SUGAR BEET (*Beta vulgaris*)   Imad Eujayl and Carl Strausbaugh, USDA-ARS
    Beet curly top; *Beet curly top virus*   NWISRL, 3793 N. 3600 E., Kimberly, ID 83341

Beet curly top resistance in USDA-ARS Kimberly germplasm lines, 2015.

Fourteen sugar beet (*Beta vulgaris* L.) breeding lines from the USDA-ARS Kimberly Sugar Beet program 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 sources of germplasm 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 six replications. The fields were sprinkler irrigated, cultivated, and hand weeded as necessary. Plant populations were hand 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. 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). During the disease rating, leaf samples were collected and evaluated by enzyme-linked immunosorbent assay (ELISA) as described previously (Plant Dis. 94:972-976). 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 both visual ratings and ELISA. Based on the overall visual rating, KDH13 and KDH4-9 performed the same as the resistant check and were better than all other entries. Additionally, ELISA data also indicated that these two lines had significantly lower virus titer than all other entries including the resistant check. These results confirm that these two lines could serve as reliable sources for curly top resistance and can be readily used in breeding for BCTV resistance in sugar beet. These results and the germplasm will be accessible to all interested parties through the USDA-ARS, NPGS GRIN database (http://www.ars-grin.gov/npgs/index.html).

Entry[y]	Description of *Beta vulgaris* lines	Curly top ratings[z]			
		ELISA[x]	13 Jul	20 Jul	Overall
KDH13	Doubled haploid = PI663862	0.27 g	2.8 h	3.4 d	3.1 f
KDH4-9	Doubled haploid derived from C762-17	0.26 g	3.3 gh	3.6 d	3.4 f
HM PM90	Resistant check	0.56 f	3.4 g	3.7 d	3.6 f
KEMS12-600	PI 622567 gamma irradiated at 600GY	0.55 f	4.5 f	4.8 c	4.6 e
KEMS6-600	KEMS6 gamma irradiated at 600GY	0.54 f	4.5 ef	5.3 c	4.9 de
KEMS12	PI 622570	0.59 ef	5.0 c-f	5.5 c	5.3 de
KEMS9	PI 672569	0.66 c-f	5.1 c-e	5.5 c	5.3 c-e
KEMS6	PI 663873 EMS treated	0.58 f	5.2 b-d	5.5 c	5.3 c-e
KEMS8-600	PI 663873 EMS treated	0.63 d-f	5.0 d-f	5.8 bc	5.4 c-e
KEMS8	PI 663873 EMS treated	0.80 a-e	5.1 c-e	5.7 bc	5.4 b-d
K39-16	PI 608798 mass selection	0.69 b-f	5.5 b-d	6.6 ab	6.0 a-c
KEMS12-450	PI 622570 gamma irradiated at 450GY	0.85 a-c	5.6 a-c	6.6 ab	6.1 ab
K19-19	PI663873 mass selection	0.83 a-d	5.8 ab	6.8 a	6.3 a
K19-19-600	K19-19 gamma irradiated at 600GY	0.89 ab	5.8 ab	6.9 a	6.3 a
SV2012RR	Susceptible check	0.95 a	5.8 ab	7.2 a	6.5 a
KEMS9-600	PI 622569 gamma irradiated at 600GY	0.89 ab	6.2 a	7.4 a	6.8 a
Overall mean		0.66	4.9	5.6	5.3
$P > F$[w]		<0.0001	<0.0001	<0.0001	<0.0001
LSD		0.21	0.6	1.0	0.7

[z] 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.
[y] Two entries were commercial check cultivars: SV2012RR (susceptible) and HM PM90 (resistant).
[x] ELISA = the enzyme-linked immunosorbent assay (ELISA) values recorded at OD 405 nm. The 8 negative background checks (4 per plate) for the ELISA assay averaged 0.11 ± 0.01.
[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.