

Beet curly top resistance in USDA-ARS Kimberly germplasm, 2019.

Eight sugar beet (*Beta vulgaris* L.) germplasm breeding lines and segregating populations produced by the USDA-ARS Kimberly sugar beet program and two commercial check cultivars [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 P₂O₅/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. Entries 1, 2, 3, 4, 5, and 8 had BCTV resistance since they were not significantly different from the resistant check. Evidence of introgression of BCTV resistance genes from KDH13 into susceptible parental lines (KEM09-16CT, K39-33 and KEMS06) had been confirmed by the higher resistance levels shown in F₃ families and F₄ lines than the susceptible parents in previous studies. Therefore, these families will be subjected to single trait selection. Entry 3 (KPS25-CTN16) was a result of selection for resistance to BCTV and higher sucrose content. The segregating F₃ families are suitable for single trait selection and advancement to breeding lines to enrich the BCTV resistance gene pool in the USDA-ARS sugar beet germplasm.

Entry ^z	Source ^y	Description	Curly top rating ^x
4	KDH13	PI663862, doubled haploid BCTV resistant genetic stock	4.5 d
5	KDH4-9	PI683513, doubled haploid BCTV resistant genetic stock	4.5 cd
2	KDH13/KEMS9-16CT	F ₄ lines selected from BCTN 2016 (PI663862 X PI672569)	4.6 b-d
CH6	HM PM90	Resistant commercial check	4.6 b-d
1	KDH13/K39-33	F ₃ Families (PI663862 X K39-33)	4.6 bc
8	KDH13/KEMS6	F ₃ families (PI663862 X PI683514)	4.9 b-d
3	KPS25-16CT	Selection from CTN-2016 for higher sucrose content and BCTV resistance	5.2 b
6	KEMS12/KPS24	F ₂ population (PI672570 X KPS24)	6.2 a
7	KEMS12/KPS25	F ₂ population (PI672570 X KPS25)	6.6 a
CH5	SV2012RR	Susceptible commercial check	6.7 a
<i>P</i> > <i>F</i> ^w			<0.0001

^z Two entries were commercial check cultivars (bold): CH5 (susceptible), and CH6 (resistant). KDH13 (bold) is a resistant line produced by the USDA-ARS Kimberly sugar beet program and released as a BCTV resistant line.

^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.