SUGAR BEET (*Beta vulgaris*)
Rhizomania; *Beet necrotic yellow vein virus*
Storage rot; *Athelia*-like sp., *Botrytis cinerea*, and *Penicillium* spp.

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Kimberly sugar beet germplasm evaluated for rhizomania and storage rot resistance in Idaho, 2022.

Six sugar beet (*Beta vulgaris* L.) lines from the USDA-ARS Kimberly sugar beet program (description begins with K), one sugar beet line from the USDA-ARS East Lansing program (description begins with EL), and five check cultivars were screened for resistance to *Beet necrotic yellow vein virus* (BNYVV), the causal agent of rhizomania, and to storage rot. The rhizomania evaluation was conducted at the USDA-ARS North Farm in Kimberly, ID which has Portneuf silt loam soil and had been in barley in 2021. In the spring the field was plowed and fertilized (110 lb N and 160 lb P_2O_5/A) and roller harrowed on 6 Apr 22. The germplasm was planted (density of 114,048 seeds/A) on 3 May. The plots were one row 10-ft long with 22-in. between-row spacing and arranged in a randomized complete block design with six replicates. The crop was managed according to standard cultural practices for southern Idaho. The trial relied on endemic field inoculum for rhizomania and storage rot development. The plots were rated for rhizomania foliar symptom (percentage of plants with yellow, stunted, upright leaves) development on 15 Aug. The plants were mechanically topped and hand harvested on 12 Oct. At harvest, ten roots per plot were rated for rhizomania symptom development using a scale of 0 to 9 (0 = healthy and 9 = dead; Plant Disease 93:632-638). At harvest, eight roots per plot were also placed in a mesh-onion bag and kept in an indoor commercial storage facility (temperature set point 34°F) in Paul, ID on 13 Oct. On 14 Mar 23, after 152 days in storage, the roots were evaluated for the percentage of root surface area covered by fungal growth or rot. Except for root ratings, data were analyzed in SAS (Ver. 9.4) using the general linear model (Proc GLM) procedure, and Fisher's protected least significant difference (α = 0.05) was used for mean comparisons. The root ratings were analyzed in a nonparametric analysis as described by Shah and Madden (Phytopathology 94:33-43).

Rhizomania symptom development was uniform and other disease problems were not evident in the plot area. Entries 4 and 5 were not included in the table since they did not germinate well enough to establish plots. The BNYVV susceptible check plots (Check 1 and Red beet) had 100% foliar symptoms and high root disease ratings. Resistant checks 3 and 4 had 0% foliar symptoms and a low root rating which indicates that resistance based on the *Rz1* gene is holding up. Single gene resistance (Check 2) had an 8% foliar rating indicating *Rz2* resistance is not completely effective, but the root ratings were still good. Entry 3 had a level of BNYVV resistance similar to resistant checks based on both foliar and root ratings. Although entries 1, 2, 6, and 7 all had poor foliar ratings, their root ratings were better than those for the susceptible checks. Both entries 1 and 3 were described as containing some rhizomania resistance in their release notes, but entry 1 appears to have lost some of its resistance, while entry 3 remains resistant. All the entries had some resistance to fungal rots in storage, but only entry 3 performed well for all three variables. Some entries may serve as a starting point for identifying additional sources of resistance to BNYVV and storage rots.

Entry[z]	Description	Root rot in storage (%)[y]	RZ foliar rating (% susceptible plants)	RZ root rating[x]
Check 3	BTSSALCHK3 (*Rz1Rz1 Rz2Rz2*) = *Rz1* + *Rz2* resistant check	12 f	0 c	19 f
Check 4	BTSSALCHK4 (*Rz1Rz1*) = *Rz1* resistant check	31 e	0 c	22 ef
3	KEMS12 = PI 672570; Rhizomania resistance	12 f	0 c	24 de
Check 2	BTSSALCHK2 (*Rz2Rz2*) = *Rz2* resistant check	38 de	8 c	26 cd
2	KEMS09-600	31 e	100 a	32 c
6	KDH13 = PI 663862; Curly top resistant breeding line	54 b-d	83 b	33 c
1	KEMS09 = PI 672569; Rhizomania resistance	65 bc	100 a	36 b
7	EL57 = PI 628274; Aphanomyces, Rhizoctonia, & Cercospora resistance	66 bc	100 a	46 b
Check 1	BTSSALCHK1 (*rzrz*) = susceptible sugar beet check	69 b	100 a	65 a
Red beet	Detroit Dark Red (*rzrz*) = susceptible red beet check	99 a	100 a	87 a
P > F[w]		<0.0001	<0.0001	<0.0001
LSD		16	14	Trans

[z] All lines were *Beta vulgaris* subsp. *vulgaris*. Five commercial cultivars were included as checks.

[y] Root rot in storage = the percent of root surface area covered by fungal growth or rot. Fungal growth was dominated by an *Athelia*-like basidiomycete (Mycologia 104:70-78), *Penicillium expansum*, and *Penicillium cellarum*. Trace levels of *Botrytis cinerea* were also present.

[x] Ten roots per plot were evaluated for rhizomania symptoms using a scale of 0-9 (0 = healthy and 9 = dead; Plant Disease 92:581-587). Root rating = a disease severity index value for each plot established using the following formula: [((A)0+(B)1+(C)2+(D)3+(E)4+(F)5+(G)6+(H)7+(I)8+(J)9)/90]100, where A-J are the number of plants in categories 0-9, respectively.

[w] *P* > F was the probability associated with the F value. LSD = Fisher's protected least significant difference value (α = 0.05). Within a column, means followed by the same letter did not differ significantly based on Fisher's protected LSD. Trans = root ratings were rank transformed prior to analysis with the mixed linear models (Proc MIXED) procedure, but the non-transformed means have been presented in the table. Mean separation for the root ratings was based on a PDIFF comparison with a probability cutoff of 0.05.