Acknowledgments

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Registration of FC710 (4X) Tetraploid, Multigerm Sugarbeet Germplasm

Sugarbeet (*Beta vulgaris* L.) germplasm FC710 (4X) (Reg. no. GP-239, PI 633733) was developed by the USDA-ARS, Fort Collins, CO, in cooperation with the Beet Sugar Development Foundation, Denver, CO. This line has excellent resistance to root-rotting strains (AG-2-2) of *Rhizoctonia solani* Kühn. It is also resistant to leaf spot (caused by *Cercospora beticola* Sacc). It is released as a tetraploid pollinator, or population from which to select tetraploid pollinators with resistance to rhizoctonia root rot and cercospora leaf spot. FC710 (4X) is released from seed production 20001022 and has also been tested as 971017.

FC710 (4X) is tetraploid ($2n = 4x = 36$), multigerm (*MM*), non-O-type, pseudo-self-fertile, and has 29% green hypocotyls (93 plants counted). It is a colchicine doubled version of FC710 (Hecker and Ruppel, 1991), which was registered in 1991. Performance of FC710 (4X) and FC710 are similar when tested side-by-side for disease resistance. FC 710 (PI 542971) was developed through two cycles of recurrent selection, with progeny tests for rhizoctonia root rot resistance and sucrose yield, and nine cycles of mass selection for rhizoctonia root rot. It is 42% from C817 (synthetic from GW 359), 28% from breeding lines resistant to cercospora leaf spot and black root (caused by *Aphanomyces cochlioides* Drechs.) and 30% from reciprocal hybrids between elite sugarbeet breeding lines and *Beta vulgaris* subspecies *maritima* accessions (i.e., approximately 15% *Beta vulgaris* ssp. *maritima* germplasm). Ninety-one colchicine treated seedlings with thickened or distorted hypocotyls were selected, transplanted, and induced to flower. Pollen from approximately 100 plants was sized to determine ploidy (Hecker, 1988), and seed was harvested individually (mother roots) from 34 tetraploid C_0 plants. Five seeds of each mother plant were planted and induced to flower. Again, pollen was sized to confirm ploidy and 75 tetraploid plants from 28 of the original C_0 mother roots harvested for seed to produce the C_1. The C_1 seed was planted in the greenhouse and pollen sized to confirm ploidy level. The C_2 seed was harvested from 48 tetraploid plants. C_2 seed went through another cycle of seed production and pollen sizing in the greenhouse, 100 plants were grown and 91 plants harvested to produce C_3 seed. This seed was tested in artificially created epiphytotics of rhizoctonia root rot and cercospora leaf spot (Panella, 1998), bulk increased in a field isolation plot in 1997 (180 plants) and again in 2000 (182 plants). The increased seed was tested from 1998 through 2002.

FC710 (4X) exhibited excellent resistance to rhizoctonia root rot when tested under severe disease pressure (Ruppel et al., 1979). FC710 (4X) performance was equal or superior to rhizoctonia-resistant checks in disease index (DI) ratings in 2000 and 2002 (DI of 0 = no root rot and 7 = all plants dead). FC710 (4X) performed significantly better than the susceptible check (FC901/C817). FC710 (4X) had mean DIs of 3.6 and 2.4 (2000 and 2002), whereas the highly resistant check (FC705/1) had DIs of 3.1 and 1.7, respectively. Percentages of resistant plants (those rated 0 or 1) were 0 and 31 for FC710 (4X); and 13 and 58 for the highly resistant check. FC710 (4X) also exhibited moderate resistance to cercospora leaf spot when tested in an artificial epiphytotic (Ruppel and Gaskill, 1971). In tests from 1999 and 2000, it was significantly better than the susceptible control and not significantly different from the resistant control. The following DI ratings (DI of 0 = no leaf spot and 10 = all plants dead) represent the most severe rating (last of three or four ratings each season). In 1999 and 2000, DIs of FC710 (4X) were 3.3 and 2.7; DIs of the resistant control (FC504CMS/FC502-2//SP6322-0) were 2.7 and 2.3; DIs of the susceptible control (SP351069-0) were 6.3 and 3.7, respectively. FC710 (4X) does not have tolerance to the *Beet curly top virus* and has never been tested for resistance to black root.

In 2002, FC710 (4X) was tested for agronomic quality. One-row plots, replicated six times, were planted at the USDA-ARS Crops Research Lab-Fort Collins Research Farm, CO, on 3 May. Plots were 3.04 m long with 56 cm between rows and 20 to 25 cm within-row spacing. Roots were harvested on 8 October and sent to the tare lab of Western Sugar Co. (Scotts Bluff, NE) for analyses. The average value of three commercial varieties (Beta 6045, HM1955, and Monohikari) was used as a standard for comparison. In percentage sucrose, FC710 (4X) was 92.2% of the standard, and in sugar loss to molasses, FC710 (4X) was 118.2% of the standard.

Breeder seed of FC710 (4X) is maintained by USDA-ARS and will be provided in quantities sufficient for reproduction upon written request to Lee Panella (lpanella@lamar.colostate.edu), Sugarbeet Research, USDA-ARS, Crops Research Laboratory, 1701 Center Ave., Fort Collins, CO 80526-2083. Seed of this release has been deposited in the National Plant Germplasm System where it will be available for research purposes, including development and commercialization of new cultivars. We request that appropriate recognition be made of the source when this germplasm contributes to a new cultivar. U.S. Plant Variety Protection will not be requested for FC710 (4X).

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Registration of CP03, CP04, CP05, and CP06 Sugarbeet Germplasms with Resistance to Powdery Mildew, Rhizomania, and Other Diseases

Sugarbeet (*Beta vulgaris* L.) germplasm lines CP03 (Reg. no. GP-240, PI 632284), CP04 (Reg. no. GP-241, PI 632285), CP05 (Reg. no. GP-242, PI 632286), and CP06 (Reg. no. GP-243, PI 632287) were developed by the USDA-ARS in cooperation with the Beet Sugar Development Foundation (BSDF) and the California Beet Growers Association. They were released in 2003.

CP03 and CP04 are multigerm (*MM*), self-sterile (S^sS^s), germplasm lines that segregate for resistance to powdery mildew (*Pm*) (Lewellen & Schrandt, 2001; Janssen et al., 2003) [caused by *Erysiphe polygoni* DC. (syn. *E. betae* Weltzien)] and rhizomania (*Rz1*) (Lewellen et al., 1987) [caused by *Beet necrotic yellow vein virus* (BNYVV)]. CP03 and CP04 have identical developmental histories except for the *B. vulgaris* subsp. *maritima* source of resistance to powdery mildew. Resistance within CP03 is from WB97 (PI 546394) and CP04 is from WB242 (PI 546413). Through the BC_3F_1 generation, CP03 was the same as CP01 (PI 610490) and CP04 as CP02 (PI 610491) (Lewellen, 2000). For the fourth backcross, C78/3 (PI 628752) (Lewellen, 2004) was used. For backcrosses five and six, C37 (PI 590715) (Lewellen et al., 1985) was again used as the recurrent parent. Theoretically, CP03 and CP04 would have approximately 87% of their germplasm from C37, 12% from C78/3, and 1% from the wild beet source of resistance to powdery mildew. Starting from the BC_4F_1 generations, in general, individual plants were selected from the backcross families for resistance to powdery mildew and rhizomania and pair-crossed in the greenhouse to the recurrent parent. For the BC_6F_1 families, individual pair-crosses were evaluated in the field at Salinas in a March planting under natural powdery mildew and rhizomania infected conditions. Individual plants from within these families were selected in November for high resistance to both powdery mildew and rhizomania and for nonbolting. Within sets of families from each source of resistance, selected plants were combined and increased in mass to produce BC_6F_2 populations released as CP03 and CP04. CP03 is from seed lot P227 and had been developed and tested as lines P327, P127, P027, P917, and P815. CP04 is from seed lot P228 and had been developed and tested as lines P328, P128, P028, P918, and P816. Other than for powdery mildew and rhizomania, disease resistance and agronomic traits of CP03 and CP04 should be similar to C37, but in the BC_6F_1 families, obvious, visual differences were evident. Segregation for annualism and *B. vulgaris* subsp. *maritima* coloring patterns still occurred. In addition, in tests in Brawley, CA, CP04 was more resistant to rhizomania under high temperature conditions than CP03 or C78/3 and appeared to be tolerant to phytotoxemia from the feeding of leafhoppers [*Empoasca fabae* (Harris) and *E. solana* DeLong], retaining its canopy longer in a full, dark green condition. In preliminary tests, CP04 appeared to segregate for partial resistance to sugarbeet cyst nematode (*Heterodera schachtii* Schmidt). In the BSDF nursery near Kimberly, ID, CP03 and CP04 were slightly more susceptible to *Beet curly top virus* (BCTV) than C37. In tests at Salinas in 2003, they had similar reactions to *Beet chlorosis virus* (BChV) and *Erwinia carotovora betavasculorum* Thomsen et al. and for bolting tendency. CP03 and CP04 should be useful as enhanced sources of resistance to powdery mildew found in *B. vulgaris* subsp. *maritima* and for genetic and plant pathological research.

CP05 and CP06 are multigerm (*MM*), self-sterile (S^sS^s) germplasm lines that segregate for resistance to powdery mildew (*Pm*) and rhizomania (*Rz1*). CP05 and CP06 have identical developmental histories except for the *B. vulgaris* subsp. *maritima* source of resistance to powdery mildew. Resistance within CP05 is from WB97 and CP06 is from WB242. Through the BC_3F_2 generation, CP05 was the same as CP01 (PI 610490) and CP06 as CP02 (PI 610491). From backcross four through seven, the recurrent parent for CP05 and CP06 was C78/3. Usually, the lines were advanced from seed produced on C78/3 or from reciprocal pairs that had identical appearance in field plots. Starting from the BC_3 generations, in general, individual plants were selected from the backcross families for resistance to powdery mildew and rhizomania and pair-crossed under paper bags in the greenhouse to C78/3. For the BC_7F_1 families, individual pair-crosses were evaluated in the field at Salinas in a March planting under natural powdery mildew and rhizomania infected conditions. Individual plants from within these families were selected in November for high resistance to powdery mildew, resistance to rhizomania, and for nonbolting. Within sets of families from each source of resistance, selected plants were combined and increased in mass to produce the BC_7F_2 populations released as CP05 and CP06. CP05 is from seed lot P229 and had been developed and tested as lines P329, P129, P029, P919, and P809. CP06 is from seed lot P230 and had been developed and tested as lines P330, P130, P030, P920, and P810. In addition to powdery mildew resistance conditioned by *Pm*, CP05 and CP06 likely have the moderate slow-mildewing type of resistance derived from C78/3, in contrast to CP03 and CP04. The other disease resistance and agronomic traits of CP05 and CP06 should be similar to C78/3, but obvious visual differences remain. Up through BC_7F_1 families, annualism and coloring patterns of *B. vulgaris* subsp. *maritima* lines WB97 and WB242 still occurred. CP05 and CP06 appeared to be moderately resistant to BCTV but slightly more susceptible than C78/3. They had similar reactions as C78/3 to BChV and sugarbeet *Erwinia*. CP05 and CP06 should be useful as enhanced sources of resistance to powdery mildew originally found in *B. vulgaris* subsp. *maritima* and for genetic and plant pathological research.

Breeder seed is maintained by the USDA-ARS and will be provided to sugarbeet researchers in quantities adequate for reproduction, upon request to the author (rlewellen@pw.ars.usda.gov). U.S. Plant Variety Protection will not be requested for CP03, CP04, CP05, and CP06.

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