

Notice of Release of **FC721** and **FC721CMS** Sugarbeet Germplasms

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
WASHINGTON, DC
AND
BEET SUGAR DEVELOPMENT FOUNDATION
DENVER, COLORADO

SUGARBEET (*Beta vulgaris* L.) germplasms FC721 (Reg. no. GP- , PI 594910) and FC721CMS (Reg. no. GP- , PI 594911) were developed by the USDA-ARS in cooperation with the Beet Sugar Development Foundation. They were released in 1996 from seed productions 931005HO and 931005HO1. These germplasms were released as sources of resistance to root-rotting strains of *Rhizoctonia solani* Kühn and incorporate moderate tolerance to the curly top virus and leaf spot caused by *Cercospora beticola* Sacc.

FC721 is a diploid, monogerm, O-type, self-fertile (S^f), sugarbeet germplasm resistant to root and crown rot caused by *R. solani* AG-2-2. It is relatively homogenous, easy bolting, and moderately tolerant to the curly top virus and *Cercospora* leaf spot caused by *Cercospora beticola* Sacc. FC721 segregates for hypocotyl color (39% *rr*) and genetic male sterility (*aa*). It is the O-type (maintainer line) of its CMS equivalent, FC721CMS, which is the BC₁₀ with C718CMS (1) as the nonrecurrent parent. One parental component of FC721 was a population developed from selected S₁ plants crossed to FC701 (2). The S₁ progeny were from populations that had been developed (in the early 1950s), selected, recombined, and reselected from a number of curly top and leaf spot resistant sources that included SLC122-0, US 22/3 (3), US 22/4 (4), US 201 (5), SL 202, and US 35/2. The parent derived from these S₁ selections x FC701 segregated for genetic male sterility. Twenty-three male-sterile plants were pollinated by 13 fertile plants from C718 (1) to produce the F₁ from which FC721 was selected. C718 from the USDA-ARS sugarbeet breeding program in Salinas, CA is bolting resistant, moderately resistant to curly top, and has good combining ability for root and sucrose yield (1). The female parent combined sources of resistance to *Rhizoctonia* root rot, *Cercospora* leaf spot, and curly top virus.

F₂ plants were selfed in the greenhouse and O-type indexed. Twenty-five O-type, S₁ plants were bulk increased in the greenhouse. The resulting population underwent five cycles of mass selection for resistance to *Rhizoctonia* root rot concurrent with three cycles of mass selection for monogerm seedballs. The smallest population size during this selection process was nine plants.

In a 1994 replicated field evaluation for resistance to *R. solani* at Fort Collins, CO (6), FC721 and FC721CMS were not significantly different from each other or from the resistant check, but were significantly more resistant than the susceptible check. FC721 and FC721CMS had mean disease indices (DIs) of 1.8 and 2.3, compared with 1.8 and 4.9 for the resistant (FC703) and susceptible (FC901/C817//413) checks, respectively (DI of 0 = no root rot and 7 = all plants dead). Percentages of

resistant plants (those rated 0 or 1) were 36, 36, 60, and 5 for FC721, FC721CMS, and the resistant and susceptible checks. The 1994 epiphytotic was severe and an excellent test of resistance to *Rhizoctonia* root rot. In the more moderate 1995 epiphytotic, DIs of 1.7, 1.7, 1.8, and 3.4 for FC721, FC721CMS, resistant and susceptible checks were obtained. Percentages of healthy plants (those rated 0 or 1) were 45, 43, 58 and 7 for FC721, FC721CMS, resistant check, and susceptible check, respectively. ([Table 1](#))

FC721 and FC721CMS were tested in 1994 and 1995 in the Beet Sugar Development Foundation's curly top nursery in Kimberly, ID. Under the severe epiphytotic of 1994, FC721 and FC721CMS performed intermediately -- significantly poorer than the resistant control (Beta G6040), but significantly better than the susceptible control (FC718). FC721 and FC721CMS had mean DIs of 7.2 and 6.8, compared with 5.2 and 8.3 for the resistant and susceptible checks, respectively [Mumford's classification: 0 (= healthy) to 9 (= plant dead)]. In the more moderate 1995 epiphytotic, FC721 was not significantly different from the resistant check and FC721CMS was intermediate. FC721 and FC721CMS had mean DIs of 4.3 and 4.7, compared with 3.8 and 6.3 for the resistant and susceptible checks (L609), respectively. ([Table 1](#))

FC721 and FC721CMS also show some resistance to *Cercospora* leaf spot when tested in an artificial epiphytotic (7). When tested in the mild epiphytotic of 1994, they were not significantly better than the susceptible control (SP351069-0) or significantly different from the resistant control (FC504CMS/FC502-2//SP6322-0). In 1995, which was more severe than 1994, FC721 and FC721CMS were intermediate in resistance (significantly different from both resistant and susceptible controls) with mean DIs of 4.5 and 4.7, compared with 3.5 and 6.2 for the resistant and susceptible checks (L609), respectively. ([Table 1](#))

General combining ability of FC721 has not been tested. FC721 is proposed for use as an O-type population, with multiple disease resistance from which to select O-type monogerm parents for use in commercial three-way resistant hybrids.

Seed of FC721 and its CMS equivalent is maintained by the USDA-ARS and will be provided in quantities sufficient for reproduction upon written request to the corresponding author. We request that an appropriate recognition be made of the source when this germplasm contributes to the development of a new cultivar.

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References and Notes

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Table 1. These germplasms were tested in artificial epiphytotics of curly top virus (Kimberly, ID), *Rhizoctonia* root rot (Fort Collins, CO), and *Cercospora* leaf spot (Fort Collins, CO) for 2 yr.

Designation	Source	Curly Top		Leaf Spot		Rhizoctonia					Rhizoctonia				
		1994	1995	1994	1995	1994					1995				
		DI ^a 2nd	DI 2nd	DI ^b 3rd	DI 3rd	DI ^c	% Hlthy ^d	% Hrvst ^e	Z% ^f Hlthy	Z% Hrvst	DI	% Hlthy	% Hrvst	Z% Hlthy	Z% Hrvst
	LSD ^g	0.94	0.87	0.56	0.67	0.8			15.86	14.47	0.80			14.92	15.35
FC721	931005HO	7.2	4.3	4.3	4.5	1.8	35.73	100.00	33.38	90.00	1.7	45.49	98.82	41.97	87.19
FC721CMS	931005HO1	6.8	4.7	3.5	4.7	2.3	35.66	91.39	33.50	77.20	1.7	43.23	100.00	38.39	90.00
Beta G6040	94A068	5.2	3.8												
FC718	911032	8.3	5.5												
L609 (french)	941002		6.3												
Leaf Spot Resistant Check ^h				3.3	3.5										
Leaf Spot Susceptible Check ⁱ				4.5	6.2										
Highly Resistant Check ^j						1.4	64.92	100.00	54.16	90.00	1.4	58.42	100.00	53.09	90.00
Resistant Check ^k						1.8	59.52	93.33	50.80	83.00	1.8	44.07	97.71	38.39	84.47
Susceptible Check ^l						4.9	4.51	40.32	7.72	39.24	3.4	7.06	83.92	9.82	69.71

^aDisease Index is based on Mumford's Classification: 0 (= healthy) to 9 (= plant dead)

^bDisease Index is based on a scale of 0 (=healthy) to 9 (= plant dead).

^cDisease Index is based on a scale of 0 (=healthy) to 7 (= plant dead).

^dPercent of healthy roots (disease classes 0 and 1 combined).

^ePercent of harvestable roots (disease classes 0 through 3 combined).

^fPercentages were transformed to arcsin-square roots to normalize the data for analyses.

^g=0.05

^h((FC:504CMS x FC:502/2) x SP6322-0)

iSP351069-0

jFC705/1

kFC703

lFC901/C817//413

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