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, 2019.

Thirty sugar beet (*Beta vulgaris* L.) germplasm lines produced by the USDA-ARS Ft. Collins sugar beet program and three commercial check cultivars [Beta G6040 (resistant), HM PM90 (resistant), and SV2012RR (susceptible)] 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 2018. The field was plowed and then fertilized (90 lb N and 110 lb P_2O_5/A) and roller harrowed on 11 Apr. The germplasm was planted (density of 142,560 seeds/A) on 3 Jun. The plots were two rows 10-ft long with 22-in. row spacing and treatments were arranged in a randomized complete block design with six replications. The field was sprinkler irrigated, cultivated, and hand weeded as necessary. Plant populations were thinned to about 47,500 plants/A on 29 Jun. Plants were inoculated at the four- to six-leaf growth stage on 3 Jul with approximately six viruliferous (containing the following BCTV strains: California/Logan and Severe) beet leafhoppers (*Circulifer tenellus* Baker) 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 with Lorsban 4E (1.5 pints/A) on 17 Jul to kill the beet leafhoppers. Plots were rated for foliar symptom development on 22 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 rank transformed and analyzed in SAS using the general linear model procedure (Proc GLM), and Fisher's protected least significant difference (LSD; $\alpha = 0.05$) was used for mean comparisons. The non-transformed means are presented in the table.

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. Statistically, 15 of the entries contain some minor resistance since their visual ratings were significantly lower than those for the susceptible check. However, only entries 9 and 27 were not significantly different from both resistant checks. Entries 9 and 27 along with entries with similar levels of resistance will be retested and, if resistance is confirmed, these lines will be considered for incorporation into the USDA-ARS germplasm improvement program as a source of resistance to BCTV.

Entry[z]	Source[y]	Description	Curly top rating[x]
CH6	HM PM90	Resistant check	4.3 n
1	Beta G6040	Resistant check	5.3 nm
9	20151036MS	20131009; 20081012PF - LSR Bvm (PI540596 biennial - France) x S%MM pop - LSR=2.5	5.8 nm
27	20171023HO1	20141016HO & 20141016HO1; 20121023HO & HO1; Bulk increase of C812-41	6.0 l-n
23	20161028PF	20121014-x; B.I. of 8 half-sib families (Blk Inc of 05-FC1023m(iso)[2005A020]	6.0 j-m
3	1997A050	FC607, LSR/CTR, easy bolting, O-type, 2X, mm, self sterile	6.1 k-m
28	20171020	FC1742	6.2 j-m
8	20151014HO	20121019HO & HO1 - Increase 03-FC1015HO & HO1	6.2 j-m
29	20171021	FC1743	6.2 i-m
14	20151016	20111024-x, 20071011, [(FC907xFC709-2) & 9931 (Salinas)]x[C790-15cmsxFC1036]	6.2 h-m
11	20151018	20121056 - Blk Inc F3 LSRMM x RhzcR/LSR selected for RhzcR - hs 10A-1775	6.3 g-m
2	19951017	FC727	6.3 f-l
30	20171023HO	20141016HO & 20141016HO1; 20121023HO & HO1; Bulk increase C812-41	6.3 j-m
4	20041010HO	FC712/MonoHy A4	6.4 e-k
13	20151020	20101013-xs; B.I. Roots 20101013-24; 20101013-03; 20101013-71; 20101013-76	6.4 e-k
10	20151017	20121018HO-x - Blk inc rhizoctonia resistance 2014; Individuals from half-sib families	6.4 e-l
22	20161027PF	20101014HO-xs; BI of selfed families from 07-FC124-425	6.4 e-l
24	20161029PFHO	20121018HO-x & 20121018HO1; 03-FC1014-22 (hs sel FC201)	6.6 d-j
25	20161030PFHO	20121018HO-x & 20121018HO1; 03-FC1014-22 (hs sel FC201) -sel 6R/CTR Kimberly	6.6 c-i
21	20161023PF	20111018-x, 20071006H2 (Iso 3); (Z325 x [LSR Giant Poly (PI535826) x SucroseMM])	6.6 c-g
5	20101004	FC708 *Rhizoctonia* resistant, leaf spot resistant O-type	6.7 c-h
12	20151019	20141011MS - (20081001-13MS) LSR sel SucroseMM x PI 535833 (Saturn) - 20121054	6.7 c-f
17	20161003PF	20111039MS/PF; BI seed from Z325 (hi sucrose sugar beet) x BGRC28938	6.7 a-d
20	20161017	20141020; Increase F3 of CN12-446 x FC708 [SBCN x RhzcR/LSR]	6.8 b-e
6	20141022PF	Bulk 0931 & 9933 x BCN resistant, Iranian sugar beet landrace	6.9 a-d
18	20161004HO	20121018HO-119pf & 20121018HO-187pf20121018HO-187pf	6.9 a-d
CH5	SV2012RR	Susceptible check	6.9 a-d
16	20151046PFHO	20101016HO1-xs/20101016HO-x; (07-FC1015-420) 2007A091	7.0 a-d
19	20161016PF	20141035; 20121055; 20081012PF; LSRsel Bvm (PI540596 biennial - France) x S%MM	7.0 a-c
15	20151044PFHO	20101015HO1-x/20131012MS; Selfed families of 20101015HO1-x/20101015HO-xs	7.1 a-c
26	20181028	B.v. vulgaris Poland REKORD POLY 2010i PI 535827 2010I SD	7.5 a
7	20141035	Increase 2 LSR BVM (biennial - France) x SucroseMM pop - PI 540596	7.6 ab
$P > F$[w]			<0.0001

[z] Three entries were commercial check cultivars (bold): 1 (resistant), CH5 (susceptible), and CH6 (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 when using rank transformed data. Within a column, means followed by the same letter did not differ significantly based on Fisher's protected least significant difference (LSD; $\alpha = 0.05$) value. The non-transformed mean values are presented.