

**Registration of FC720, FC722, and FC722CMS
Monogerm Sugarbeet Germplasms Resistant to
Rhizoctonia Root Rot and Moderately Resistant to
Cercospora Leaf Spot**

Sugarbeet (*Beta vulgaris* L.) germplasms FC720, FC722, and FC722CMS (Reg. no. GP-250, GP-251, GP-251cms; PI 636335, PI 636336, PI 636337) were developed by the USDA-ARS, at Fort Collins, CO, in cooperation with the Beet Sugar Development Foundation (BSDF), Denver, CO. FC720 and FC722 have good resistance to root-rotting strains (AG-2-2) of *Rhizoctonia solani* Kühn and good to moderate resistance to Cercospora leaf spot (caused by *Cercospora beticola* Sacc.), but are not resistant to the *Beet curly top virus* (BCTV). FC720 and FC722 are populations from which to select Rhizoctonia and Cercospora resistant, monogerm, O-type parents to infuse some rhizoctonia and leaf spot resistance on the female side of hybrids, and FC722CMS provides a CMS female with these characteristics. FC720 is released from Fort Collins seed production 20001017, FC722 from 19961010HO, and FC722CMS from 19961010HO1.

FC720 is an O-type germplasm with 73% green (*rr*) hypocotyls (26 plants counted) and is segregating for monogermity (*mm*) and self-sterility (*S^s*). FC722 is an O-type germplasm with 15% green hypocotyls (*rr*) (59 plants counted) and is segregating for monogermity (*mm*) and self-sterility (*S^s*). Both germplasms have 'FC708' (PI 590845) (Hecker and Ruppel, 1981), a rhizoctonia- and cercospora-resistant monogerm O-type release from the Fort Collins program as one parent. The other parent, 'C718' (PI 590849) (Lewellen et al., 1978), is a germplasm released from the USDA-ARS sugarbeet improvement program in Salinas, CA, and is moderately susceptible to virus yellows, moderately resistant to bolting, and moderately resistant to BCTV; it has very good combining ability for root and gross sugar yield.

FC720 is a product of six generations of mass selection for rhizoctonia resistance among the progeny of the cross C718 × (C718 × FC708). The initial population had 25% of its genes from FC708 and 75% from C718. The smallest population size was 13 plants. FC722 is a product of six generations of cyclic mass selection for rhizoctonia root rot resistance among the progeny of the cross C718 × FC708. The initial population had 50% of its genes from FC708 and 50% from C718. The smallest population size was 13 plants. FC722CMS is the genetic-cytoplasmic male sterile equivalent of FC722 backcrossed nine times. The original cross was C718CMS × FC708. It was backcrossed continually to the populations, from which FC722 was derived, and went through five generations of cyclic mass selection for rhizoctonia root rot resistance.

FC720, FC722, and FC722CMS exhibited good resistance to rhizoctonia root rot when tested under strong disease pressure (Ruppel et al., 1979). FC720, FC722, and FC722CMS's performance was equal to the rhizoctonia-resistant check in disease index (DI) ratings (DI of 0 = no root rot and 7 = all plants dead), except in 1999 when FC722CMS was significantly less resistant than the resistant check (FC703, PI 590656; Hecker and Ruppel, 1977), but significantly more resistant than the susceptible check (FC901/C817). FC720, FC722, and FC722CMS always performed significantly better than the susceptible check. FC720 had mean disease indices (DIs) of 4.1, 4.0, and 1.7 (1999-2001, respectively), whereas the resistant check had mean DIs of 3.8, 3.8, and 2.6 and the susceptible check had mean DIs of 5.9, 5.5, 4.6. FC722 had mean DIs of 4.0, 4.2, and 2.4; and FC722CMS had mean DIs of 4.6,

4.2, and 2.4. Percentages of resistant plants (those rated 0 or 1) were 8, 3, and 47 for FC720; 6, 0, and 17 for FC722; 2, 0, and 13 for FC722CMS; 22, 13, and 98 for the highly resistant check (FC705/1, PI 590754; Hecker and Ruppel, 1985); 12, 3, and 21 for the resistant check and 0, 0, and 3 for the susceptible check (1999-2001), respectively.

FC720, FC722, and FC722CMS also exhibited resistance to cercospora leaf spot when tested in an artificial epiphytotic (Ruppel and Gaskill, 1971). In 3 yr of tests (1998, 1999, 2002), they were significantly better than the susceptible check and not significantly different from the resistant check, except for FC722, which had significantly less resistance than the resistant check in 1999. 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). The DIs of FC720, FC722, and FC722CMS, respectively, were 3.2, 3.7, and 3.7; 3.8, 3.7, and 4.0; 3.7, 3.7, and 4.0; DIs of the resistant check (FC504CMS/FC502-2//SP6322-0) were 2.8, 2.7, and 3.7; DIs of the susceptible check (SP351069-0) were 5.8, 6.3, and 5.0 (in 1998, 1999, and 2002, respectively). FC720, FC722, and FC722CMS did not show tolerance to the BCTV, even though the parent line, C718, was moderately BCTV-resistant.

In 2002, FC720, FC722, and FC722CMS were planted on 3 May in one-row plots, replicated six times at the USDA-ARS Fort Collins Research Farm. 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 Western Sugar Co. tare lab in Scottsbluff, NE, for analyses. The average sucrose concentration and sugar loss to molasses of three commercial varieties—Beta 6045, HM1955, and Monohikari—was used as a standard for comparison. Sucrose concentrations of FC720, FC722, and FC722CMS, respectively, were 86.0, 70.2, and 76.3% of the standard, and in sugar loss to molasses, FC720, FC722, and FC722CMS were 113.3, 114.9, and 123.7%, respectively, of the standard.

Breeder seed of FC720, FC722, and FC722CMS is maintained by USDA-ARS and will be provided in quantities sufficient for reproduction upon written request to Sugarbeet Research, USDA-ARS, Crops Research Laboratory, 1701 Center Ave., Fort Collins, CO 80526-2083. Seed of this release will be deposited in the National Plant Germplasm System where it will be available for research purposes, including development and commercialization of new varieties and 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 FC720, FC722, or FC722CMS.

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