as germplasm sources for further improvements and as sources of combined disease and bolting resistance in highly productive backgrounds. They need to be evaluated as early generation lines for the potential development of pollinators for commercial hybrids. U.S. Plant Variety Protection will not be sought for these lines.

Breeder seed is maintained by the USDA-ARS and will be provided to sugarbeet researchers in quantities adequate for reproduction, on request to the author (rlewellen@pw.ars.usda.gov or rtlewellen@hotmail.com).

R.T. LEWELLEN*

Acknowledgments

The technical assistance of J.A. Orozco, D.L. Lara, and D. Puga, and data analysis by L.C. Wing are gratefully acknowledged. The assistance of Dr. S.R. Kaffka and G.R. Peterson with VY inoculated progeny tests at U.C., Davis is also acknowledged.

References

Lewellen, R.T. 2000. Registration of rhizomania resistant sugarbeet × *Beta vulgaris* subsp. *maritima* germplasms C26, C27, and C51. Crop Sci. 40:1513–1515.

USDA. ARS, National Genetic Resources Program. 1993. Germplasm Resources Information Network-(GRIN). [Online Database] National Germplasm Resources Laboratory, Beltsville, Maryland. Available: http://www.ars-grin.gov/cgi-bin/npgs/html/acc_search.pl?accid = C918; verified 30 July 2003.

USDA-ARS, U.S. Agric. Res. Stn., Crop Improvement and Production Res., 1636 E. Alisal St., Salinas, CA 93905. Cooperative investigations by the USDA-ARS, the Beet Sugar Development Foundation, and the California Beet Growers Association. Registration by CSSA. Accepted 30 June 2003. *Corresponding author (rlewellen@pw.ars.usda.gov or rtlewellen@hotmail.com).

Published in Crop Sci. 44:359–361 (2004).

Registration of FC724 Monogerm, O-Type, Sugarbeet Germplasm

Sugar beet (*Beta vulgaris* L.) germplasm FC724 (Reg. no. GP-228, PI 632251) was developed by the USDA-ARS, Fort Collins, CO, in cooperation with the Beet Sugar Development Foundation, Denver, CO. FC724 has high 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 is *Beet curly top virus* (BCTV) susceptible. FC724 was developed as a population from which to select monogerm O-type parental lines with enhanced Rhizoctonia resistance. There is no CMS equivalent. FC724 was released in 2003 from seed production 19961014.

FC724 is an O-type germplasm with 12% green hypocotyls (14/116 plants) and is segregating for monogerm (*mm*). It is a product of nine generations of cyclic mass selection for resistance to Rhizoctonia root rot and two cycles of recurrent selection for general combining ability. The approximate genetic contribution of the parents to the original population was 20% 611100-0, 17% FC 601/2, and 63% FC 702 (Hecker and Gaskill, 1972). The original crosses were FC 702 (Hecker and Gaskill, 1972) by selfed progeny lines from FC 601/2 and from 611100-0. Breeding line 611100-0 was developed through a polycross of several BCTV and leaf spot resistant lines: SLC122-0, US22/3 (PI 590708; Murphy et al., 1948), US201 (PI 590678), US22/4 (SL92 = PI 610266; Coons et al., 1955), SL202 (F_2 of US35/2 × US22/4). FC601/2 consisted of selected progeny lines from SL202 × SLC122-0. Because the original crosses were made to male-sterile plants (genetic male sterility-*aa*), it is possible that FC724 is segregating for genetic male sterility, but no male sterile-plants were observed in the last seed production.

Testcross hybrids were produced with Fort Collins breeding lines to test for general combining ability in 1974 and 1977. Remnant, selfed seed from superior lines was recombined after each cycle of testing. The population has gone through nine cycles of selection in the USDA-ARS Rhizoctonia nursery at Fort Collins (Panella, 1998), has been O-type indexed to remove restorer genes, and has been selected for monogerm seed throughout the development process. The smallest population size was 19 plants.

FC724 exhibited excellent resistance to Rhizoctonia root rot when tested under strong disease pressure (Ruppel et al., 1979). FC724's performance was not significantly different from the highly resistant check (FC 705/1) (Hecker and Ruppel, 1985) in disease index (DI) ratings from 1998 through 2001, respectively (DI of 0 = no root rot and 7 = all plants dead). FC724 performed significantly better than the susceptible check (FC901/C817) (Gaskill et al., 1967). FC724 had mean disease indices (DIs) of 2.3, 3.1, 3.1, and 1.7 (1998–2001, respectively), whereas the highly resistant check had DIs of 2.7, 3.3, 3.1, and 1.6, respectively. Percentages of resistant plants (those rated 0 or 1) were 47, 16, 5, and 52 for FC724; 33, 22, 13, and 53 for the highly resistant check and 12, 12, 3, and 44 for the resistant check (FC 703) (Hecker and Ruppel, 1977), (1998–2001, respectively).

FC724 also exhibited resistance to Cercospora leaf spot when tested in an artificial epiphytotic (Ruppel and Gaskill, 1971). In 2 yr of tests, it was significantly better than the susceptible check and not significantly different from the resistant check in 1 yr and had significantly less resistance than the resistant check in the other. 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 FC724 were 4.0 and 3.2; DIs of the resistant check (FC504CMS/FC502-2//SP6322-0) (Coe and Hogaboam, 1971; Smith and Gaskill, 1979) were 2.8 and 2.9; DIs of the susceptible check (SP351069-0) were 6.5 and 5.8, respectively. FC724 does not show tolerance to the BCTV.

In 2002, FC724 was planted in one-row plots, replicated six times at the USDA-ARS Fort Collins Research Farm, on May 3. Plots were 3.04 m long with 56 cm between rows and 20 to 25 cm within-row spacing. Roots were harvested on October 8 and sent to the Western Sugar Co. tare lab in Scotts Bluff, NE, for analyses. The average sucrose concentration and sugar loss to molasses of three commercial varieties—Beta 6045, HM1955, Monohikari—was used as a standard for comparison. Sucrose concentration of FC724 was 96.3% of the standard, and in sugar loss to molasses, FC724 was 97.9% of the standard.

Breeder seed of FC724 is maintained by USDA-ARS and, for at least 5 yr, will be provided in quantities sufficient for reproduction on written request to Sugar Beet 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 is available for research purposes, including development and commercialization of new lines or cultivars. The developing organizations request appropriate recognition of the source when this germplasm contributes to a new cultivar. U.S. Plant Variety Protection will not be requested for FC724.

L. PANELLA* AND L.E. HANSON

References

Coe, G.E., and G.J. Hogaboam. 1971. Registration of sugarbeet parental line SP 6322–0. Crop Sci. 11:947.

Coons, G.H., F.V. Owen, and D. Stewart. 1955. Improvement of the sugar beet in the United States. Adv. Agron. 7:89–139.

Gaskill, J.O., C.L. Schneider, A.M. Murphy, and G.E. Coe. 1967. Breeding for combined resistance to leaf spot and curly top in sugar beet. J. Am. Soc. Sugar Beet Technol. 14:518–537.

Hecker, R.J., and J.O. Gaskill. 1972. Registration of FC 701 and FC 702 sugarbeet germplasm. Crop Sci. 12:400.

Hecker, R.J., and E.G. Ruppel. 1977. Registration of diploid and tetraploid FC 701/4 and FC 703 sugarbeet germplasm. Crop Sci. 17:678.

Hecker, R.J., and E.G. Ruppel. 1985. Registration of Rhizoctonia root rot resistant sugarbeet germplasms FC 701/6, FC 702/7, and FC 705/1. Crop Sci. 25:374.

Murphy, A.M., F.V. Owens, and G.K. Ryser. 1948. New sugar beet strains from U.S. 22 with higher curly-top resistance. Proc. Am. Soc. Sugar Beet Technol. 5:179–180.

Panella, L. 1998.Screening and utilizing *Beta* genetic resources with resistance to *Rhizoctonia* root rot and *Cercospora* leaf spot in a sugar beet breeding program. p. 62–72. *In* L. Frese et al. (ed.) Int. *Beta* Genetic Resources Network. A report on the 4th Int. *Beta* Genetic Resources Workshop and World *Beta* Network Conf., Izmir, Turkey. 28 Feb.–3 Mar. 1996. International Crop Network Series No. 12, Int. Plant Genetic Resources Inst, Rome.

Ruppel, E.G., C.L. Schneider, R.J. Hecker, and G.J. Hogaboam. 1979. Creating epiphytotics of *Rhizoctonia* root rot and evaluating for resistance to *Rhizoctonia solani* in sugarbeet field plots. Plant Dis. Rep. 63:518–522.

Ruppel, E.G., and J.O. Gaskill. 1971. Techniques for evaluating sugarbeet for resistance to *Cercospora beticola* in the field. J. Am. Soc. Sugar Beet Technol. 16:384–389.

Smith, G.A., and J.O. Gaskill. 1979. Registration of six sugarbeet germplasm lines. Crop Sci. 19:131.

USDA-ARS, Crops Research Lab., 1701 Center Ave., Fort Collins, CO 80526-2081. A joint contribution of USDA-ARS and the Beet Sugar Development Foundation. Registration by CSSA. Accepted 31 May 2003. *Corresponding author (lpanella@lamar.colostate.edu).

Published in Crop Sci. 44:361–362 (2004).

Registration of T589 and T2100 Sunflower Germplasms with Modified Tocopherols

Two sunflower (*Helianthus annuus* L.) germplasms were jointly developed and released by the Institute for Sustainable Agriculture (CSIC) and the Center of Agricultural Research and Development (CIFA-Junta Andalucía) at Córdoba, Spain, in 2001. T589 (Reg. no. GP-271, PI 632415) has an increased level of β tocopherol in the seed oil. T2100 (Reg. no. GP-272, PI 632416) has an increased level of γ tocopherol in the seed oil. Oil from seeds of cultivated sunflower has no less than 90% of the total tocopherols in the α tocopherol form, which has the lowest antioxidant property of the tocopherols (Demurin et al., 1996). More than 30% of the total tocopherols in the oil of T589 are in the β tocopherol form, whereas more than 85% of the total tocopherols in the oil of T2100 are in the γ tocopherol form. Both traits are associated with improved oxidative stability of the seed oil.

T589 was initially selected from PI 307937, a selection of 'Peredovik' originally collected from the National Institute of Agricultural Research, Madrid, Spain, in 1965, in which seeds with an increased β tocopherol content were identified after nondestructive analysis of half seeds for tocopherol content (Goffman et al., 1999). Fifteen seeds with an α tocopherol content between 647.9 and 862.8 mg kg^{-1} in the oil and a β tocopherol content between 407.9 and 593.4 mg kg^{-1} in the oil were identified after the analysis of 100 seeds of PI 307937. The other 85 seeds had predominantly α tocopherol, with a maximum β tocopherol content of 64.3 mg kg^{-1} in the oil. All the seeds with an increased β tocopherol content produced plants that expressed the character uniformly, with the β tocopherol content ranging from 339.9 to 542.3 mg kg^{-1} in the oil. T589 was developed by bulking an equal number of seeds from these plants. The germplasm was multiplied during the 2000 and 2001 growing seasons, during which the increased levels of β tocopherol were consistently expressed. Crosses of T589 with the standard line HA 89 produced F_1 seeds with a standard tocopherol profile, and F_2 progenies that segregated in a three standard to one increased β tocopherol ratio, indicating that increased β tocopherol content is controlled by a recessive allele at a single locus. T589 has a plant height of 125.6 ± 3.9 cm, a 1000-seed weight of 57 ± 3 g, a seed oil content of 386 ± 21 g kg^{-1}, and flowers 78.3 ± 1.1 d after planting. Plants are nonbranched.

T2100 was a selection from CO-77-256, an old accession of Peredovik from the germplasm collection of the Institute for Sustainable Agriculture at Córdoba. Single-seed analyses for tocopherol content in CO-77-256 identified six seeds with an α tocopherol content ranging from 56.3 to 93.2 mg kg^{-1} in the oil and a γ tocopherol content varying from 919.9 to 1069.4 mg kg^{-1} in the oil. The remaining seventy-two seeds of CO-77-256 had predominantly α tocopherol, with a maximum γ tocopherol content of 101.3 mg kg^{-1} in the oil. All the seeds with an increased γ tocopherol content produced plants that expressed the character uniformly, with a γ tocopherol content ranging from 1051.7 to 1123.5 mg kg^{-1} in the oil. T2100 was developed by bulking an equal number of seeds from plants having increased γ tocopherol content. Similar levels of γ tocopherol were observed in seeds of T2100 when the germplasm was multiplied during the 2000 and 2001 growing seasons. Crosses of T2100 with HA 89 produced F_1 seeds with a standard tocopherol profile, and F_2 progenies that segregated in a three standard to one increased γ tocopherol ratio, revealing that the increased levels of γ tocopherol are controlled by a recessive allele at a single locus. T2100 has a plant height of 101.2 ± 5.0 cm, a 1000-seed weight of 42 ± 2 g, a seed oil content of 400 ± 18 g kg^{-1}, and flowers 74.6 ± 1.2 d after planting. Plants are non-branched.

Sunflower germplasms with tocopherol profiles similar to T589 and T2100 have been reported by Demurin et al. (1996). They developed two inbred lines, LG 15 derived from an open-pollinated cultivar VNIIMK 8931 with a β tocopherol level comprising 50% of the total tocopherol content, similar to T589, and LG 17 derived from the Russian germplasm accession VIR 44 with a γ tocopherol level comprising 95% of the total tocopherol content, similar to T2100. A comparative evaluation of T589, T2100, LG 15, and LG 17 has not been conducted.

Because tocopherols are fat soluble compounds, they act as natural antioxidants of fats and oils (Kamal-Eldin and Appelqvist, 1996). Both β and γ tocopherol exhibit an increased in vitro antioxidant effect compared to α tocopherol (Pongracz et al., 1995). Therefore, T589 and T2100 can be used for developing sunflower lines with improved oxidative stability of the oil. They are also useful for basic and applied research on plant tocopherols. Breeder seed of T589 and T2100 will be maintained by the CSIC and will be provided on request to the senior author. Appropriate recognition is requested if these germplasms contribute to the development of new breeding lines or hybrids. U.S. Plant Variety Protection will not be requested for T589 and T2100.

L. Velasco,* J.Domínguez, and J.M. Fernández-Martínez