions and Metapopulation Dynamics, 1-5 August 2003, Kuusamo, Finland*.

Nikolov, V. 1975. [Investigations on the biology of seed germination of *Agrostis capillaris* L. and *Festuca fallax* Thuill. from grass coenoses on Vitosha Mountain.] *Fitologiia (Sofia)* 1975: 25-33.

Nilsson, C., A. Ekblad, M. Dynesius, S. Backe, M. Gardfjell, B. Carlberg, S. Hellqvist and R. Jansson. 1994. A comparison of species richness and traits of riparian plants between a main river channel and its tributaries. *Journal of Ecology* 82: 281-295.

Nilsson, S.G., and I.N. Nilsson 1978. Species richness and dispersal of vascular plants to islands in Lake Möckeln, southern Sweden. *Ecology* 59: 473-480.

Nittler, L.W., and T.J. Kenny. 1969. Seedling difference among *Agrostis* species and varieties. *Crop Science* 9: 627-628.

North, H.F.A., and T.E. Odland. 1935. The relative seed yields in different species and varieties of bent grass. *Journal of the American Society of Agronomy* 27: 374-383.

Oakley, R.A. 1923a. The behavior of Rhode Island bent redtop mixtures. *Bulletin of the Green Section of the United States Golf Association* 3: 213-215.

Oakley, R.A. 1923b. Vegetative planting of bent grasses: An historical sketch. *Bulletin of the Green Section of the United States Golf Association* 3: 114-119.

Oakley, R.A. 1924. Some suggestions for beginners on the vegetative planting of creeping bent. *Bulletin of the Green Section of the United States Golf Association* 4: 182-184.

Odland, T.E. 1930. Bent grass seed production in Rhode Island. *Bulletin of the United States Golf Association Green Section* 10: 201-204.

Ogasawara, M., N.-I. Park and Y. Suto. 2003. [Growth responses of annual bluegrass (*Poa annua* L.) and creeping bentgrass (*Agrostis palustris* Huds.) to soil water.] *Journal of Japanese Society of Turfgrass Science* 32: 1-4.

Ohmura, T., T. Sasakuma and S. Kaneko. 1997. Identification of *Poa pratensis* L. and *Agrostis* spp. cultivars by random amplified polymorphic DNA (RAPD) markers. *International Turfgrass Society Research Journal* 8: 359-366.

Olff, H., and J.P. Bakker. 1991. Long-term dynamics of standing crop and species composition after the cessation of fertilizer application to mown grassland. *Journal of Applied Ecology* 28: 1040-1052.

Olff, H., J. Huisman and B.F. van Tooren. 1993. Species dynamics and nutrient accumulation during early primary succession in coastal sand dunes. *Journal of Ecology* 81: 693-706.

ONHIC. 2004. *Rare, Threatened and Endangered Species of Oregon*. Oregon Natural Heritage Information Center [ONHIC], Institute for Natural Resources, Oregon State University, Portland. 105 pp.

Oomes, M.J.M., H. Olff and H.J. Altena. 1996. Effects of vegetation management and raising the water table on nutrient dynamics and vegetation change in a wet grassland. *Journal of Applied Ecology* 33: 576-588.

Osborne, B.A., and W.J. Whittington. 1981a. Ecophysiological aspects of interspecific and seasonal variation in nitrate utilization in the genus *Agrostis*. *New Phytologist* 87: 595-614.

Osborne, B.A., and W.J. Whittington. 1981b. Variation in nitrate reductase activity between *Agrostis* species and ecotypes. *New Phytologist* 89: 581-590.

Ostmeyer, T. 2004a. The next big thing? Biotechnology is coming to a golf course near you, and it could change the job of the superintendent forever. *Golf Course Management* 72(1): 56-69.

Ostmeyer, T. 2004b. The next big thing? 'Bring it on!' For some superintendents, seeing Roundup Ready creeping bentgrass in action is believing. *Golf Course Management* 72(1): 63 & 65.

Ostmeyer, T. 2004c. The next big thing? Words from the wise. Scientific community sees herbicide resistance as just the tip of the iceberg for biotech in turfgrass. *Golf Course Management* 72(1): 66.

Ovesná, J., K. Poláková and L. Leišová. 2002. DNA analyses and their applications in plant breeding. *Czech Journal of Genetics and Plant Breeding* 38: 29-40.

Owen, M., and G.J. Thomas. 1979. The feeding ecology and conservation of wigeon wintering at the Ouse Washes, England. *Journal of Applied Ecology* 16: 795-809.

Owen, N.W., M. Kent and M.P. Dale. 2004. Plant species and community responses to sand burial on the machair of the Outer Hebrides, Scotland. *Journal of Vegetation Science* 15: 669-678 + Appendices 1 & 2 (2 pp.).

Pakeman, R.J., and A.G. Marshall. 1997. The seedbanks of the Breckland heaths and heath grasslands, eastern England, and their relationship to the vegetation and the effects of management. *Journal of Biogeography* 24: 375-390.

Pakeman, R.J., and J.L. Small. 2005. The role of the seed bank, seed rain and the timing of disturbance in gap regeneration. *Journal of Vegetation Science* 16: 121-130.

Pakeman, R.J., J.P. Attwood and J. Engelen. 1998. Sources of plants colonizing experimentally disturbed patches in an acidic grassland, in eastern England. *Journal of Ecology* 86: 1032-1041.

Pakeman, R.J., G. Digneffe and J.L. Small. 2002. Ecological correlates of endozoochory by herbivores. *Functional Ecology* 16: 296-304.

Pammenter, N.W., P.M. Drennan and V.R. Smith. 1986. Physiological and anatomical aspects of photosynthesis of two *Agrostis* species at a sub-Antarctic island. *New Phytologist* 102: 143–160.

Panter, J., and A. May. 1997. Rapid changes in the vegetation of a shallow pond in Epping Forest, related to recent droughts. *Freshwater Forum* 8: 55-64.

Parks, C.G., S.R. Radosevich, B.A. Endress, B.J. Naylor, D. Anzinger, L.J. Rew, B.D. Maxwell and K.A. Dwire. 2005. Natural and land-use history of the Northwest mountain ecoregions (USA) in relation to patterns of plant invasions. *Perspectives in Plant Ecology, Evolution and Systematics* 7: 137-158.

Partridge, T.R., and J.B. Wilson. 1987. Salt tolerance of salt marsh plants of Otago, New Zealand. *New Zealand Journal of Botany* 25: 559-566.

Pauchard, A., and P.B. Alaback. 2004. Influence of elevation, land use, and landscape context on patterns of alien plant invasions along roadsides in protected areas of south-central Chile. *Conservation Biology* 18: 1-11.

Paunero, E. 1947 [1946]. Las especies españolas del género *Agrostis*. *Anales del Jardín Botánico de Madrid* 7: 561-644.

Paunero, E. 1953. Las agrostídeas españolas. *Anales del Instituto Botánico Antonio José Cavanilles* 11: 319-417.

Pehrsson, O. 1988. Effects of grazing and inundation on pasture quality and seed production in a salt marsh. *Vegetatio* 74: 113-124.

Pennanen, T., R. Strömmer, A. Markkola and H. Fritze. 2001. Microbial and plant community structure across a primary succession gradient. *Scandinavian Journal of Forest Research* 16: 37-43.

[PGGR] Project Group for Genetic Resources. 2003. *A Nordic Approach to Access and Rights to Genetic Resources*. Project Group for Genetic Resources. Nordic Genetic Resources Council. ANP 2003:717. 99 pp.

Philipson, W.R. 1937. A revision of the British species of the genus *Agrostis* Linn. *Journal of the Linnean Society, Botany (London)* 51: 73-151 & plates h-t.

Phillips, S.M., and W.-L. Chen. 2003. Notes on grasses (Poaceae) for the *Flora of China,* I: *Deyeuxia*. *Novon* 13: 318-321.

Pieper, J.J., and W.L. Burlison. 1930. Redtop seed production in Illinois. *Bulletin of the United States Golf Association Green Section* 10: 225-228.

Piper, C.V. 1918. Rhode Island bent and related grasses, Part I in C.V. Piper and F.H. Hillman, *The Agricultural Species of Bent Grasses*. USDA Bulletin No. 692: 1-14.

Piper, C.V. 1922. *Important Cultivated Grasses*. USDA Farmers' Bulletin No. 1254.

Piper, C.V. 1923. "Bent". *Bulletin of the Green Section of the United States Golf Association* 3: 195-197.

Piper, C.V. 1925. *Cultivated Grasses of Secondary Importance*. USDA Farmers' Bulletin No. 1433.

Piper, C.V., and F.H. Hillman. 1918. *The Agricultural Species of Bent Grasses*. Part I. Rhode Island bent and related grasses, pp. 1-14 by C.V. Piper. Part II. The seeds of redtop and other bent grasses, pp. 15-27 by F.H. Hillman. USDA Bulletin No. 692. 27 pp.

Piper, C.V., and R.A. Oakley. 1921. Vegetative propagation of putting green grasses. *Bulletin of the Green Section of the United States Golf Association* 1: 124-126.

Piper, C.V., and R.A. Oakley. 1922a. Conserve the bent seed supply. *Bulletin of the Green Section of the United States Golf Association* 2: 255.

Piper, C.V., and R.A. Oakley. 1922b. Some observations on velvet bent. *Bulletin of the Green Section of the United States Golf Association* 2: 171-173.

Piper, C.V., and R.A. Oakley. 1924. Confusion in the identification of the named strains of creeping bent. *Bulletin of the Green Section of the United States Golf Association* 4: 265-266.

Pitcher, L.H., and B.A. Zilinskas. 2002. *Agrobacterium tumefaciens*-mediated transformation of turfgrasses using the selectable marker phosphomannose isomerase. Pp. 48-49 in *Proceedings of the Eleventh Annual Rutgers Turfgrass Symposium, Cook College, January 10-11, 2002* (eds. B. Huang and B. Fitzgerald). Rutgers University, New Brunswick, New Jersey.

Pitcher, L.H., S. Lakkaraju and B.A. Zilinskas. 2000. Transformation of tall fescue and velvet bentgrass using *Agrobacterium tumefaciens*. Page 39 in *Proceedings of the Ninth Annual Rutgers Turfgrass Symposium, Cook College, January 13-14, 2000* (eds. S.E. Hart, B. Fitzgerald and S. Lycan). Rutgers University, New Brunswick, New Jersey.

Pohl, R.W. 1978. *How to Know the Grasses*, 3rd Ed. *Agrostis*, Bentgrass (pp. 83-86). Wm. C. Brown Co. Publishers, Dubuque, Iowa.

Pojar, J., and A. MacKinnon, eds. 1994. *Plants of the Pacific Northwest Coast: Washington, Oregon, British Columbia & Alaska*. Lone Pine Publishing, Vancouver, British Columbia, Renton, Washington and Edmonton, Alberta. 527 pp.

Pollard, A.J., K. Dandridge Powell, F.A. Harper and J.A.C. Smith. 2002. The genetic basis of metal hyperaccumulation in plants. *Critical Reviews in Plant Sciences* 21: 539-566.

Ponomarev, A.N., and M.B. Rusakova. 1968. [The daily rhythm of pollination and its role in the formation of grass species.] *Botanicheskii Zhurnal* 53: 1371-1383.

Pons, T.L. 1989. Dormancy, germination and mortality of seeds in heathland and inland sand dunes. *Acta Botanica Neerlandica* 38: 327-335.

Pote, J., and B. Huang. 2003. Protein changes in response to increasing temperatures in *Agrostis* species. Page 47 in *Proceedings of the Twelfth Annual Rutgers Turfgrass Symposium, Cook College, January 9-10, 2003* (eds. J. Murphy, D. Corrington and B. Fitzgerald). Rutgers University, New Brunswick, New Jersey.

Prieto-Baena, J.C., P.J. Hidalgo, E. Domínguez and C. Galán. 2003. Pollen production in the Poaceae family. *Grana* 42: 153-160.

Probatova, N.S. 1974. Zametki o zlakakh flory Dalnego Vostoka (Notae de Gramineis florae Orientis extremi) [The genus *Agrostis* L. on the Kurile Islands]. *Novosti Sistematiki Vysshikh Rastenii – Akademiia Nauk SSSR* 11: 57-69.

Probatova, N.S. 1984. Novye taksony sem. Poaceae s Dalnego Vostoka SSSR [New taxa of the Poaceae from the Far East of the USSR]. *Botanicheskii Zhurnal* 69: 251-259.

Probatova, N.S., and S.S. Kharkevich. 1983. Novye taksony Poaceae iz Khabarovskogo kraya (New taxa of Poaceae from the Khabarovsk region). *Botanicheskii Zhurnal* 68: 1408-1414.

Purves, D.W., and R. Law. 2002. Fine-scale spatial structure in a grassland community: Quantifying the plant's-eye view. *Journal of Ecology* 90: 121-129.

Pyšek, P., D.M. Richardson, M. Rejmánek, G.L. Webster, M. Williamson and J. Kirschner. 2004. Alien plants in checklists and Floras: Towards better communication between taxonomists and ecologists. *Taxon* 53: 131-143.

Qian J., and Sun B.-X. 1998. [Intergeneric crossing genus ×*Agropogon* new to China.] *Acta Botanica Yunnanica* 20: 403-404.

Rachmilevitch, S., H. Lambers and B. Huang. 2006. Root respiratory characteristics associated with plant adaptation to high soil temperature for geothermal and turf-type *Agrostis* species. *Journal of Experimental Botany* 57: 623-631.

Radko, A.M. 1968. Bentgrasses for putting greens. *USGA Green Section Record* 5(6): 11-12.

Rajbhandari, K.R. 1985. The genus *Agrostis* in Nepal, 1. *Journal of Japanese Botany* 60: 65-78.

Rajbhandari, K.R. 1987. The genus *Agrostis* in Nepal, 2. *Journal of Japanese Botany* 62: 299-310.

Rakoczy-Trojanowska, M. 2002. Alternative methods of plant transformation — a short review. *Cellular and Molecular Biology Letters* 7: 849–858.

Ralston, D.S., and W.H. Daniel. 1972. Effect of temperature and water-table depth on the growth of creeping bentgrass roots. *Agronomy Journal* 64: 709-713.

Ramírez, C., C. San Martín, V. Finot and D. Ríos. 1992. Evaluación de praderas usando indicadores ecológicos. *Agro Sur (Valdivia)* 20: 85-100.

Rampton, H.H., and T.M. Ching. 1966. Longevity and dormancy in seeds of several cool season grasses and legumes buried in soil. *Agronomy Journal* 58: 220-223.

Rampton, H.H., and T.M. Ching. 1970. Persistence of crop seeds in soil. *Agronomy Journal* 62: 272-277.

Randall, R.P. 2002. *A Global Compendium of Weeds*. R.G. and F.J. Richardson, Melbourne. 905 pp.

Rapson, G.L., and J.B. Wilson. 1988. Non-adaptation in *Agrostis capillaris* L. (Poaceae). *Functional Ecology* 2: 479-490.

Rapson, G.L., and J.B. Wilson. 1992a. Genecology of *Agrostis capillaris* L. (Poaceae) — an invader into New Zealand. 1: Floral phenology. *New Zealand Journal of Botany* 30: 1-11.

Rapson, G.L., and J.B. Wilson. 1992b. Genecology of *Agrostis capillaris* L. (Poaceae) — an invader into New Zealand. 2: Responses to light, soil fertility, and water availability. *New Zealand Journal of Botany* 30: 13-24.

Rauser, W.E. 1984a. Isolation and partial purification of cadmium-binding protein from roots of the grass *Agrostis gigantea*. *Plant Physiology* 74: 1025-1029.

Rauser, W.E. 1984b. Partial purification and charcterization of copper-binding protein from roots of *Agrostis gigantea* Roth. *Journal of Plant Physiology* 115: 143-152.

Raven, P.J. 1986. Vegetation changes within the flood relief stage of two-stage channels excavated along a small rural clay river. *Journal of Applied Ecology* 23: 1001-1011.

RBGK (Royal Botanic Gardens, Kew). 1984. *Agrostis* (p. 50), *Polypogon* (p. 50) in S.M. Walters, A. Brady, C.D. Brickell, J. Cullen, P.S. Green, J. Lewis, V.A. Matthews, D.A. Webb, P.F. Yeo and J.C.M. Alexander. *The European Garden Flora*, Volume II, Monocotyledons (Part II). Cambridge University Press, Cambridge, England, U.K.

Redwine, S.M. 2000. *Evaluation of Drought and Salinity Tolerance in Transgenic Creeping Bentgrass*. M.S. Thesis, Michigan State University, East Lansing. 81 pp.

Reicher, Z.J., and G.A. Hardebeck. 2002. Overseeding strategies for converting golf course fairways to creeping bentgrass. *HortScience* 37: 508-510.

Reichman, J.R., L.S. Watrud, E.H. Lee, C.A. Burdick, M.A. Bollman, M.J. Storm, G.A. King and C. Mallory-Smith. 2006. Establishment of transgenic herbicide-resistant creeping bentgrass (*Agrostis stolonifera* L.) in non-agronomic habitats. *Molecular Ecology* (in press).

Reid, V.A. 1998. *The Impact of Weeds on Threatened Plants*. Science & Research Internal Report 164, New Zealand Department of Conservation, Wellington. 67 pp.

Richardson, W. 1818. *An Essay on Agriculture; …to which is added, A Memoir…on the Nature and Nutritive Qualities of Fiorin Grass, with Practical Remarks on its Abundant Properties, and the Best Mode of Cultivating that Extraordinary Vegetable*. Whitmore and Fenn, London, England. — as quoted in J. Monteith Jr., 1929, Cultivating creeping bent a hundred years ago. *Bulletin of the United States Golf Association Green Section* 9: 8-15.

Ridgway, K.P., J.M. Duck and J.P.W. Young. 2003. Identification of roots from grass swards using PCR-RFLP and FFLP of the plastid *trn*L (UAA) intron. *BMC Ecology* 3(8): http://www.biomedcentral.com/1472-6785/3/8. 6 pp.

Ridley, H.N. 1930. *The Dispersal of Plants Throughout the World*. L. Reeve & Co., Ashford, Kent, England, U.K. 744 pp.

Riege, D.A., and R. Del Moral. 2004. Differential tree colonization of old fields in a temperate rain forest. *American Midland Naturalist* 151: 251-264.

Roalson, E.H., and K.W. Allred. 1997. Vegetative proliferation in *Polypogon monspeliensis* (Gramineae). *Aliso* 16: 81.

Robbins, W. 1940. *Alien Plants Growing Without Cultivation in California*. Agricultural Experiment Station Bulletin 637. University of California, Berkeley. 128 pp.

Roberts, H.A. 1981. Seed banks in soils. *Advances in Applied Biology* 6: 1-45.

Robinson, M.F., L.A. Brilman and W.R. Kneebone. 1991. Registration of 'SR 1020' creeping bentgrass. *Crop Science* 31: 1702-1703.

Roden, C.M. 1998. Persistence, extinction and different species pools within the flora of lake islands in western Ireland. *Journal of Biogeography* 25: 301-310.

Rogers, M. 1992. What's available in creeping bentgrasses? *Grounds Maintenance* 27(1): 33, 36, 38, 40.

Roland, A.E., and M. Zinck. 1998. *Roland's Flora of Nova Scotia*, Rev. (3rd) Ed., Vol. 2. *Agrostis* L. (pp. 1131-1134). Nimbus Publishing and Nova Scotia Museum, Halifax.

Romani, M., E. Piano and L. Pecetti. 2002. Collection and preliminary evaluation of native turfgrass accessions in Italy. *Genetic Resources and Crop Evolution* 49: 341-348.

Romero García, A.T., and G. Blanca. 1988. Contribución al estudio cariosistemático del género *Agrostis* L. (Poaceae) en la Península Ibérica. *Boletim da Sociedade Broteriana*, Sér. 2, 61: 81-104.

Romero García, A.T., and C. Morales Torres. 1980. Notas acerca de algunas gramíneas de la provincia de Granada. *Anales del Jardín Botánico de Madrid* 37: 629-643.

Romero García, A.T., G. Blanca López and C. Morales Torres. 1988a. Relaciones filogenéticas entre las especies ibéricas del género *Agrostis* L. (Poaceae). *Lagascalia* 15 (Extra): 411-415.

Romero García, A.T., G. Blanca López and C. Morales Torres. 1988b. Revisión del Género *Agrostis* L. (Poaceae) en la Península Ibérica. Ruizia Vol. 7: 1-160.

Roovers, P., S. Baeten and M. Hermy. 2004. Plant species variation across path ecotones in a variety of common vegetation types. *Plant Ecology* 170: 107-119.

Rose, A.B., K.H. Platt and C.M. Frampton. 1995. Vegetation change over 25 years in a New Zealand short-tussock grassland: Effects of sheep grazing and exotic invasions. *New Zealand Journal of Ecology* 19: 163-174.

Rose-Fricker, C.A., M.L. Fraser, W.A. Meyer and S.A. Bonos. 2004. Registration of 'Greenwich' velvet bentgrass. *Crop Science* 44: 349-350.

Ross, S.M. 1986. Vegetation change on highway verges in south-east Scotland. *Journal of Biogeography* 13: 109-117.

Rothanzl, J. 2002. Struktura Genet *Agrostis capillaris* v Heterogenním Prostředí Vytvořeném Mraveništi Druhu *Lasius flavus* [Genet structure of *Agrostis capillaris* in heterogeneous environments created by anthills of *Lasius flavus*]. Charles University, Prague. 82 pp.

Roxburgh, S.H., J.B. Wilson, H. Gitay and W.McG. King. 1994. Dune slack vegetation in southern New Zealand. *New Zealand Journal of Ecology* 18: 51-64.

Rozefelds, A.C.F., L. Cave, D.I. Morris and A.M. Buchanan. 1999. The weed invasion in Tasmania since 1970. *Australian Journal of Botany* 47: 23-48.

Rozema, J., and B. Blom. 1977. Effects of salinity and inundation on the growth of *Agrostis stolonifera* and *Juncus gerardii*. *Journal of Ecology* 65: 213-222.

Ruemmele, B.A. 2000a. Colonial bentgrass for drought, heat, and wear. *Diversity* 16(1&2): 34-35.

Ruemmele, B.A. 2000b. Watching grass grow. *Grounds Maintenance* 35(5): 28, 30-32, 43.

Ruemmele, B.A. 2003. *Agrostis capillaris* (*Agrostis tenuis* Sibth.) colonial bentgrass. Pp. 187-200 in M.D. Casler and R.R. Duncan, eds., *Turfgrass Biology, Genetics, and Breeding*. John Wiley & Sons, Hoboken, New Jersey.

Rúgolo de Agrasar, Z.E. 1982. Revalidación del género *Bromidium* Nees et Meyen emend. Pilger (Gramineae). *Darwiniana* 24: 187-216.

Rúgolo de Agrasar, Z.E., and A.M. Molina. 1992. Las especies del género *Agrostis* (Gramineae: Agrosteae) de la Argentina. *Parodiana* 7(1-2): 179-255.

Rúgolo de Agrasar, Z.E., and A.M. Molina. 1997a. Las especies del género *Agrostis* L. (Gramineae: Agrostideae) de Chile. *Gayana, Botánica* 54: 91-156.

Rúgolo de Agrasar, Z.E., and A.M. Molina. 1997b. Presencia del híbrido ×*Agropogon littoralis* (Gramineae: Agrostideae) en Chile. *Hickenia – Boletín del Darwinion* 2(44): 209-214.

Rumball, W., and M.B. Forde. 1977. Plant introduction trials. Performance of *Agrostis* species at Palmerston North. *New Zealand Journal of Experimental Agriculture* 5: 409-411.

Rumball, W., and G.S. Robinson. 1982. 'Grasslands Egmont' amenity browntop (*Agrostis capillaris* L. syn. *Agrostis tenuis* Sibth.). *New Zealand Journal of Experimental Agriculture* 10: 175-177.

Rydlová, J., and M. Vosátka. 2003. Effect of *Glomus intraradices* isolated from Pb-contaminated soil on Pb uptake by *Agrostis capillaris* is changed by its cultivation in a metal-free substrate. *Folia Geobotanica* 38: 155-166.

Saikkonen, K., J. Ahlholm, M. Helander, S. Lehtimäki and O. Niemeläinen. 2000. Endophytic fungi in wild and cultivated grasses in Finland. *Ecography* 23: 360-366.

San Martín, C., C. Ramírez, J. San Martín and R. Villaseñor. 2001. Flora y vegetación del Estero Reñaca (V Region, Chile). *Gayana, Botánica* 58: 31-46.

San Martín, C., C. Ramírez and H. Rubilar. 2002. Ecosociología de los pantanos de cortadera en Valdivia, Chile. *Ciencia e Investigación Agraria* 29: 171-179.

Sauer, C.O. 1942. The settlement of the humid East. Pp. 157-166 in *Climate and Man: Yearbook of Agriculture, 1941*. U.S. Government Printing Office [GPO], Washington, D.C.

Sauer, C.O. 1976. European backgrounds of American agricultural settlement. *Historical Geography* 6: 35-57.

Schardl, C.L., A. Leuchtmann and M.J. Spiering. 2004. Symbioses of grasses with seedborne fungal endophytes. *Annual Review of Plant Biology* 55: 315-340 + C1-C3.

Schat, H., M. Llugany and R. Bernhard. 2000. Metal-specific patterns of tolerance, uptake and transport of heavy metals in hyperaccumulating and nonhyperaccumulating metallophytes. Pp. 171-188 in N. Terry and G. Bañuelos, eds., *Phytoremediation of Contaminated Soil and Water*. Lewis Publishers, Boca Raton, Florida.

Schat, H., M. Llugany, R. Vooijs, W.J. Hartley and P.M. Bleeker. 2002. The role of phytochelatins in constitutive and adaptive heavy metal tolerances in hyper-accumulator and non-hyperaccumulator metallophytes. *Journal of Experimental Botany* 53: 2381-2392.

Scheef, E.A., M.D. Casler and G. Jung. 2003. Development of species-specific SCAR markers in bentgrass. *Crop Science* 43: 345-349.

Schery, R.W. 1973. The bright side of bentgrass. *Seed World* No. 111(3): 2-3.

Schippers, P., J.M. van Groenendael, L.M. Vleeshouwers and R. Hunt. 2001. Herbaceous plant strategies in disturbed habitats. *Oikos* 95: 198-210.

Schmidt, R.E., and R.E. Blaser. 1967. Effect of temperature, light and nitrogen on the growth and metabolism of Cohansey bentgrass (*Agrostis palustris* Huds.). *Crop Science* 7: 447-451.

Scholz, H. 1962. *Agrostis castellana*: Eine neue Fremdpflanze in Schleswig-Holstein. *Die Heimat* 69: 405-406.

Scholz, H. 1965. *Agrostis tenuis* 'Highland Bent' ein Synonym der *Agrostis castellana*. *Berichte der Deutschen Botanischen Gesellschaft* 78: 322-325.

Scholz, H. 2000. *Agrostis vinealis*. *Société pour l'Échange des Plantes Vasculaires de l'Europe et du Bassin Méditerranéen: Bulletin* 28: 134.

Schoth, H.A. 1930. Bent grass seed production in the Pacific Northwest. *Bulletin of the United States Golf Association Green Section* 10: 206-211.

Schoth, H.A. 1939. Seed production of turf grasses on the Pacific Coast. *Turf Culture* 1: 111-119.

Schröder, H.K., H.E. Andersen and K. Kiehl. 2005. Rejecting the mean: Estimating the response of fen plant species to environmental factors by non-linear quantile regression. *Journal of Vegetation Science* 16: 373-382 + Appendix 1 (4 pp).

Schulte, R.P.O., and J.H. Neuteboom. 2002. Advanced analysis of dry-weight-rank data to discriminate direct and indirect interactions between white clover and grasses in a multi-species pasture under a range of management strategies. *Grass and Forage Science* 57: 113-123.

Scott, W.A., and C.J. Hallam. 2002. Assessing species misidentification rates through quality assurance of vegetation monitoring. *Plant Ecology* 165: 101-115.

Sell, P., and G. Murrell. 1996. *Flora of Great Britain and Ireland*, Vol. 5, Butomaceae – Orchidaceae. *Agrostis* L. (pp. 186-191). Cambridge University Press, Cambridge, England, U.K.

Sessions, L.A., and D. Kelly. 2000. The effects of browntop (*Agrostis capillaris*) dominance after fire on native shrub germination and survival. *New Zealand Natural Sciences* 25: 1-9.

Sessions, L.A., and D. Kelly. 2002. Predator-mediated apparent competition between an introduced grass, *Agrostis capillaris*, and a native fern, *Botrychium australe* (Ophioglossaceae), in New Zealand. *Oikos* 96: 102-109.

Shaltout, K.H., and M.A. El-Sheikh. 1991. Gradient analysis of canal vegetation in Nile Delta region. *Feddes Repertorium* 102: 639-645.

Sharaf El-Din, A., H. El-Kady and Y. Sodany. 1993. Gradient analysis of the common species in the saline and marshy habitats in the Nile Delta. *Feddes Repertorium* 104: 387-394.

Shearman, R.C., and J.B. Beard. 1972. Stomatal density and distribution in *Agrostis* as influenced by species, cultivar, and leaf blade surface and position. *Crop Science* 12: 822-823.

Sheldrick, R.D., R.H. Lavender and T.M. Martyn. 1990. Dry-matter yield and response to nitrogen of an *Agrostis stolonifera*-dominant sward. *Grass and Forage Science* 45: 203-213.

Shildrick, J.P. 1976. Highland bent: A taxonomic problem. *Journal of the Sports Turf Research Institute* 52: 142-150.

Shildrick, J.P. 1980. Turfgrass seed mixtures in the United Kingdom. Pp. 57-64 in *Proceedings of the Third International Turfgrass Conference: Sponsored by the International Turfgrass Society, July 11-13, 1977, Munich, West Germany* (ed. J.B. Beard). ASA, CSSA, SSSA and ITS, Madison, Wisconsin.

Shipley, B. 2002. Trade-offs between net assimilation rate and specific leaf area in determining relative growth rate: Relationship with daily irradiance. *Functional Ecology* 16: 682-689.

Shipley, B., P.A. Keddy, D.R.J. Moore and K. Lemky. 1989. Regeneration and establishment strategies of emergent macrophytes. *Journal of Ecology* 77: 1093-1110.

Shipley, B., P.A. Keddy, C. Gaudet and D.R.J. Moore. 1991. A model of species density in shoreline vegetation. *Ecology* 72: 1658-1667.

Silvertown, J., S. Holtier, J. Johnson and P. Dale. 1992. Cellular automaton models of interspecific competition for space – the effect of pattern on process. *Journal of Ecology* 80: 527-534.

Silvertown, J., M.E. Dodd, D.J.G. Gowing and J.O. Mountford. 1999. Hydrologically defined niches reveal a basis for species richness in plant communities. *Nature* 400: 61-63.

Simon, E. 1977. Cadmium tolerance in populations of *Agrostis tenuis* and *Festuca ovina*. *Nature* 265: 328-330.

Simon, E., and C. Lefèbvre. 1977. Aspects de la tolerance aux metaux lourds chez *Agrostis tenuis* Sibth., *Festuca ovina* L. et *Armeria maritima* (Mill.) Willd. *Oecologia Plantarum* 12: 95-110.

Simpson, D.R. 1967. A Study of Species Complexes in *Agrostis* and *Bromus*. Ph.D. Dissertation, University of Washington, Seattle. 88 pp.

Skogley, C.R. 1973. *Velvet Bentgrass*. Bulletin University of Rhode Island Cooperative Extension Service 199. 9 pp.

Skuterud, R. 1984. Growth of *Elymus repens* (L.) Gould and *Agrostis gigantea* Roth at different light intensities. *Weed Research* 24: 51-57.

Smith, A. 1972. The pattern of distribution of *Agrostis* and *Festuca* plants of various genotypes in a sward. *New Phytologist* 71: 937-945.

Smith, R.A.H., and A.D. Bradshaw. 1979. The use of metal-tolerant plant populations for the reclamation of metalliferous wastes. *Journal of Applied Ecology* 16: 595-612.

Smith, R.S., R.S. Shiel, D. Millward, P. Corkhill and R.A. Sanderson. 2002. Soil seed banks and the effects of meadow management on vegetation change in a 10-year meadow field trial. *Journal of Applied Ecology* 39: 279-293 + Tables S1 & S2.

Sokolovskaya, A.P. 1938. A caryo-geographical study of the genus *Agrostis*. *Cytologia* 8: 452-467.

Sokolovskaya, A.P., and N.S. Probatova. 1974. Kariosistematicheskoye issledovanie Dal'nego Stochnykh vidov *Agrostis* L. [Karyosystematic investigation of the Far Eastern species of *Agrostis* L.]. *Botanicheskii Zhurnal* 59: 1278-1287.

Soltis, D.E., P.S. Soltis and J.A. Tate. 2003. Advances in the study of polyploidy since *Plant Speciation*. *New Phytologist* 161: 173-191.

Soreng, R.J., and P.M. Peterson. 2003. *Agrostis*, pp. 42-89 in Catalogue of New World grasses (Poaceae): IV. Subfamily Pooideae. Contributions from the United States National Herbarium Vol. 48.

Soreng, R.J., P.M. Peterson, G. Davidse, E.J. Judziewicz, F.O. Zuloaga, T.S. Filgueiras and O. Morrone. 2003. Catalogue of New World grasses (Poaceae): IV. Subfamily Pooideae. Contributions from the United States National Herbarium Vol. 48: 1-730.

Spooner, B.M., and S.L. Kemp. 2005. *Epichloë* in Britain. *Mycologist* 19: 82-87.

Spooner, D.M., W.L.A. Hetterscheid, R.G. van den Berg and W.A. Brandenburg. 2002. Plant nomenclature and taxonomy: An horticultural and agronomic perspective. *Horticultural Reviews* 28: 1-60.

Stace, C.A. 1975. *Agrostis* L. × *Calamagrostis* Adans. Page 579 in C.A. Stace, ed., *Hybridization and the Flora of the British Isles*. Academic Press, London.

Staniforth, R.J., and P.A. Scott. 1991. Dynamics of weed populations in a northern subarctic community. *Canadian Journal of Botany* 69: 814-821.

Steed, J.E., and L.E. DeWald. 2003. Transplanting sedges (*Carex* spp.) in southwestern riparian meadows. *Restoration Ecology* 11: 247-256.

Steer, J., and J.A. Harris. 2000. Shifts in the microbial community in rhizosphere and non-rhizosphere soils during the growth of *Agrostis stolonifera*. *Soil Biology and Biochemistry* 32: 869-878.

Steiner, A.M. 1982 [1981]. Zur Reproduzierbarkeit quantitativer Messungen an Spelzfrüchten bei der Echtheitsbestimmung in der Saatgutprüfung (*Agrostis* spp., *Festuca* sssp. [*sic*]) [Reproducibility of quantitative measurements of florets for verification in seed testing (*Agrostis* spp., *Festuca* sssp.)]. *Landwirtschaftliche Forschung* 38 (Special Issue): 406-418.

Steiner, A.M., and H. Lupold. 1978. Zur Echtheitsbestimmung mittels morphologischer Merkmale der Spelzfrüchte bei *Agrostis*-Arten [Verification of species of *Agrostis* by means of morphological characters of the florets]. *Landwirtschaftliche Forschung* 31: 359-369.

Steyermark, J.A. 1963. *Flora of Missouri*. Iowa State University Press, Ames. 1725 pp.

Sticklen, M.B. 2001. Genetic engineering: An ultimate solution to the turfgrass problems. Vol. 30: 40-43 in *Proceedings of the 71st Annual Michigan Turfgrass Conference, 15-18 January 2001, East Lansing, Michigan* (eds. K. Frank, R. Calhoun and J. Schonfelder).

Sticklen, M.B., D. Warkentin, C.-A. Liu, R.K. Hajela, L. Graham, H. Zhong, B. Peterson, J. Vargas Jr. and B. Branham. 1996. Genetic transformation in *Agrostis palustris* Huds. (creeping bentgrass). Pp. 153-163 in *Plant Protoplasts and Genetic Engineering VII* (ed. Y.P.S. Bajaj). Biotechnology in Agriculture and Forestry Vol. 38. Springer-Verlag, Berlin and New York.

Stier, J. 2003. Managing the new 'alpha'-bents. *Grounds Maintenance* 38(8): G1-G5.

Stockey, A., and R. Hunt. 1994. Predicting secondary succession in wetland mesocosms on the basis of autecological information on seeds and seedlings. *Journal of Applied Ecology* 31: 543-559.

Stoddart, D.M. 1982. Does trap odour influence estimation of population size of the short-tailed vole, *Microtus agrestis*? *Journal of Animal Ecology* 51: 375-386.

Stromberg, J. 1997. Exotic herbaceous species in Arizona's riparian ecosystems. Pp. 45-57 in J.H. Brock, M. Wade, P. Pyšek and D. Green, eds., *Plant Invasions: Studies from North America and Europe*. Backhuys Publishers, Leiden.

Stubbendieck, J., S.L. Hatch and K.J. Kjar. 1982. *North American Range Plants*, 2nd Ed. University of Nebraska Press, Lincoln. 464 pp.

Stuckey, I.H., and W.G. Banfield. 1946. The morphological variations and the occurrence of aneuploids in some species of *Agrostis* in Rhode Island. *American Journal of Botany* 33: 185-190.

Suckling, F.E.T, and M.B. Forde. 1978. Genetic resources in high-rainfall hill pastures of New Zealand. I. Collection of ryegrass, browntop, and white clover. *New Zealand Journal of Agricultural Research* 21: 499-508.

Sugiura, K., C. Inokuma, N. Imaizumi and C. Cho. 1998. Generation of herbicide-resistant creeping bentgrass (*Agrostis palustris* Huds.) plants by electroporation-mediated direct gene transfer into protoplasts. *Journal of Turfgrass Management* 2(4): 35-41.

Sweeney, P.M., R.C. Golembiewski and T.K. Danneberger. 1996. Random amplified polymorphic DNA analysis of dry turfgrass seed. *HortScience* 31: 400-401.

Sweeney, P.M., T.K. Danneberger, D. Wang and M. McBride. 2001. Root weight, nonstructural carbohydrate content, and shoot density of high-density creeping bentgrass cultivars. *HortScience* 36: 368-370.

Symeonidis, L., T. McNeilly and A.D. Bradshaw. 1985a. Differential tolerance of three cultivars of *Agrostis capillaris* L. to cadmium, copper, lead, nickel and zinc. *New Phytologist* 101: 309-315.

Symeonidis, L., T. McNeilly and A.D. Bradshaw. 1985b. Interpopulation variation in tolerance to cadmium, copper, lead, nickel and zinc in nine populations of *Agrostis capillaris* L. *New Phytologist* 101: 317-324.

Tamm, A., K. Kull and M. Sammul. 2002. Classifying clonal growth forms based on vegetative mobility and ramet longevity: A whole community analysis. *Evolutionary Ecology* 15: 383-401.

Tanpo, H., H. Toyoda and S. Ouchi. 1992. Callus induction and plant regeneration in creeping bentgrass (*Agrostis palustris*). *Plant Tissue Culture Letters* 9: 233-235.

Tasker, A., and M.J. Chadwick. 1978. The microdistribution of *Agrostis tenuis* on colliery spoil in relation to spoil chemical variability. *Journal of Applied Ecology* 15: 551-563.

Tateoka, T. 1975. A contribution to the taxonomy of the *Agrostis mertensii-flaccida* complex (Poaceae) in Japan. *Botanical Magazine, Tokyo* 88: 65-87.

Tateoka, T., and M. Michikawa. 1987. *Agrostis mertensii* (Poaceae) in Hokkaido. *Botanical Magazine, Tokyo* 100: 273-293.

Taylor, R.L., and G.A. Mulligan. 1968. *Flora of the Queen Charlotte Islands, Part 2, Cytological Aspects of the Vascular Plants*. Canada Department of Agricuture Monograph No. 4, Part 2. 148 pp.

Taylor, T.T. 1957. Turfgrass — its development and progress. *USGA Journal and Turf Management* 10(5): 28-32.

Tegg, R.S., and P.A. Lane. 2004. A comparison of the performance and growth of a range of turfgrass species under shade. *Australian Journal of Experimental Agriculture* 44: 353-358.

Terakawa, T., T. Sato and M. Koike. 1992. Plant regeneration from protoplasts isolated from embryogenic suspension cultures of creeping bentgrass (*Agrostis palustris* Huds.). *Plant Cell Reports* 11: 457-461.

Tercek, M.T. 2005. Ecology and evolution of geothermally adapted *Agrostis* of North America and Kamchatka. http://agrostis.topcities.com/research/resintro.html

Tercek, M.T., and J.L. Whitbeck. 2004. Heat avoidance life history strategy controls the distribution of geothermal *Agrostis* in Yellowstone. *Ecology* 85: 1955-1966.

Tercek, M.T., D.P. Hauber and S.P. Darwin. 2003. Genetic and historical relationships among geothermally adapted *Agrostis* (bentgrass) of North America and Kamchatka: Evidence for a previously unrecognized, thermally adapted taxon. *American Journal of Botany* 90: 1306-1312.

Teyssonneyre, F., C. Picon-Cochard, R. Falcimagne and J.-F. Soussana. 2002. Effects of elevated CO_2 and cutting frequency on plant community structure in a temperate grassland. *Global Change Biology* 8: 1034-1046.

Thompson, K., and J.P. Grime. 1979. Seasonal variation in the seed banks of herbaceous species in ten contrasting habitats. *Journal of Ecology* 67: 893-921.

Thompson, K., J.G. Hodgson, R.M. Smith, P.H. Warren and K.J. Gaston. 2004. Urban domestic gardens (III): Composition and diversity of lawn floras. *Journal of Vegetation Science* 15: 373-378.

Thrower, L.B., and D.H. Lewis. 1973. Uptake of sugars by *Epichloë typhina* (Pers. ex Fr.) Tul. in culture and from its host *Agrostis stolonifera* L. *New Phytologist* 72: 501-508.

Tiku, B.L., and R.W. Snaydon. 1971. Salinity tolerance within the grass species *Agrostis stolonifera* L. *Plant and Soil* 35: 421-431.

Tinney, F.W. 1936. Chromosome behavior in *Agrostis nebulosa*. *Botanical Gazette* 97: 822-833.

Tomić, Z., and G. Šurlan-Momirović. 1999. Variability of ploidy level of five *Agrostis* species present in Serbia. *Plant Genetic Resources Newsletter* 119: 12.

Tomić, Z., D. Sokolović and G. Šurlan-Momirović. 1999. Dry matter and seed production in some inbred lines of three *Agrostis* species. *Herbage Seed as a Key Factor for Improving Production and Environmental Quality; Proceedings: Fourth International Herbage Seed Conference, Perugia, Italy, May 23-27, 1999*. http://www.css.orst.edu/ihsg/abstract/1999/08_dry_matter_and_seed...

Tomić, Z., M. Žujović, S. Mrfat-Vukelić, Z. Nešić, V. Krnjaja and V. Pudlo. 2003. Genetic resource of five *Agrostis* species present in Serbia and their utilisation. *Czech Journal of Genetics and Plant Breeding* 39 (Special Issue): 38-40.

Tompkins, D.K., J.B. Ross and D.L. Moroz. 2000. Dehardening of annual bluegrass and creeping bentgrass during late winter and early spring. *Agronomy Journal* 92: 5-9.

Tompkins, D.K., J.B. Ross and D.L. Moroz. 2004. Effects of ice cover on annual bluegrass and creeping bentgrass putting greens. *Crop Science* 44: 2175-2179.

Toole, V.K., and E.J. Koch. 1977. Light and temperature controls of dormancy and germination in bentgrass seeds. *Crop Science* 17: 806-811.

Traba, J., F.M. Azcarate and B. Peco. 2004. From what depth do seeds emerge? A soil seed bank experiment with Mediterranean grassland species. *Seed Science Research* 14: 297-303.

Tregillus, C.A. 1926. Rhode Island bent as a putting green turf. *Bulletin of the Green Section of the United States Golf Association* 6: 143-144.

Tsuyuzaki, S. 1993. Recent vegetation and prediction of the successional sere on ski grounds in the highlands of Hokkaido, northern Japan. *Biological Conservation* 63: 255-260.

Turner, R.G. 1970. The sub-cellular distribution of zinc and copper within roots of metal-tolerant clones of *Agrostis tenuis* Sibth. *New Phytologist* 69: 725-731.

Tutin, T.G. 1980. *Agrostis* L. (pp. 232-235, 405-406), ×*Agropogon* P. Fourn. (p. 236) in *Flora Europaea*, Vol. 5 (eds. T.G. Tutin, V.H. Heywood, N.A. Burges, D.M. Moore, D.H. Valentine, S.M. Walters and D.A. Webb). Cambridge University Press, Cambridge, England, U.K.

Tyrrel, S.F., P.B. Leeds-Harrison and K.S. Harrison. 2002. Removal of ammoniacal nitrogen from landfill leachate by irrigation onto vegetated treatment planes. *Water Research* 36: 291-299.

Tzvelev [Tsvelev], N.N. 1983 [1976]. *Grasses of the Soviet Union [Zlaki SSSR]*, Part 1. *Agrostis* L. (pp. 482-506). Amerind Publishing Co., New Delhi [Nauka Publishers, Leningrad].

Ungar, I.A. 1978. Halophyte seed germination. *Botanical Review* 44(2): 233-264.

USDA. 1948. *Grass: The Yearbook of Agriculture* (ed. A. Stefferud). U.S. GPO, Washington, D.C. 892 pp.

USDA. 1961. *Seeds: The Yearbook of Agriculture* (ed. A. Stefferud). U.S. GPO, Washington, D.C. 591 pp.

USDA Forest Service. 1940. *Range Plant Handbook*, Rev. Ed. U.S. GPO, Washington, D.C.

USGA. 1922a. Geography of fine turf grasses. *Bulletin of the Green Section of the United States Golf Association* [USGA] 2: 214-215.

USGA. 1922b. Harvesting bent seed in Germany. *Bulletin of the Green Section of the United States Golf Association* 2: 90.

USGA. 1922c. South German mixed bent seed. *Bulletin of the Green Section of the United States Golf Association* 2: 31.

USGA. 1924a. How to select and compare vegetative strains of creeping bent. *Bulletin of the Green Section of the United States Golf Association* 4: 297-298.

USGA. 1924b. Named strains of creeping bent. *Bulletin of the Green Section of the United States Golf Association* 4: 240.

USGA. 1924c. Strains of creeping bent. *Bulletin of the Green Section of the United States Golf Association* 4: 210.

USGA. 1925a. Creeping bent and seaside bent. *Bulletin of the Green Section of the United States Golf Association* 5: 74-75.

USGA. 1925b. Remarkable bent turf. *Bulletin of the Green Section of the United States Golf Association* 5: 268.

USGA. 1930a. Identifying strains of creeping bent. *Bulletin of the United States Golf Association Green Section* 10: 51-54.

USGA. 1930b. Sources of golf course grass seed. *Bulletin of the United States Golf Association Green Section* 10: 218-224.

USGA. 1931. Kinds and quantities of turf seeds purchased by golf courses. *Bulletin of the United States Golf Association Green Section* 11: 222-223.

USGA. 1932. When is a bent grass a creeping bent? *Bulletin of the United States Golf Association Green Section* 12: 37-38.

van den Eede, G., H. Aarts, H.-J. Buhk, G. Corthier, H.J. Flint, W. Hammes, B. Jacobsen, T. Midtvedt, J. van der Vossen, A. von Wright, W. Wackernagel and A. Wilcks. 2004. The relevance of gene transfer to the safety of food and feed derived from genetically modified (GM) plants. *Food and Chemical Toxicology* 42: 1127-1156.

Vandenkoornhuyse, P., K.P. Ridgway, I.J. Watson, A.H. Fitter and J.P.W. Young. 2003. Co-existing grass species have distinctive arbuscular mycorrhizal communities. *Molecular Ecology* 12: 3085-3095.

van der Burg, W.J., G. Vierbergen and K.T. Koenders. 1979. Identification of *Agrostis* spp. *Seed Science and Technology* 7: 531.

van Eck, W.H.J. M., H.M. van de Steeg, C.W.P.M. Blom and H. de Kroon. 2004. Is tolerance to summer flooding correlated with distribution patterns in river floodplains? A comparative study of 20 terrestrial grassland species. *Oikos* 107: 393-405.

van Oene, H., E.J.M. van Deursen and F. Berendse. 1999. Plant-herbivore interaction and its consequences for succession in wetland ecosystems: A modeling approach. *Ecosystems* 2: 122-138.

Vécrin, M.P., and S. Muller. 2003. Top-soil translocation as a technique in the re-creation of species-rich meadows. *Applied Vegetation Science* 6: 271-278.

Vergara, G.V., and S.S. Bughrara. 2003. AFLP analyses of genetic diversity in bentgrass. *Crop Science* 43: 2162-2171.

Vergara, G.V., and S.S. Bughrara. 2004. Genetic differentiation of tetraploid creeping bentgrass and hexaploid redtop bentgrass genotypes by AFLP and their use in turfgrass breeding. *Crop Science* 44: 884-890.

Vester, G. 1999. Experimentelle Untersuchungen zum vegetativen Kolonisation- und Konkurrenzverhalten bei *Agrostis vinealis* und *A. capillaris*. In *29. Jahrestagung der Gesellschaft für Ökologie [GfÖ], 13-18 September 1999, Universität Bayreuth*. Bayreuth, Germany. http://www.bitoek.uni-bayreuth.de/gfoe/programm

Vogt, K., L. Rasran and K. Jensen. 2004. Water-borne seed transport and seed deposition during flooding in a small river-valley in Northern Germany. *Flora* 199: 377-388.

Voss, E.G. 1972. *Michigan Flora, Part 1, Gymnosperms and Monocots*. *Agrostis* (pp. 199-204). Cranbrook Institute of Science Bulletin 55, Bloomfield Hills, Michigan and University of Michigan Herbarium, Ann Arbor.

Vovk, A.G. (Вовк, А.Г.) 1970. Khromosomni chisla vidiv ta form ukrainskikh mitlic (rid *Agrostis* L.) [Chromosome numbers of Ukrainian *Agrostis* L. species and forms]. *Ukrains'kii Botanichnii Zhurnal* 27: 739-742.

Wagner, M., P. Poschlod and R.P. Setchfield. 2003. Soil seed bank in managed and abandoned semi-natural meadows in Soomaa National Park, Estonia. *Annales Botanici Fennici* 40: 87-100.

Wainscott, T.L. 1961. New gulley stopper … creeping bent. *Successful Farming* 59: 44-45.

Walker, S. 2000. Post-pastoral changes in composition and guilds in a semi-arid conservation area, Central Otago, New Zealand. *New Zealand Journal of Ecology* 24: 123-137.

Walker, S., and W.G. Lee. 2002. Alluvial grasslands of Canterbury and Marlborough, eastern South Island, New Zealand: Vegetation patterns and long-term change. *Journal of the Royal Society of New Zealand* 32: 113–147.

Wang, Y., M. Browning, B.A. Ruemmele, J.M. Chandlee, A.P. Kausch and N. Jackson. 2003. Glufosinate reduces fungal diseases in transgenic glufosinate-resistant bentgrasses (*Agrostis* spp.). *Weed Science* 51: 130–137.

Wang, Z.-Y., and Y. Ge. 2005. Rapid and efficient production of transgenic bermudagrass and creeping bentgrass bypassing the callus formation phase. *Functional Plant Biology* 32: 769-776.

Wang, Z.-Y., and Y. Ge. 2006. Recent advances in genetic transformation of forage and turf grasses. *In Vitro Cellular & Developmental Biology – Plant* 42: 1-18.

Wang, Z.-Y., A. Hopkins and R. Mian. 2001. Forage and turf grass biotechnology. *Critical Reviews in Plant Sciences* 20: 573-619.

Wang, Z.-Y., M. Scott, J. Bell, A. Hopkins and D. Lehmann. 2003. Field performance of transgenic tall fescue (*Festuca arundinacea* Schreb.) plants and their progenies. *Theoretical and Applied Genetics* 107: 406-412.

Ward, C.Y. 1969. Climate and adaptation. Pp. 27-79 in A.A. Hanson and F.V. Juska, eds., *Turfgrass Science*. Agronomy Series Monograph No. 14. American Society of Agronomy, Madison, Wisconsin.

Warkentin, D., B. Chai, R.K. Hajela, H. Zhong and M.B. Sticklen. 1998. Development of transgenic creeping bentgrass (*Agrostis palustris* Huds.) for fungal diseases resistance. Pp. 153-161 in M.B. Sticklen and M.P. Kenna, eds., *Turfgrass Biotechnology: Cell and Molecular Genetic Approaches to Turfgrass Improvement*. Ann Arbor Press, Chelsea, Michigan.

Warnke, S.E. 2003. Creeping bentgrass (*Agrostis stolonifera* L.). Pp. 175-185 in M.D. Casler and R.R. Duncan, eds., *Turfgrass Biology, Genetics, and Breeding*. John Wiley & Sons, Hoboken, New Jersey.

Warnke, S.E., D.S. Douches and B.E. Branham. 1997. Relationships among creeping bentgrass cultivars based on isozyme polymorphisms. *Crop Science* 37: 203-207.

Warnke, S.E., D.S. Douches and B.E. Branham. 1998. Isozyme analysis supports allotetraploid inheritance in tetraploid creeping bentgrass (*Agrostis palustris* Huds.). *Crop Science* 38: 801-805.

Watkins, A.J., and M.R. Macnair. 1991. Genetics of arsenic tolerance in *Agrostis capillaris* L. *Heredity* 66: 47-54.

Watrud, L.S., E.H. Lee, A. Fairbrother, C. Burdick, J.R. Reichman, M. Bollman, M. Storm, G. King and P.K. Van de Water. 2004. Evidence for landscape level, pollen-mediated gene flow from genetically modified creeping bentgrass with *CP4 EPSPS* as a marker. *Proceedings of the National Academy of Sciences (USA)* 101: 14533-14538.

Watrud, L.S. 2005. Long distance pollen-mediated gene flow from creeping bentgrass. *ISB News Report* January 2005: 1-3.

Watson, L., and M.F. Dallwitz. 1992. *The Grass Genera of the World*. CABI Publishing, Wallingford, England, U.K. 1038 pp. (Updated online: Aveneae 1998, *Agrostis* 1999).

[WCMC] World Conservation Monitoring Centre. 1998. *1997 IUCN Red List of Threatened Plants* (eds. K.S. Walter and H.J. Gillett). IUCN – The World Conservation Union, Gland, Switzerland and Cambridge, England, U.K. 862 pp.

Weakley, A.S. 2006 (ms. 1/06). *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas*. University of North Carolina Herbarium, Chapel Hill. 1026 pp.

Weber, C.A. 1920. Die mesophilen Straussgraswiesen der Marschen im Mittellaufe der Weser. Mit vergleichenden Ausblicken auf andere Pflanzenvereinen und Lebensgemeinshcaften. Ein Beitrag zur Kenntnis der Grasflur der Wesermarschen. *Abhandlungen - Naturwissenschaftlicher Verein zu Bremen* 25: 1-63.

Weber, E. 2003. *Invasive Plant Species of the World: A Reference Guide to Environmental Weeds*. CABI Publishing, Wallingford, England, U.K. 548 pp.

Weiller, C.M., M.J. Henwood, J. Lenz and L. Watson. 1995– . Pooideae (Poaceae) in Australia (ms.). http://biodiversity.uno.edu/delta/pooid/www/ [accessed 12/2003].

Welch, D. 1985. Studies in the grazing of heather moorland in north-east Scotland. IV. Seed dispersal and plant establishment in dung. *Journal of Applied Ecology* 22: 461-472.

Welsh, S.L., N.D. Atwood, S. Goodrich and L.C. Higgins, eds. 1993. *A Utah Flora*, 2nd Ed. Brigham Young University, Provo. 986 pp.

Whalley, K.A., M.S.I. Khan and A.D. Bradshaw. 1974. The potential for evolution of heavy metal tolerance in plants. I: Copper and zinc tolerance in *Agrostis tenuis*. *Heredity* 32: 309-319.

White, D.B., and M.H. Smithberg. 1980. Cold acclimation and deacclimation in cool-season grasses. Pp. 149-154 in *Proceedings of the Third International Turfgrass Conference: Sponsored by the International Turfgrass Society, July 11-13, 1977, Munich, West Germany* (ed. J.B. Beard). ASA, CSSA, SSSA and ITS, Madison, Wisconsin.

White, E.G. 1991. The changing abundance of moths in a tussock grassland, 1962-1989, and 50- to 70-year trends. *New Zealand Journal of Ecology* 15: 5-22.

White Jr., J.F., and D.A. Chambless. 1991. Endophyte–host associations in forage grasses. XV. Clustering of stromata-bearing individuals of *Agrostis hyemalis* infected by *Epichloë typhina*. *American Journal of Botany* 78: 527-533.

White Jr., J.F., P.M. Halisky, S. Sun, G. Morgan-Jones and C.R. Funk Jr. 1992. Endophyte–host associations in grasses. XVI. Patterns of endophyte distribution in species of the tribe Agrostideae. *American Journal of Botany* 79: 472-477.

Widén, K.-G. 1971. The Genus *Agrostis* in Eastern Fennoscandia. Taxonomy and Distribution. Flora Fennica 5: 1-209.

Wiinstedt, K. 1929. Floriskiske Meddelelser: Graes-hybrider i Danmark. *Botanisk Tidsskrift* 41: 424-439.

Wilcox, A. 1998. Early plant succession on former arable land. *Agriculture, Ecosystems and Environment* 69: 143-157.

Wilkinson, J.F., and J.B. Beard. 1972. Electrophoretic identification of *Agrostis palustris* and *Poa pratensis* cultivars. *Crop Science* 12: 833-834.

Williams, A., N. Reed, J. Popenoe and D. Roja. 2000. *FY2000 Progress Report: Exotic Plant Management*. Division of Resource Management and Science, Redwood National and State Parks, Orick, California. 10 pp.

Williams, E.D. 1970. Studies on the growth of seedlings of *Agropyron repens* (L.) Beauv. and *Agrostis gigantea* Roth. *Weed Research* 10: 321-330.

Williams, E.D. 1973a. A comparison of the growth and competition behaviour of seedlings and plants from rhizomes of *Agropyron repens* (L.) Beauv. and *Agrostis gigantea* Roth. *Weed Research* 13: 422-429.

Williams, E.D. 1973b. Seed germination of *Agrostis gigantea* Roth. *Weed Research* 13: 310-324.

Williams, E.D. 1975. Growth of seedlings of *Agropyron repens* (L.) Beauv. and *Agrostis gigantea* Roth in cereal crops. *Weed Research* 15: 299-306.

Williams, E.D. 1977. Growth of seedlings of *Agropyron repens* (L.) Beauv. and *Agrostis gigantea* Roth in wheat and barley: Effect of time of emergence, nitrogen supply and cereal seed rate. *Weed Research* 17: 69-76.

Williams, E.D. 1978. Germination and longevity of seeds of *Agropyron repens* (L.) Beauv. and *Agrostis gigantea* Roth in soil in relation to different cultivation regimes. *Weed Research* 18: 129-138.

Williams, W.M. 1996. Genetic resources of temperate native and low-input grasses in New Zealand and Australian collections. *New Zealand Journal of Agricultural Research* 39: 513-526.

Wilson, A.M., and K. Thompson. 1989. A comparative study of reproductive allocation in 40 British grasses. *Functional Ecology* 3: 297-302.

Wilson, J.B. 1988. The cost of heavy-metal tolerance: An example. *Evolution* 42: 408-413.

Wilson, J.B., and G.L. Rapson. 1995. The genetics of naturalization: A comparison of morphological variation within and between populations of *Agrostis capillaris* L. as an exotic in New Zealand and as a native in Britain. *New Zealand Journal of Ecology* 19: 195-202.

Wilson, M.V., C.A. Ingersoll, M.G. Wilson and D.L. Clark. 2004. Why pest plant control and native plant establishment failed: A restoration autopsy. *Natural Areas Journal* 24: 23-31.

Winkler, E., D. Prati and M. Peintinger. 2003. Clonal plants in lake-shore grasslands under flood stress: A 15-year study at Lake Constance plus simulation modelling. Page 83 in *7th Clonal Plant Workshop: Reproductive Strategies, Biotic Interactions and Metapopulation Dynamics, 1-5 August 2003, Kuusamo, Finland*.

Wipff, J.K., and C. Fricker. 2001. Gene flow from transgenic creeping bentgrass (*Agrostis stolonifera* L.) in the Willamette Valley, Oregon. *International Turfgrass Society Research Journal* 9: 224-242.

Wipff, J.K., and C. Rose-Fricker. 2000. Determining gene flow of transgenic creeping bentgrass and gene transfer to other bentgrass species. *Diversity* 16(1&2): 36-39.

Wipff, J.K., and C. Rose Fricker. 2001. Tracking the pollen of transgenic bentgrasses. *Golf Course Management* 69(5): 53-57.

Wolters, M., and J.P. Bakker. 2002. Soil seed bank and driftline composition along a successional gradient on a temperate salt marsh. *Applied Vegetation Science* 5: 55-62.

Wolters, M., A. Garbutt and J.P. Bakker. 2005. Plant colonization after managed realignment: The relative importance of diaspore dispersal. *Journal of Applied Ecology* 42: 770-777 + Appendix S1 & Figure S1.

Woodward, F.I., C. Körner and R.C. Crabtree. 1986. The dynamics of leaf extension in plants with diverse altitudinal ranges. I. Field observations on temperature responses at one altitude. *Oecologia* 70: 222-226.

Wright, A.G. 1980. Amenity grass seed production in practice. *Grassland Research and Practice Series* 1: 31-33.

Wu, L. 1976. Esterase isoenzymes in populations of *Agrostis stolonifera* L. *Botanical Bulletin of Academia Sinica* 17: 175-184.

Wu, L. 1981. The potential for evolution of salinity tolerance in *Agrostis stolonifera* L. and *Agrostis tenuis* Sibth. *New Phytologist* 89: 471-486.

Wu, L., and J. Antonovics. 1975. Zinc and copper uptake by *Agrostis stolonifera*, tolerant to both zinc and copper. *New Phytologist* 75: 231-237.

Wu, L., and A.D. Bradshaw. 1972. Aerial pollution and the rapid evolution of copper tolerance. *Nature* 238: 167.

Wu, L., and D.R. Huff. 1983. Characteristics of creeping bentgrass clones (*Agrostis stolonifera* L.) from a salinity-tolerant population after surviving drought stress. *HortScience* 18: 883-885.

Wu, L., A.D. Bradshaw and D.A. Thurman. 1975. The potential for evolution of heavy metal tolerance in plants. III. The rapid evolution of copper tolerance in *Agrostis stolonifera*. *Heredity* 34: 165-178.

Wu, L., X. Guo and S.G. Banuelos. 1997. Accumulation of seleno-amino acids in legume and grass plant species grown in selenium-laden soils. *Environmental Toxicology and Chemistry* 16: 491-497.

Xie C.-Y., Shang Y.-S., Tang C.-B. and Mo Z.-P. 2003. Survey and evaluation of the germplasm resources of wild bentgrass (*Agrostis*) species in Guizhou. *Journal of Mountain Agriculture and Biology* 22: 23-26.

Xiao, L., and S.-B. Ha. 1997. Efficient selection and regeneration of creeping bentgrass transformants following particle bombardment. *Plant Cell Reports* 16: 874-878.

Xing, J., T. Gianfagna and B. Huang. 2005. Transgenic bentgrasses with the *ipt* gene for increased cytokinin biosynthesis. Page 21 in *Proceedings of the Fourteenth Annual Rutgers Turfgrass Symposium, Cook College, January 13-14, 2005* (eds. D. Giménez and B. Fitzgerald). Rutgers University, New Brunswick, New Jersey.

Xu, Q., and B. Huang. 2001. Morphological and physiological characteristics associated with heat tolerance in creeping bentgrass. *Crop Science* 41: 127-133.

Yamamoto, I., and J.M. Duich. 1994. Electrophoretic identification of cross-pollinated bentgrass species and cultivars. *Crop Science* 34: 792-798.

Yatskievych, G. 1999. *Steyermark's Flora of Missouri*, Rev. Ed., Vol. 1. *Agrostis* L. (bent grass) (pp. 623-629). Missouri Department of Conservation, Jefferson City, and Missouri Botanical Garden Press, St. Louis.

Ye, Z.H., Z.-Q. Lin, S.N. Whiting, M.P. de Souza and N. Terry. 2003. Possible use of constructed wetland to remove selenocyanate, arsenic, and boron from electric utility wastewater. *Chemosphere* 52: 1571-1579.

Yu, T.T., D.Z. Skinner, G.H. Liang, H.N. Trick, B. Huang and S. Muthukrishnan. 2000. *Agrobacterium*-mediated transformation of creeping bentgrass using GFP as a reporter gene. *Hereditas* 133: 229-233.

Zabalgogeazcoa, I., B.R. Vázquez de Aldana, A. García Ciudad and B. García Criado. 2003. Fungal endophytes in grasses from semi-arid permanent grasslands of western Spain. *Grass and Forage Science* 58: 94-97.

Zedler, J.B., and S. Kercher. 2004. Causes and consequences of invasive plants in wetlands: Opportunities, opportunists, and outcomes. *Critical Reviews in Plant Sciences* 23: 431-452.

Zedler, P.H., and C. Black. 2004. Exotic plant invasions in an endemic-rich habitat: The spread of an introduced Australian grass, *Agrostis avenacea* J.F. Gmel., in California vernal pools. *Austral Ecology* 29: 537-546.

Zenbayashi, K., H. Koga, T. Enomoto, F. Akiyama and T. Tsukiboshi. 1996. *Acremonium* endophytes found in *Agrostis clavata* Trin., *A. clavata* Trin. subsp. *matsumurae* Tateoka and *Poa trivialis* L. in Japan. *Annals of the Phytopathological Society of Japan* 62: 281-282.

Zhao, H., S.S. Bughrara and J.A. Oliveira. 2006. Genetic diversity in colonial bentgrass (*Agrostis capillaris* L.) revealed by *Eco*RI-*Mse*I and *Pst*I-*Mse*I AFLP markers. *Genome* 49: 328-335.

Zhong, H., C. Srinivasan and M.B. Sticklen. 1991. Plant regeneration via somatic enbryogenesis in creeping bentgrass (*Agrostis palustris* Huds.). *Plant Cell Reports* 10: 453-456.

Zhong, H., M.G. Bolyard, C. Srinivasan and M.B. Sticklen. 1993. Transgenic plants of turfgrass (*Agrostis palustris* Huds.) from microprojectile bombardment of embryogenic callus. *Plant Cell Reports* 13: 1-6.

Zhong, H., C.-A. Liu, J.M. Vargas Jr., D. Penner and M.B. Sticklen. 1998. Simultaneous control of weeds, dollar spot and brown patch diseases in transgenic creeping bentgrass. Pp. 203-210 in M.B. Sticklen and M.P. Kenna, eds., *Turfgrass Biotechnology: Cell and Molecular Genetic Approaches to Turfgrass Improvement*. Ann Arbor Press, Chelsea, Michigan.

Table 1. Summary on *Agrostis* (31-35 spp.) and *Polypogon* (8 spp.) in USA and Canada (5/31/2006)
(see "White Paper: Perspective on Creeping Bentgrass, *Agrostis stolonifera* L." – USDA/APHIS/BRS, B. MacBryde)

The species are numbered in alphabetical order, so for example the number 30 = *Agrostis stolonifera*. See also Figure 1, and Table 2 for further information.

ORIGIN or INTEGRATION IN FLORA, and USE (O/I, U): Nv = Native, **Nz** = Naturalized, **I** = Introduced, extent of naturalization unknown; **A** = Agronomic.

NATIVE RANK (Master *et al*. 2000); in taxon's native range**: G1** = critically rare; **G2** = rare; **G3** = vulnerable; **G4** = apparently secure; **G5** = widespread, abundant and secure; **T** (trinomial) = ranking for a botanical variety or subspecies; **Q** = a question (problem) in taxonomy (TNC/NatureServe 2002, ranks in brackets by APHIS/BRS).

WEED CONCERN IN COUNTRY: S = Serious, **P** = Principal, **C** = Common, **X** = Behaves as weed, importance unknown (Holm *et al.* 1979, *A Geographical Atlas of World Weeds*); **H&S:** Häfliger & Scholz 1981, *Grass Weeds 2*; and these **additional references for *Agrostis stolonifera*: Serious** – Australia pastures and/or crops (*e.g.* Brown & James 1998), **Moderate invasive** threat – California coast in wetlands (Dudley 1998); **and for *Polypogon monspeliensis*: Troublesome** – California (Zedler & Kercher 2004).

HYBRIDS: F1 = F_1 with sterility/fertility not reported; **f** = fertile (without details), **s** = sterile, **v** = variable in crossing or in reports (perhaps sterile and low or higher fertilities).

Species (Taxa)	Common Names	O/I, U	Distribution in USA & Canada	Native Rank	Weed Concern	Hybrids With Other Species / Comments on Taxonomy &/or Range	Hybrids With *A. stolonifera*
1 *Agrostis aequivalvis* (Trinius) Trinius	Arctic or Northern Bentgrass	Nv	AK to OR; Canada (BC)	G5?		Syn. of *Podagrostis aequivalvis per* Soreng *et al*. 2003, FNA 2005. Intergrades with 18 (Harvey 2004).	
2 *Agrostis anadyrensis* Soczava	Anadyr Bentgrass	Nv	AK?	[G4?]			
3 *Agrostis avenacea* J.F. Gmelin	Pacific Bentgrass, Fairy Blowngrass	Nv?, Nz	Nv? HI, Nz CA, TX, SC, OH	[G4G5]	Invasive in California vernal pools (Zedler & Black 2004)	Syn. of *Lachnagrostis filiformis per* Soreng *et al*. 2003, FNA 2005. Nv Australasia, New Guinea, perhaps Easter Island, HI	
4 *Agrostis blasdalei* A.S. Hitchcock	Blasdale's or Cliff Bentgrass	Nv	CA endemic	**G2**		F1 with 10 (Harvey 2004). Incl. *A. blasdalei* var. *marinensis per* Harvey 1993, 2004 & CNPS 2001, 2005, but not Gov. California.	
5 *Agrostis canina* Linnaeus	Velvet Bentgrass	Nz, **A**	HI, OR, MN, MI, ME to TN; Canada (BC & E)	G5	C (Finland, Russia); **in H&S**	sF1 with 21, and with 34	vF1; rare?
6 *Agrostis capillaris* Linnaeus	Colonial (or Rhode Island) Bentgrass, Browntop	Nz, **A**	Most E & W states but few in midcontinent; Canada	[G5]	P (Chile, NZ, Russia), C, X; **in H&S**	vF1 & **vF2** with 7, and with 13; F1 with 8 and probably 14; F1 s? with 34	vF1; frequent?
7 *Agrostis castellana* Boissier & Reuter	Dryland (incl. Highland) Bentgrass	(Nz), **A**	WA, OR, CA, AL, many states?; Canada?	[G5]	X (Australia, NZ, Portugal)	Confounded with 6, *q.v.* (& Table 2)	vF1; infreq.?
8 *Agrostis clavata* Trinius	Clubbed Bentgrass	Nv	AK; Canada (Yukon)	G4G5	C (Japan)	F1 with 6 and 29	
9a *Agrostis clivicola* Crampton var. *clivicola*	Coastal Bluff Bentgrass	Nv	CA endemic	**G3?T3?Q**		Syn. of 10 *per* Harvey 1993, 2004, but not Kartesz 2006	
9b *Agrostis clivicola* var. *punta-reyesensis* Crampton	Point Reyes Bentgrass	Nv	CA endemic	**G3?T1Q**		Syn. of 10 *per* Harvey 1993, 2004, FNA 2005, but not Kartesz 2006	
10 *Agrostis densiflora* Vasey	Dense-flowered Bentgrass	Nv	CA-OR	G3G4		F1 with 4 (Harvey 2004); F1? with 12 (Carlbom 1967, p. 88).	
11 *Agrostis elliottiana* J.A. Schultes	Elliott's Bentgrass	Nv	Mainly S & mid-latitude US (FL-PA-KS to CA, & MA, ME)	G5			
12 *Agrostis exarata* Trinius	Spike Bentgrass	Nv	Mostly W US (including HI), also KY, VT; W Canada	G5	C (Japan)	F1? with 10; F1 with 13? (Welsh *et al*. 1993) & 29	sF1 with 30?
13 *Agrostis gigantea* Roth	Redtop, Black Bentgrass	Nz, **A**	All states (including HI); Canada	[G5]	C, X (Australia, Canada, NZ); **in H&S**	vF1 & **vF2** with 6 (occasional?); sF1 with 21 (rare?); 13 or perhaps 30 (*i.e., A.s. s.l.*) F1 with 12 (Welsh *et al*. 1993; *cf*. Harvey 2004).	vF1; occasional?
14 *Agrostis hallii* Vasey	Hall's Bentgrass	Nv	CA-OR, & WA?	G4G5		fF1 with 25; and F1 with probably 6	

15 *Agrostis hendersonii* A.S. Hitchcock	Henderson's Bentgrass	Nv	CA-OR	[**G2?**]		Incl. *A. aristiglumis* (endemic CA); perhaps 15 & 22 related or one sp. (Harvey 2004; Beetle 1945).	
16 *Agrostis hooveri* Swallen	Hoover's Bentgrass	Nv	CA endemic	[**G2**]			
17 *Agrostis howellii* Scribner	Howell's Bentgrass	Nv	OR endemic	**G2**		Also WA? (FNA 2006 draft map).	
18 *Agrostis humilis* Vasey	Mountain or Alpine Bentgrass	Nv	W US (AK to NM); W Canada	[G5]		Syn. of *Podagrostis humilis per* Soreng *et al*. 2003, FNA 2005. Incl. *A. thurberiana* (W US, Can.) *per* Harvey 2001, FNA 2005 (but not Harvey 1993, Welsh *et al*. 1993 *q.v.*, or [as *P. thurberiana*] Soreng *et al*. 2003; *cf*. Biek 2000). Intergrades with #1 (Harvey 2004).	
19 *Agrostis hyemalis* (Walter) Britton, Sterns & Poggenburg	Winter Bentgrass	Nv	E US; PR; E Canada (Ontario)	G5			
20 *Agrostis idahoensis* Nash	Idaho Redtop or Bentgrass	Nv, (**A**)	W US; W Canada	[G5?]		Hybrid origin? (Welsh *et al*. 1993).	F1
21 *Agrostis mertensii* Trinius	Northern or Arctic Bentgrass	Nv	AK-CO, ME-NY, WV & TN to SC; Canada	G5		F1 with 34; sF1 with 5, and 13 (rare?).	F1; rare
22 *Agrostis microphylla* Steudel	Small-leaved Bentgrass	Nv	WA to CA & NV; Canada (BC)	G4		Perhaps 15 conspecific (Harvey 2004).	
23 *Agrostis nebulosa* Boissier & Reuter	Cloudgrass	I, (Nz)	Nz in CA, OH, perhaps elsewhere	[G3G4]		Nv Iberian Peninsula	
24 *Agrostis oregonensis* Vasey	Oregon Redtop or Bentgrass	Nv	W US (CA to WY & AK); W Canada	G4			
25 *Agrostis pallens* Trinius	Leafy or Dune Bentgrass, Seashore Bentgrass	Nv	CA to WA & MT, MA; W Canada	[G4G5]		fF1 with 14. Incl. *A. diegoensis* (*cf*. Harvey 1993, 2001; Biek 2000).	F1
25A *Agrostis pauzhetica* Probatova	Thermal Bentgrass	Nv	CA & WY	[**G1G2**]		Tercek 2005 (= "thermal *A. scabra*"); also Russia (Kamchatka Peninsula) (Kharkevich *et al*. 1985).	
26 *Agrostis perennans* (Walter) Tuckerman	Upland Bentgrass, Autumn Bentgrass	Nv	E US, OR & CA, & WA?; E Canada	G5		Incl. *A. altissima* per Kartesz 2006, FNA 2005, but not Weakley 2006	
27 *Agrostis rossiae* Vasey	Ross' Bentgrass	Nv	WY endemic	**G1**			
28 *Agrostis sandwicensis* Hillebrand	Hawaii Bentgrass	Nv	HI endemic	**G3**			
29 *Agrostis scabra* Willdenow	Rough Bentgrass, Ticklegrass	Nv	All states but HI?; Canada	G5		F1 with 8, 12 and 32; and F1? (≈ 20) with 33 (Welsh *et al*. 1993).	F1
30 *Agrostis stolonifera* Linnaeus	**Creeping, Spreading, Carpet, and Marsh Bentgrass**	**Nz, Nv?, A**	**Nz all states, Nv? few N states; also Nz, Nv? in Canada**	**G5**	**C, X; in H&S; Serious (Australia), Mod. (CA, OR?, HI?)**	**F1 with 10-11 other *Agrostis* spp. and 3 *Polypogon* spp.; vF1, vF2; common?**	
31 *Agrostis tandilensis* (Kuntze) Parodi	Kennedy's Bentgrass	Nz	CA	G3G5		Syn. of *Bromidium tandilense per* Soreng *et al*. 2003, FNA 2005; Nv Argentina, Uruguay, S Brazil	
32 *Agrostis trinii* Turczaninow	Trinius' Bentgrass	Nv	AK	[G5?]		F1 with 29; syn. of 34 *per* Kartesz 2006, FNA 2005, but not Tzvelev 1983 [1976], Probatova 1984 *etc*., Kharkevich *et al*. 2003 [1985], Koyama 1987	F1
33 *Agrostis variabilis* Rydberg	Alpine or Mountain Bentgrass	Nv	W US; W Canada (BC, AB)	G5		F1? (≈ 20) with 29 (Welsh *et al*. 1993)	

34 *Agrostis vinealis* Schreber	Brown Bentgrass	Nz, Nv	Nz several states?, Nv AK; Canada?	G5?		F1 with 21; F1 s? with 6; sF1 with 5	vF1; rare?
Table 1 Subpart. *Polypogon* and ×*Agropogon* (*Agrostis* × *Polypogon*) Intergeneric Hybrids (see Table 2)							
1P *Polypogon australis* Brongniart	Chilean Beardgrass	Nz	AZ, UT?, NV?, CA, OR?, WA?			Nv South America	
2P *Polypogon elongatus* Kunth	Streambank Beardgrass	Nz	CA, AZ, CO, TX	[G5]		Nv Mexico to Uruguay	
3P *Polypogon fugax* Nees ex Steudel	Asian Beardgrass, Hill Rabbitsfoot-grass	(I?)	HI, CA & OR (old reports)	[G5]		Nv Iraq to Burma	F1 (×*Agropogon*)
4P *Polypogon imberbis* (Philippi) Johow	Short-haired Beardgrass	Nz	CA?			Nv South America	
5P *Polypogon interruptus* Kunth	Ditch Beardgrass	Nv	Mainly W US (incl. HI), LA, WI, NY; Canada (BC)	[G5]		Nv USA to Argentina	
6P *Polypogon maritimus* Willdenow	Mediterranean Beardgrass	Nz	CA, NV, UT, NM, SC, GA, FL			Nv Mediterranean region	
7P *Polypogon monspeliensis* (Linnaeus) Desfontaines	Annual Rabbitsfoot-grass	Nz	Most states (incl. AK, HI); Canada	[G4G5]	**In H&S**; Among most troublesome (CA wetlands)	F1 with 8P; Nv S Europe to Turkey	vF1; infreq.? (×*Agropogon*)
8P *Polypogon viridis* (Gouan) Breistroffer	Water Beardgrass, Beardless Rabbitsfoot-grass	Nz	Mostly W (incl. HI), CT, NJ, VA, SC; PR; Canada (BC)	[G5?]	C (Portugal, Egypt, Iraq), X (NZ); **in H&S**	F1 with 7P; Nv S Europe to Pakistan	sF1; rare? (×*Agropogon*)

Table 2. Details on Some *Agrostis* and *Polypogon* in USA and Canada, and Their Hybrids (5/31/2006)
(see section 1.7, Table 1 and Figure 1 of "White Paper: Perspective on Creeping Bentgrass, *Agrostis stolonifera* L." – USDA/APHIS/BRS, B. MacBryde)

***Agrostis* Species** (some synonyms), [subg. *Agrostis* incl. section, or subg. *Zingrostis*]; **also Bigeneric Hybrids**	**USA; and Nativity (Native Range)**	**Species, Bigeneric Hybrids: Ploidy and Genomic Details** (main cytotype bolded)	**Natural Hybrids: Parents of Crosses**	**Natural or Spontaneous Hybrids: Country of Occurrence Reported** ("spontaneous" hybrids have naturalized parents)	**Experimental Hybrids: Cross in Greenhouse, or by Spontaneous Pollen Flow in Field Test** (analysis **K**aryological, **T**ransgenic, or **O**ther)	**Hybrids: Ploidy and Genome, Information About Sexual Reproduction; Comments** (not indicating direction of cross, *i.e.* which species was female parent, which male)
30 ***A. stolonifera*** (*A. alba* of some authors, but not Linnaeus; *A. alba* var. *palustris*, *A. stolonifera* var. *palustris*, *A. palustris*; *A. stolonifera* var. *compacta*; *A. stolonifera* var. *maritima*) [Sect. *Vilfa*]; **Creeping Bentgrass**	Naturalized only, or perhaps native at some northern salt marshes and lakesides (but not native in New England). Native Iceland, Eurasia and North Africa.	**2*n* = 4*x* = 28**, $A_2A_2A_3A_3$ (strict allotetraploid – Jones 1956b, 1956c; Warnke *et al*. 1998); also, at least in Europe (Harvey 2004), 2*n* = 5*x* = 35, $A_2A_2A_3A_3A_3$ or $A_2A_2A_2A_3A_3$ and 2*n* = 6*x* = 42, $A_2A_2A_2A_3A_3A_3$ Also aneuploidy (frequent), B-chromosomes, aneusomaty (Björkman 1954, Kik *et al*. 1993, Frey 1997).	30 × 5 (***A.* ×*castriferrei***); 30 × 6 (***A.* ×*murbeckii***); 30 × 7; 30 × 12 (apparently); 30 × 13; 30 × 21; 30 × 32; 30 × 34; 30 × Pf (intergeneric); 30 × Pm (intergeneric); 30 × Pv (intergeneric).	See under the other parental species. Some hybrids are sterile but vegetatively vigorous by stolons or rhizomes (or both).	30 × 5 (T + O); 30 × 6 (T + K); 30 × 7 (T); 30 × 13 (T + K); 30 × 20 (T); 30 × 23 failed (T); 30 × 25 (T); 30 × 29 (T); 30 × *A*. sp. (T); 30 × 32 (T + O); 30 × 34 (K); 30 × Pf (T + O); 30 × Pm (T + O); 30 × Pv (T + O).	See *Agrostis stolonifera* hybrids under the other parental species (listed alphabetically). Reproduction of *Agrostis stolonifera* often mainly vegetative, by stolons (*e.g.* Kik *et al*. 1990b, 1992). Sexual reproduction predominately outcrossing (Davies 1953; Belanger *et al*. 2003b), with some cultivars perhaps obligately so (Warnke *et al*. 1998; *cf*. Belanger *et al*. 2003b). Also highly self-fertile clone, and selfing has been utilized (Warnke *et al*. 1998; Tomić *et al*. 1999). 2*n* = 2*x* = 14 reported by Tomić *et al*. 2003; further taxonomic study may be warranted.
4 ***A. blasdalei*** **Blasdale's or Cliff Bentgrass**	Native California (endemic).	**2*n* = 6*x* = 42** (Harvey 2004).	4 × 10	**4 × 10: USA:** west-central **CA** (Harvey 2004).		
5 ***A. canina*** (*A. canina* var. *fascicularis*; *A. pallida* With., but not DC.) [Sect. *Agrostis*]; **Velvet Bentgrass**	Naturalized. Native Europe into E Asia.	**2*n* = 2*x* = 14**, A_1A_1 Also aneuploidy, possibly polyploidy (4*x*, 5*x*, 6*x*, 8*x*); and B-chromosomes (Romero García & Blanca 1988, Frey 1997).	30 × 5 (***A.* ×*castriferrei***); 5 × 6 & 5 × 13 (both unconfirmed, or error – Widén 1971).	**30 × 5:** Fennoscandia, rare (Widén 1971).	30 × 5: Greenhouse (Belanger *et al*. 2003b; had failed: Davies 1953, Björkman 1954); and transgenic field tests; 5 × 21 (Björkman 1954); 5 × 34 (Davies 1953, Björkman 1954).	**30 × 5** (would be 2*n* = 21, and hybrid name's type unknown, *per* Widén 1971)**:** Confirmation needed *per* Bradshaw 1975a; now transgenic tests: field – Wipff & Fricker 2001, Christoffer 2003, greenhouse – Belanger *et al*. 2003b. **5 × 21:** Certainly sterile (Widén 1971). **5 × 34** (2*n* = 21)**:** Quite sterile (Widén 1971).

6 ***A. capillaris*** (*A. tenuis*; *A. vulgaris*) [Sect. *Vilfa*]; **Colonial Bentgrass (Rhode Island Bentgrass, Browntop)**	Naturalized. Native Eurosiberia.	**2*n* = 4*x* = 28**, $A_1A_1A_2A_2$ (segmental allotetraploid, partly from a 2*x A. canina*-like ancestor – Jones 1956b, 1956c, *cf*. Romero García *et al*. 1988b). Occasional aneuploidy, B-chromosomes (Frey 1997).	30 × 6 (***A. ×murbeckii***); 5 × 6 (unconfirmed, or error – Widén 1971); 6 × 7 (***A. ×fouilladeana***); 6 × 8; 6 × 13 (***A. ×bjoerkmanii***); 6 × 14 (probable); 6 × 34 (***A. ×sanionis***).	**30 × 6:** *e.g.* Fennoscandia (Widén 1971); Germany (Weber 1920); Netherlands (Grootjans *et al*. 1987); UK (Bradshaw 1958, 1975a, *cf*. Smith 1972, Sell & Murrell 1996); Belgium (Meerts & Lefèbvre 1989); France (Fouillade 1933); Spain (Romero García *et al*. 1988b); Portugal? (Hollman *et al*. 2005); **Canada** (Malte 1928, Hinds 1986); **USA: NW?, UT??** (Carlbom 1967, Welsh *et al*. 1993); New Zealand (Edgar & Forde 1991, Edgar & Connor 2000). **6 × 7:** UK (Sell & Murrell 1996); Belgium (Lambinon *et al*. 2004); France (Fouillade 1933); Spain (Romero García *et al*. 1988b, Romero García & Morales Torres 1980); Australia (Batson 1998a); New Zealand (Edgar & Forde 1991, Edgar & Connor 2000). **6 × 8:** Fennoscandia (Widén 1971). **6 × 13:** UK (Bradshaw 1959a, Sell & Murrell 1996); **USA: NE** likely (Stuckey & Banfield 1946, *per* Björkman 1954, Widén 1971, Bradshaw 1975a, Edgar & Forde 1991), **UT?** (Welsh *et al*. 1993). **6 × 14: NW USA?** (Pendergrass 2001). **6 × 34:** UK, Europe, Russia (Widén 1971, Bradshaw 1975a, Sell & Murrell 1996).	30 × 6; 6 × 7 (Edgar & Forde 1991, Rumball & Forde 1977 *per* Batson 1998a); 6 × 13; 6 × 34 (Davies 1953, but probably most were not hybrids *per* Widén 1971).	**30 × 6** (2*n* = 28, $A_1A_2A_2A_3$)**:** Parents readily crossing, with F_1 vegetatively vigorous and widespread, but with high sterility (Bradshaw 1975a, Sell & Murrell 1996); almost wholly abortive pollen, exceptionally a few seeds observed (Widén 1971); semi-fertile in New Zealand, with pollen fertility 41% (Edgar & Forde 1991); suspected U.S. hybrids in OR (Carlbom 1967, p. 39), possibly UT (Welsh *et al*. 1993 treat *A.s. sensu lato,* but Harvey 2004 does not and considers *A.s.* very rare in UT). Transgenic tests: field – Wipff & Fricker 2001, field and greenhouse – Belanger *et al*. 2003a, 2003b. **6 × 7** (some 2*n* = 35)**:** Partially fertile (Sell & Murrell 1996). Backcrossing into #6 in New Zealand (Edgar & Forde 1991, Edgar & Connor 2000). Formerly *Agrostis ×fouilladei*, a *nomen nudum* (Lambinon *et al*. 2004). **6 × 13** (2*n* = 35, $A_1A_1A_2A_2A_3$)**:** Crossing rather readily, including backcrosses and F_2. F_1 vegetatively vigorous, but "infertile" (pollen fertility 45%, seeds 50%). F_2 and backcrosses aneuploid, low vigor (Bradshaw 1975a). Highly sterile (Sell & Murrell 1996). Probable in UT (Welsh *et al*. 1993 treat *A.s. sensu lato,* but *A.s. sensu stricto* is very rare in UT *per* Harvey 2004). **6 × 14:** Probable in OR (K.L. Pendergrass [U.S. FWS], *via* M. Jordan [TNC] 2001 letter to J.L. White [APHIS]). **6 × 34** (2*n* = 28)**:** Unclear facility of crossing in nature and experimentally (readily crossing *per* Harvey 2004); most experimental "hybrids" (Davies 1953, Jones 1956b) likely instead selfs of #34 or #6 (Widén 1971, Bradshaw 1975a). Probably natural hybrids sterile (Widén 1971, Sell & Murrell 1996).
7 ***A. castellana*** [Sect. *Vilfa*]; **Dryland Bentgrass (including Highland Bentgrass)**	Introduced. Native Western Mediterranean.	2*n* = 4*x* = 28, $A_1A_1A_2A_2$ and 2*n* = 6*x* = 42, $A_1A_1A_1A_2A_2A_2$ In Portugal also aneuploidy, B-chromosomes (Frey 1997).	30 × 7; 6 × 7 (***A. ×fouilladeana***).	**Both:** France (Fouillade 1933); **6 × 7:** UK (Sell & Murrell 1996); Belgium (Lambinon *et al*. 2004); Spain (Romero García *et al*. 1988b, Romero García & Morales Torres 1980); Australia (Batson 1998a); New Zealand (Edgar & Forde 1991, Edgar & Connor 2000).	30 × 7 (varied results in transgenic field tests); 6 × 7 (Edgar & Forde 1991, Rumball & Forde 1977 *per* Batson 1998a).	**30 × 7:** Pollen very irregular (Romero García *et al*. 1988b). Transgenic tests: greenhouse and field – Belanger *et al*. 2003a, 2003b, field – Wipff & Fricker 2001, but not Christoffer 2003. **6 × 7** (some 2*n* = 35)**:** Partially fertile (Sell & Murrell 1996). Backcrossing into #6 in New Zealand (Edgar & Forde 1991, Edgar & Connor 2000). Formerly *Agrostis ×fouilladei*, a *nomen nudum* (Lambinon *et al*. 2004).

8 ***A. clavata***; **Clubbed Bentgrass**	**Native** Alaska and Yukon	**2*n* = 6*x* = 42**	6 × 8; 8 × 29	**6 × 8:** Fennoscandia (Widén 1971). **8 × 29:** Russia (Kharkevitch *et al*. 2003 [1985]).		
10 ***A. densiflora***; **Dense-flowered Bentgrass**	**Native** California to Oregon.	**2*n* = 6*x* = 42** (Harvey 1993).	4 × 10; 10 × 12 (perhaps).	**4 × 10: USA:** west-central **CA** (Harvey 2004)	10 × 12 (perhaps, as F_1 seeds not grown out).	**10 × 12:** Good seed set in experimental cross, but the seeds not grown out to confirm, and #10 can self-pollinate (Carlbom 1967, p. 88).
12 ***A. exarata***; **Spike Redtop**, **Spike Bentgrass**	**Native** Far E Siberia and W North America: Alaska–Mexico.	**2*n* =** 4*x* = 28, **6*x* = 42**, and 8*x* = 56 (Harvey 2004, Frey 1997, Taylor & Mulligan 1968).	30 × 12 (apparently); (30? or) 13 × 12; 10 × 12 (perhaps); 12 × 29	**30 × 12: NW USA?** (Carlbom 1967). **(30? or) 13 × 12: USA: UT?** (Welsh *et al*. 1993). **12 × 29: USA: UT?** (Welsh *et al*. 1993).	10 × 12 (perhaps, as F_1 seeds not grown out).	**30 × 12:** Suspected in WA and OR, sterile (Carlbom 1967, pp. 109-110, 112). **(30? or) 13 × 12:** Apparently; Welsh *et al*. 1993 treat *A. stolonifera sensu lato* (as #13 + #30), but Harvey does not and considers *A.s.* very rare in UT. **10 × 12:** Good seed set in experimental cross, but the seeds not grown out to confirm, and #10 can self-pollinate (Carlbom 1967, p. 88). **12 × 29:** Apparently; Welsh *et al*. 1993.
13 ***A. gigantea*** (*A. stolonifera* var. *major*; *A. stolonifera* var. *gigantea*, *A. alba* var. *gigantea*; just *A. stolonifera* or "*A. alba*" for some authors; *A. nigra*) [Sect. *Vilfa*]; **Redtop (Black Bentgrass)**	Naturalized. Native Eurasia (especially Central Asia).	**2*n* = 6*x* = 42**, $A_1A_1A_2A_2A_3A_3$ (Jones 1956c; ancestry perhaps by fusion of $A_1A_2A_3$ gametes of an *A.* ×*murbeckii* – Widén 1971). Also B-chromosomes (Frey 1997), possibly ; *cf*. Hartvig 1991).	30 × 13; 5 × 13 (unconfirmed, or error – Widén 1971); 6 × 13 (***A.* ×*bjoerkmanii***); 6 × 13 (or 30?) (*A.s. s.l.*); 12 × 13 (or 30?) (*A.s. s.l.*); 13 × 21; 13 (or 30?) (*A.s. s.l.*) × 29	**30 × 13, 6 × 13 & 13 × 21:** Fennoscandia (Widén 1971). **30 × 13:** Sweden (Blom 1961 *per* Widén 1971); UK (Davies 1953, Bradshaw 1975a, Sell & Murrell 1996). **6 × 13:** UK (Bradshaw 1959a, Sell & Murrell 1996); **USA: NE** likely (Stuckey & Banfield 1946, *per* Björkman 1954, Widén 1971, Bradshaw 1975a, Edgar & Forde 1991), **UT?** (Welsh *et al*. 1993). **12 × 13 (or 30?): USA: UT?** (Welsh *et al*. 1993).	30 × 13; 6 × 13	**30 × 13** (2*n* = 35, $A_1A_2A_2A_3A_3$)**:** Experimental F_1 cross easy; vegetatively vigorous, but only 25% pollen and seed fertilities (Bradshaw 1975a), or highly or usually sterile (Sell & Murrell 1996, Dore & McNeill 1980, Widén 1971); transgenic tests: field – Wipff & Fricker 2001, Watrud *et al*. 2004, greenhouse – Belanger *et al*. 2003b. **6 × 13** (2*n* = 35, $A_1A_1A_2A_2A_3$)**:** Crossing rather readily, including backcrosses and F_2. F_1 vigorous vegetatively, but "infertile" (pollen fertility 45%, seeds 50%). F_2 and backcrosses aneuploid, low vigor (Bradshaw 1975a). Highly sterile (Sell & Murrell 1996). Probable in UT (Welsh *et al*. 1993 treat *A.s. sensu lato*, but *A.s. sensu stricto* is very rare in UT *per* Harvey 2004). **12 × 13 (or 30?):** Apparently; Welsh *et al*. 1993 treat *A. stolonifera sensu lato* (as #13 + #30), but Harvey 2004 does not and considers *A.s.* very rare in UT. **13 × 21** (2*n* = 49)**:** Probably not easily formed in nature; rare, no pollen or seeds (Widén 1971). **(30? or) 13 × 29:** Apparently; Welsh *et al*. 1993 treat *A. stolonifera sensu lato* (as #13 + #30), but Harvey 2004 does not and considers *A.s.* very rare in UT.

14 ***A. hallii***; **Hall's Bentgrass**	**Native** California and Oregon, and also Washington?	**2*n* = 6*x* = 42** (Harvey 1993).	6 × 14 (probable); 14 × 25 (apparently).	**6 × 14: NW USA?** (Pendergrass 2001). **14 × 25: NW USA?** (Carlbom 1967).		**6 × 14:** Probable in OR (K.L. Pendergrass [U.S. FWS], *via* M. Jordan [TNC] 2001 letter to J.L. White [APHIS]). **14 × 25:** Probable (and fertile) in OR (Carlbom 1967, pp. 98, 126).
20 ***A. idahoensis***; **Idaho Bentgrass, Idaho Redtop**	**Native** Western North America — Alaska to California and New Mexico.	**2*n* = 4*x* = 28** (Harvey 2004).			30 × 20 (transgenic test – Christoffer 2003).	**30 × 20:** Transgenic test: field – Christoffer 2003. (Perhaps "*A. idahoensis*" is not a sp. but varied hybrids, from #12 crossing with #29 and/or each crossing with #33, *per* Welsh *et al*. 1993, but *cf*. Harvey 1993, 2001, 2004.)
21 ***A. mertensii*** (*A. borealis*) [Sect. *Agrostis*]; **Northern or Arctic Bentgrass**	**Native**, somewhat circumpolar, S in mountains.	**2*n* =** 2*x* = 14, 3*x* = 21, 6*x* = 42 (but 6*x* is *A. scabra per* Harvey 2004), 7*x* = 49, and **8*x* = 56**; also aneuploidy (Frey 1997).	30 × 21; 13 × 21; 21 × 34	**All three:** Fennoscandia (Widén 1971).	5 × 21 (Björkman 1954); 21 × 34 (Björkman 1954).	**30 × 21** (2*n* = 42) (Björkman 1954, Widén 1971). **5 × 21:** Certainly sterile (Widén 1971). **13 × 21** (2*n* = 49)**:** Probably not easily formed in nature; rare, no pollen or seeds (Widén 1971). **21 × 34** (2*n* = 42) (Widén 1971).
23 ***A. nebulosa*** [Subg. *Zingrostis*]; **Cloudgrass**	Cultivated; occasional escape, in Ohio established (Harvey 2004). Native Iberian Peninsula.	**2*n* = 2*x* = 14** (Tinney 1936, Romero García & Blanca 1988, Frey 1997).			30 × 23 (no transgenic flow found in field test – Christoffer 2003).	No transgenic flow found (Christoffer 2003).
25 ***A. pallens*** (*A. diegoensis*); **Leafy or Dune Bentgrass**	**Native** Western North America: W BC – Calif., & NV, ID, MT.	**2*n* = 6*x* = 42**, 8*x* = 56 (Harvey 1993, 2004, Frey 1997).	14 × 25	**NW USA?** (Carlbom 1967).	30 × 25 (transgenic test – Wipff & Fricker 2001, Christoffer 2003).	**30 × 25:** Transgenic test: field – Wipff & Fricker 2001, Christoffer 2003. **14 × 25:** Probable (and fertile) in OR (Carlbom 1967, pp. 98, 126).
29 ***A. scabra*** (*A. hyemalis* or "*A. hiemalis*" var. *scabra*); **Rough Bentgrass**, **Ticklegrass**	**Native** Greenland, North America to Mexico and NE Asia.	**2*n* = 6*x* = 42** (Frey 1997).	(30? or) 13 (*A.s. s.l.*) × 29; 8 × 29; 12 × 29; 29 × 32 (***A.* ×*amurensis***).	**(30? or) 13 × 29 & 12 × 29: USA: UT?** (Welsh *et al*. 1993). **8 × 29:** Russia (Kharkevitch *et al*. 2003 [1985]). **29 × 32:** Russia (Probatova & Kharkevich 1983, Kharkevich *et al*. 2003 [1985]).	30 × 29 (transgenic test – Christoffer 2003).	**30 × 29:** Transgenic test: field – Christoffer 2003. **(30? or) 13 × 29:** Apparently; Welsh *et al*. 1993 treat *A. stolonifera sensu lato* (as #13 + #30), but Harvey 2004 does not and considers *A.s.* very rare in UT.
***A.* sp.**	Unknown: from eastern Oregon		30 × *A*. sp.		30 × *A*. sp. (transgenic test – Wipff & Fricker 2001).	Species unidentified (Wipff & Fricker 2001); native or introduced and perhaps naturalized.
32 ***A. trinii*** (*A. vinealis* subsp. *trinii*, *A. coarctata* subsp. *trinii*; *A. flaccida* subsp. *trinii*); **Trinius' Bentgrass**	**Native** E Asia to W Alaska.	**2*n* =** 2*x* = 14, **4*x* = 28** (Frey 1997). Also B-chromosomes (Frey 1997).	30 × 32 (***A.* ×*ussuriensis***); 29 × 32 (***A.* ×*amurensis***).	**30 × 32:** Russia (Probatova 1984, Kharkevich *et al*. 2003 [1985]). **29 × 32:** Russia (Probatova & Kharkevich 1983, Kharkevich *et al*. 2003 [1985]).	30 × 32 (transgenic test – Christoffer 2003).	**30 × 32:** Transgenic test: field – Christoffer 2003. Note: *A trinii* taxonomy unsettled; a synonym of *A. vinealis* in Kartesz 2006, but variously accepted by Koyama 1987 for Japan and several authors for Russia (*e.g.* Tzvelev 1983 [1976], Kurchenko & Ianova 1976, Kurchenko 1979c, Probatova 1984 *etc*., Kharkevich *et al*. 2003 [1985], Malyschev & Peschkova 1990.

34 ***A. vinealis*** (*A. stricta*; *A. canina* subsp. *montana*; *A. canina* var. *arida*; *A. coarctata*) [Sect. *Agrostis*]; **Brown Bentgrass**	Introduced primarily. **Native** Alaska, Eurasia, Greenland.	**2*n* = 4*x* = 28**, $A_1A_1A_2A_2$ or $A_1A_1A_1A_1$ (somewhat as autotetraploid with 2*x A. canina*-like ancestry, or perhaps from cross of 4*x A. canina* [if such] and *A. capillaris* – Jones 1956b, *cf*. Romero García *et al*. 1988b, but the "*A. canina*" ploidy over 2*x* may not be *A. canina* – Romero García & Blanca 1988; *cf*. Vergara & Bughrara 2003).	30 × 34; 6 × 34 (***A. ×sanionis***); 21 × 34	**All three:** Fennoscandia, with 30 × 34 rare (Widén 1971); both **30 × 34** & **6 × 34:** UK (Hubbard 1984, Sell & Murrell 1996).	30 × 34; 5 × 34 (Davies 1953, Björkman 1954); 6 × 34 (Davies 1953, but probably most were not hybrids *per* Widén 1971); 21 × 34 (Björkman 1954).	**30 × 34** (2*n* = 28)**:** Readily crossing *per* Harvey 2004; experimental hybrids completely sterile (Bradshaw 1975a); a few viable seeds (Davies 1953). Björkman 1954 also made a cross of 5*x* #30 and #34. **5 × 34** (2*n* = 21)**:** Quite sterile (Widén 1971). **6 × 34** (2*n* = 28)**:** Unclear facility of crossing in nature and experimentally (readily crossing *per* Harvey 2004); most experimental "hybrids" (Davies 1953, Jones 1956b) likely instead selfs of #34 or #6 (Widén 1971, Bradshaw 1975a). Probably natural hybrids sterile (Widén 1971, Sell & Murrell 1996). **21 × 34** (2*n* = 42) (Widén 1971).

Table 2 Subpart. ×*Agropogon* Intergeneric (*Agrostis* × *Polypogon*) Hybrids, and *Polypogon* Hybrids

Bigeneric Hybrids	Hybrid Range	Hybrid Ploidy	*Polypogon* Species	Hybrids' Reported Occurrence	Experimental Hybrids	Hybrids' Sexual Reproduction; Comments
1AP ***×Agropogon***, (no unique name) *Agrostis stolonifera* × *Polypogon fugax*	Spontaneous if in W USA, but likely not (*cf*. Herbst & Clayton 1998, Barkworth 2004, also Wipff & Fricker 2001).		***Polypogon fugax*** Sp.: 2*n* = 42 (Björkman 1954); native Iraq to Burma; not found in Hawaii since 1916 (Herbst & Clayton 1998), nor in CA or OR for many decades (Barkworth 2004). Intergeneric hybrid (Björkman 1960 *per* Wipff & Fricker 2001) Experimental or perhaps Spontaneous (*i.e.* from introduced parents); transgenic test – Christoffer 2003.			**30 × Pf:** Transgenic field test – Christoffer 2003.
2AP ***×Agropogon lutosus*** (×*A. littoralis*) *Agrostis stolonifera* × *Polypogon monspeliensis*	Spontaneous AL, LA, NM, CA, WA; HI?, many states?; Canada (BC). Native Western Eurasia?	**2*n* = 4*x* = 28** (Tutin 1980, Sell & Murrell 1996).	***Polypogon monspeliensis*** Sp.: 2*n* = 14, 28, 35 & 42 (Barkworth 2004, Giraldo-Cañas 2004, Harvey 1993); native S Europe to Turkey.	UK, France, Spain (Sell & Murrell 1996, Hubbard 1984; Paunero 1953); Canada (BC), **W & SE USA** (Kartesz 2006); Chile (Rúgolo de Agrasar & Molina 1997b); New Zealand (Esler 1988, Edgar & Connor 2000); Australia (Weiller *et al*. 1995-[2003]); China (Qian & Sun 1998).	30 × Pm (transgenic test – Christoffer 2003).	**30 × Pm:** Almost complete pollen and seed sterilities. Vigor varies, perhaps because of hybridization with different ecotypes of #30, which is more vigorous (Bradshaw 1975b; *cf*. Welsh *et al*. 1993). Transgenic field test – Christoffer 2003. **Pm × Pv (*P.* ×*adscendens*):** Occurs naturally in Europe (Barkworth 2004).
3AP ***×Agropogon robinsonii*** *Agrostis stolonifera* × *Polypogon viridis*	Spontaneous several states?. Native Western Eurasia?	**2*n* = 4*x* = 28**	***Polypogon viridis*** (*Agrostis viridis*; *A. semiverticillata*, *P. semiverticillatus*) Sp.: 2*n* = 14, 28 & 42 (Barkworth 2004, Giraldo-Cañas 2004, Harvey 1993); native Eurasia.	UK, rare (Hubbard 1984, Sell & Murrell 1996); **USA: UT?** (Welsh *et al*. 1993).	30 × Pv (transgenic test – Christoffer 2003).	**30 × Pv:** Experimental crossing facility uncertain. Parents highly self-incompatible; hybrid has complete pollen sterility (Bradshaw 1975b, Hubbard 1984). Short-lived perennial (Sell & Murrell 1996). Potentially several states; UT? *per* Welsh *et al*. 1993 who treat *A. stolonifera sensu lato* (as #30 + #13), but Harvey 2004 considers *A.s.* very rare in UT. Transgenic field test – Christoffer 2003. **Pm × Pv (*P.* ×*adscendens*):** Occurs naturally in Europe (Barkworth 2004).

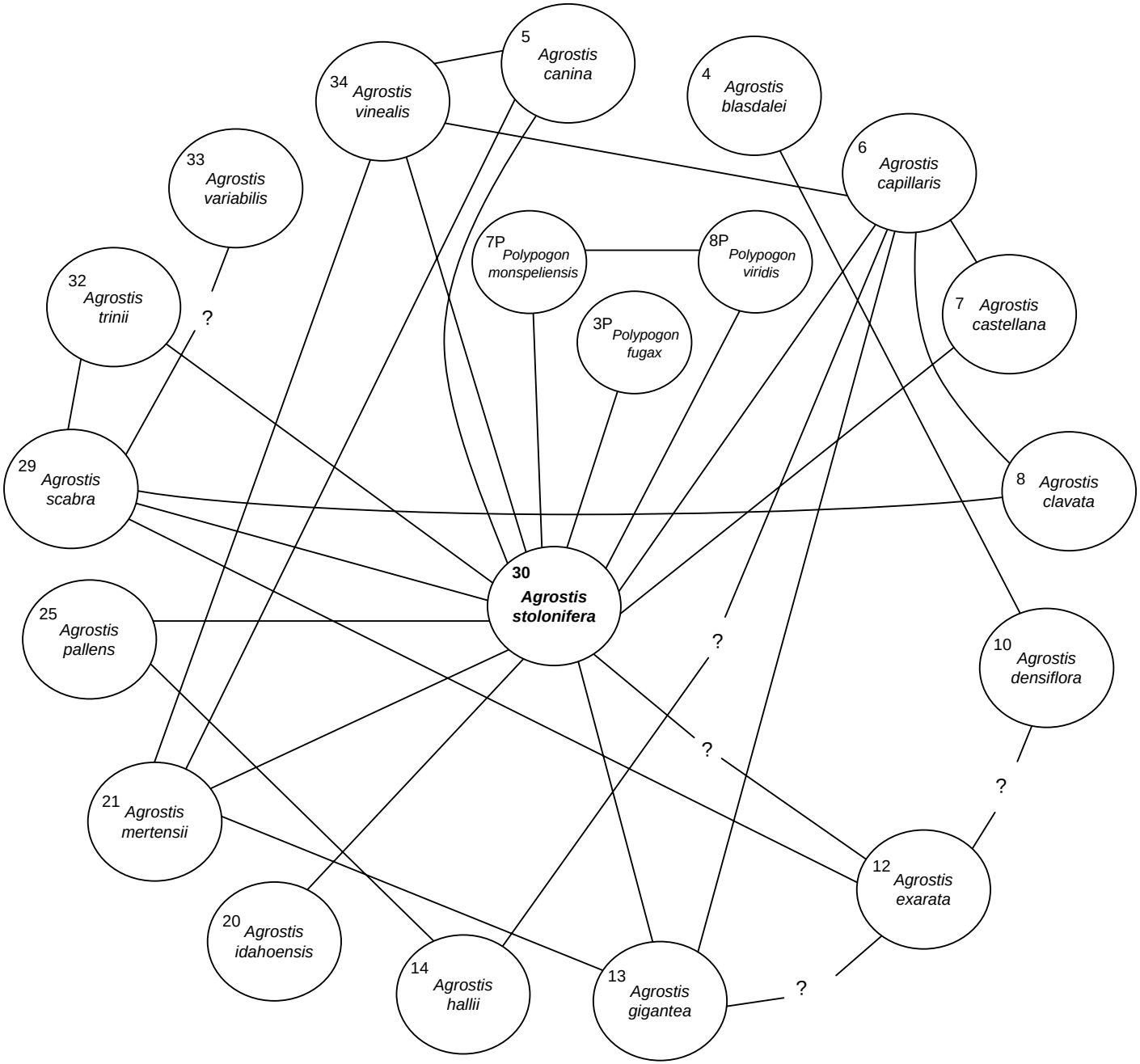

Figure 1. Known natural and/or potentially natural (spontaneous) interspecific crosses among species of *Agrostis* and/or *Polypogon* in the United States and Canada (details in Tables 1 & 2 of "White Paper: Perspective on Creeping Bentgrass, *Agrostis stolonifera* L." – USDA/APHIS/BRS, B. MacBryde, ver. 5/31/2006).

United States Department of Agriculture

Animal and Plant Health Inspection Service

Biotechnology Regulatory Services

Riverdale, Maryland

May 31, 2006