SUGAR BEET (*Beta vulgaris* ssp. *vulgaris*)
    Beet curly top; *Beet curly top virus*

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Beet curly top resistance in USDA-ARS Ft. Collins germplasm, 2016.

Fifty-one sugar beet germplasm produced by the USDA-ARS Ft. Collins sugar beet program and three commercial check cultivars [SV2012RR (susceptible), HM PM90 and Beta G6040 (resistant)] were screened for resistance to *Beet curly top virus* (BCTV). The curly top evaluation was conducted at the USDA-ARS North Farm in Kimberly, ID which has Portneuf silt loam soil and had been in barley in 2015. The field was plowed in the fall and in the spring, it was fertilized with 90 lb of N and 110 lb of P_2O_5 per acre and roller harrowed on 4 Apr. The germplasm was planted at the rate of 142,560 seeds/A on 16 May. The plots were two rows 10 ft long with 22-in row spacing and arranged in a randomized complete block design with four replications. The field was sprinkler irrigated, cultivated, and hand weeded as necessary. Plant populations were thinned to about 47,500 plants/A on 16 Jun. Plants were inoculated at the four- to six-leaf growth stage on 20 Jun with approximately six viruliferous (contained at least the following BCTV strains: Cal/Logan, CO, Severe, and Worland) beet leafhoppers per plant. The beet leafhoppers were redistributed three times a day during the first two days and then twice a day for five more days by dragging a tarp through the field. The plants were sprayed on 30 Jun with Lorsban 4E (1.5 pints/A) to kill the beet leafhoppers. Plots were rated for foliar symptom development on 13 Jul using a scale of 0 to 9 (0 = healthy and 9 = dead), with the scale treated as a continuous variable (Plant Dis. 90:1539-1544). Data were analyzed in SAS using the general linear models procedure (Proc GLM), and Fisher's protected least significant difference (LSD; α = 0.05) was used for mean comparisons.

Curly top symptom development was uniform and no other disease problems were evident in the plot area. The resistant and susceptible checks performed as expected for the visual ratings. Based on the visual rating, seven entries (1, 14, 15, 32, 40, 44, and 51) were not significantly different from the resistant check. The germplasm will be retested and, if resistance is confirmed, they may be incorporated into the USDA-ARS germplasm improvement program as sources of resistance to BCTV. These results and germplasm will be accessible to interested parties through the USDA-ARS, NPGS GRIN database (http://www.ars-grin.gov/npgs/index.html).

Entry[z]	Source	Description[y]	Curly top rating[x]
1	**1996A008**	**Beta G6040 - Resistant Check**	**3.6 v**
CH6	**HM PM90**	**Resistant check**	**3.6 uv**
44	20151019	20141011MS - B.I. hs LSR Sucrose$_{MM}$ x PI 535833 (Saturn)	4.0 t-v
15	20121013PF	FC221-1; RhzcR, RhzmR, MM, CTR, LSR	4.2 t-v
14	20121012HO	03-FC1014-22 (half sib selection within FC201) - sel in 6R	4.2 t-v
40	20151014HO	20121019HO - Increase 03-FC1015HO derivatives	4.2 s-v
32	20141009	FC1741 Population (rz1rz1Rz2Rz2)	4.4 r-v
51	20141009	FC1741 Population (rz1rz1Rz2Rz2)	4.4 q-u
9	20101010	C790-15cms x 05-FC1018 [RZM-CR-% (C931 x FC709-2)F3]	4.4 q-t
18	20131008HO	C869, PI 628754	4.5 p-t
30	20141004	FC221, PI 651016	4.6 o-t
29	20131011	1/2 sib family; (Best FC LSR x Best EL LSR) x CR011	4.7 n-t
35	20141018	BI [(FC907 x FC709-2) & 9931] x [C790-15cms x FC1036]	4.7 n-t
36	20141019PF	FC220-2; B.I. of T1 (FC220-1 - inc. 20051030) Rhzc sel	4.8 n-t
13	20111031	LSR {(BGRC 45511) *maritima* x Sucrose} x Z325aa	4.8 n-t
10	20101012	C790-15cms x RZM-CR-% (FC712 x 9931)F$_3$	5.0 m-s
41	20151016	[(FC907xFC709-2) & 9931 (Salinas)]x[C790-15cmsxFC1036]	5.1 l-r
31	20141007	FC1740 Population (Rz1Rz1Rz2Rz2)	5.1 k-r
50	20141007	FC1740 Population (Rz1Rz1Rz2Rz2)	5.2 j-q
45	20151020	20101013-xs; selected at EL in 2010 & 2011 for LSR	5.2 j-q
3	1997A050	FC607, PI 590837	5.3 i-p
34	20141016HO	20121023HO; Bulk increase of C812-41; FC1100 (Rz2)	5.3 h-o
8	20101008	(Best FC LSR x Best EL LSR) - mm seedballs Increased	5.3 h-o
47	20151036PF	LSR Bvm (PI540596 biennial - France) x S%MM pop	5.4 g-o
42	20151017	20121018HO-x – BI roots selected for rhizoctonia resistance	5.4 f-n
11	20111028	CLR family (BGRC 45511 X Sucrose$_{MM}$) sib line 20111029	5.6 e-m
37	20141021PF	20121054; LSR fodder beet - Sucrose$_{MM}$ x PI 535833 (Saturn)	5.6 e-m

28	20131010H17	Polycross - female =({SP85657-01 x FC709-2} X FC708)F$_2$	5.8 d-l
38	20141022PF	Bulk 0931 & 9933 x BCN Resistant, Iranian sugarbeet landrace	5.9 c-k
43	20151018	BI LSRMM x RhzcR/LSR sel RhzcR - hs 10A-1775	5.9 c-k
48	20151044PFHO	Selfed families of 20101015HO1-x/20101015HO-xs	5.9 c-j
7	20041010HO	FC712/MonoHy A4	5.9 c-j
17	2012A035	R840 (Blk of R740)	6.0 c-j
39	20141035PF	LSR Bvm (biennial - France- PI 540596) x Sucrose$_{MM}$	6.0 c-i
26	20131010H15	Polycross - female = ({SP85657-01 x FC709-2} X EL53)F$_2$	6.0 c-i
4	20101004	FC708, PI 590845	6.0 c-i
5	20121034	FC709-2, PI 599668	6.0 c-i
49	20151046PFHO	20101016HO1-xs/20101016HO-x; selection for CT resistance	6.1 b-h
2	19951017	FC727, PI 599669	6.1 b-h
6	20141005	FC715, PI 574625	6.1 b-g
16	20121017	20111030; BI 5 highest CLR families 20071004HO-xs	6.1 b-g
46	20141011PF	LSR from Sucrose$_{MM}$ x PI 535833 (Saturn) – 20121054 also	6.2 b-f
33	20141011PF	LSR from Sucrose$_{MM}$ x PI 535833 (Saturn) – 20121054 also	6.2 b-e
23	20131010H12	Polycross, female = ({SP85657-01/FC709-2}/FC708)/FC220-1	6.2 b-e
12	20111030	BI 5 highest CLR families 20071004HO-xs; LSRMM w/Fargo	6.4 a-d
19	20131010H08	Polycross, female = (FC708CMS X EL 53) X FC220-1	6.4 a-d
21	20131010H10	Polycross, female = ({SP85657-01/FC709-2}/EL53)/FC220-1	6.4 a-d
24	20131010H13	Polycross, female = (FC708CMS x EL53)F$_2$	6.4 a-d
CH5	**SV2012RR**	**Susceptible check**	**6.5 a-d**
20	20131010H09	Polycross, female = (FC708CMS X EL51) X FC220-1	6.5 a-d
25	20131010H14	Polycross, female = (FC708CMS X EL 51)F$_2$	6.6 a-c
27	20131010H16	Polycross, female = ({SP85657-01 x FC709-2} X EL51)F$_2$	6.8 ab
22	20131010H11	Polycross, female = ({SP85657-01/FC709-2}/EL51)/FC220-1	7.1 a
$P > F$[w]			<0.0001
LSD			0.8

[z] Two entries were commercial check cultivars: SV2012RR (susceptible) and HM PM90 (resistant).

[y] All lines were *Beta vulgaris* subspecies *vulgaris* (cultivated beet).

[x] Curly top ratings = curly top was rated using a scale of 0 to 9 (0 = healthy and 9 = dead), with disease index (DI) treated as a continuous variable.

[w] $P > F$ was the probability associated with the F value. Within a column, means followed by the same letter did not differ significantly based on Fisher's protected least significant difference (LSD; α = 0.05) value.