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

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Beet curly top resistance in USDA-ARS Plant Introduction Lines, 2015.

Thirty-one sugar beet Plant Introduction (PI) Lines from the USDA-ARS National Plant Germplasm System (NPGS), and two commercial check cultivars [SV2012RR (susceptible) and HM PM90 (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 2014. The field was plowed in the fall and in the spring, it was fertilized (90 lb N and 110 lb P_2O_5/A) and prepared for seeding using a roller harrow on 9 Apr 15. The seed from various germplasm sources was planted (density of 142,560 seeds/A) on 27 May. The plots were two rows 10 ft long with 22-in row spacing and arranged in a randomized complete block design with three replications. The fields were sprinkler irrigated, cultivated, and hand weeded as necessary. Plant populations were thinned to about 47,500 plants/A on 20 Jun. Plants were inoculated at the four- to six-leaf growth stage on 24 Jun with approximately six viruliferous beet leafhoppers (contained at least the following BCTV strains: Cal/Logan, CO, Severe, and Worland) 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 over the top of the plants through the field. The plants were sprayed with Lorsban 4E (1.5 pints/A) on 7 Jul to kill the beet leafhoppers. Plots were rated for foliar symptom development on 13 and 20 Jul using a linear 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; $\alpha = 0.05$) 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 both visual ratings. Based on overall visual rating, there were seven PI accessions (entries 1, 2, 13, 15, 16, 17, and 31) that were not significantly different from the resistant check. These germplasm sources 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]	Description	Subspecies[y]	Curly top ratings[x] 13 Jul	20 Jul	Overall
17	NSL 183461, 7411 donated from Logan, UT (J. C. Theurer)	*vulgaris*	3.2 mn	3.2 n	3.2 n
31	Resistant check, Beta G6040, 1996A008	*vulgaris*	3.3 l-n	3.2 n	3.2 n
16	NSL 183446, 5090 donated from Utah (J. C. Theurer)	*vulgaris*	3.1 n	3.5 mn	3.3 n
HM PM90	Resistant check	*vulgaris*	3.3 l-n	3.3 mn	3.3 n
13	NSL 183376, SLC 342, MM, CT, 4n, SS donated from Utah (J. C. Theurer)	*vulgaris*	3.4 k-n	3.3 mn	3.4 mn
1	Ames 2631, L 3T develop at Logan, UT; MM, CT, LS, Erw, 4n	*vulgaris*	3.8 i-n	3.5 l-n	3.7 l-n
2	Ames 2634, L 8T develop at Logan, UT; MM, CT, Erw, PM, 4n of CT8	*vulgaris*	3.6 j-n	3.8 l-n	3.7 l-n
15	NSL 183444, 4326 donated from Logan, UT (J. C. Theurer)	*vulgaris*	4.0 i-l	4.0 k-n	4.0 k-n
14	NSL 183409, 1332 donated from Logan, UT (J. C. Theurer)	*vulgaris*	4.2 h-k	4.6 j-m	4.4 j-m
28	PI 518325, WB 647, Bill of Portland, Dorset County, UK	*maritima*	4.2 h-k	4.6 j-m	4.4 j-m
26	PI 518313, WB 635, West Sussex County, England UK (21-Sep-1987)	*maritima*	4.0 i-m	5.2 h-k	4.6 j-l
23	PI 506238, FC 707(4x), C5 colchicine-induced conversion of FC 707	*vulgaris*	4.5 g-i	4.8 i-l	4.6 i-l
29	PI 518335, WB 657, Devon County, England UK (24-Sep-1987)	*maritima*	4.5 g-i	5.3 g-j	4.9 h-k
27	PI 518314, WB 636, West Sussex, England UK (21-Sep-1987)	*maritima*	4.0 i-l	6.0 d-i	5.0 g-j
30	PI 518343, WB 665, Cornwall County, England UK (26-Sep-1987)	*maritima*	4.5 g-i	5.5 f-j	5.0 g-j
25	PI 518308, WB 630, East Sussex, England UK (19-Sep-1987)	*maritima*	4.4 g-j	5.9 e-i	5.2 f-j
12	NSL 176410, Yugo 5, 4n, MM, NS 5, Novi Sad, Yugoslavia	*vulgaris*	4.9 f-h	6.2 c-h	5.6 e-i
8	NSL 86577, 72/4-4-2-0, Selection in Chile for resistance to yellow wilt	*vulgaris*	4.9 f-h	6.3 c-h	5.6 e-h
5	NSL 28073, A 0034 from Great Western Sugar	*vulgaris*	5.1 fg	6.7 a-f	5.9 d-h
22	PI 470089, selection from Kleinwanzleben z. Multigerm diploid	*vulgaris*	5.1 fg	6.7 a-f	5.9 d-h
9	NSL 141985, Janasz, a diploid, multigerm, high sugar variety from Poland	*vulgaris*	5.1 e-g	6.8 a-e	6.0 c-g
10	NSL 141986, CS 42, self-sterile monogerm variety developed in Canada	*vulgaris*	5.2 d-g	6.8 a-e	6.0 b-f
3	Ames 2638, L 11T develop at Logan, UT; MM, CT, 4n of (CT9 x CT5)	*vulgaris*	5.5 c-f	6.6 b-g	6.0 b-f
20	PI 269875, No. 920 collected Ishkuman, Pakistan (received 29-Nov-1960)	*vulgaris*	5.7 b-f	6.5 b-g	6.1 a-f
11	NSL 142025, Y905/FC 68-9163, obsolete European commercial cultivar	*vulgaris*	5.5 c-f	7.3 a-c	6.4 a-e
19	PI 269873, No. 669 collected in Nomal, Pakistan (received 29-Nov-1960)	*vulgaris*	5.8 a-f	7.3 a-c	6.5 a-e
4	NSL 28041, B 236 from Great Western Sugar	*vulgaris*	5.7 b-f	7.3 a-c	6.5 a-e
SV2012RR	Susceptible check	*vulgaris*	5.9 a-e	7.2 a-d	6.6 a-e
24	PI 518158 (Ames 8052), Ch-7805, triploid. Feb-1988. Heilongjiang, China	*vulgaris*	6.0 a-d	7.4 a-c	6.7 a-d
7	NSL 34020, A 1491 from Great Western Sugar	*vulgaris*	6.2 a-c	7.7 ab	6.9 a-c
21	PI 274395, Tertra-Tri-Polish. Poli-O. Warsaw, Poland	*vulgaris*	6.4 ab	7.7 ab	7.0 a-c
6	NSL 28096, A 1195 from Great Western Sugar. White root - Iran 1963	*vulgaris*	6.2 a-c	7.8 a	7.0 ab
18	PI 169024, Kirmizi, red type, collected 14-Jun-1948, Istanbul, Turkey	*vulgaris*	6.6 a	7.5 a-c	7.0 a
Overall mean			4.8	5.7	5.3
$P > F$[w]			<0.0001	<0.0001	<0.0001
LSD			0.9	1.2	1.0

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

[y] All lines were *Beta vulgaris*. Subspecies *vulgaris* are cultivated beet and subspecies *maritima* are sea beet, the wild progenitor.

[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; $\alpha = 0.05$) value.