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, 2019.

Eight sugar beet (*Beta vulgaris* L.) lines from the USDA-ARS Kimberly sugar beet program 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 2018. In the spring the field was plowed and 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 23 Apr. The plots were one row 10-ft long with 22-in. between-row spacing and arranged in a randomized complete block design with 6 replicates. The crop was managed according to standard cultural practices for southern Idaho. Plant populations were thinned manually to 47,500 plants/A on 5 Jun. 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 20 Aug. The plants were mechanically topped and hand harvested on 15 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), with disease index (DI) treated as a continuous variable. 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 16 Oct. On 21 Feb 20, after 129 days in storage, the roots were evaluated for the percentage of root surface area covered by fungal growth or rot. Data were analyzed in SAS (Ver. 9.4) using the general linear model (Proc GLM) procedure, and Fisher's protected least significant difference ($\alpha = 0.05$) was used for mean comparisons. The root ratings were rank transformed prior to analysis, but the non-transformed means have been presented in the table.

Rhizomania symptom development was uniform and other disease problems were not evident in the plot area. The BNYVV susceptible and red beet check plots (Check 1 and RB, respectively) had 100% foliar symptoms and high root disease ratings. The resistant check with two resistance genes, *Rz1* + *Rz2* (check 3), had no foliar symptoms and low root rating. The resistant checks with only one resistance gene had foliar symptoms ranging from 14 to 24%, but their root ratings were still within an acceptable range. Foliar symptoms indicate single gene resistance for BNYVV is becoming marginal. Based on foliar ratings, entry 6 seemed healthy, but root ratings from this entry were significantly worse than the resistant checks. Entry 6 will be investigated further to make sure the root rating was an indication of susceptibility and not just poor root shape. These observations suggest that both foliar and root ratings should be utilized when considering resistance to BNYVV, since relying on just one type of rating may be misleading. Three entries (1, 2, and 6) had resistance to fungal rots in storage, but only entry 6 performed well for both storage and the foliar RZ rating. These segregating populations and KEMS8 will serve as genetic sources for identifying additional 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	5 f	0 f	26 e
Check 2	BTSSALCHK2 (*Rz2Rz2*) = *Rz2* resistant check	21 c-e	14 ef	26 e
Check 4	BTSSALCHK4 (*Rz1Rz1*) = *Rz1* resistant check	21 c-e	24 de	32 e
7	KEMS12/KPS24 (F_2 population)	31 c	33 d	43 d
3	KPS24 (Inbred)	18 de	80 b	43 d
1	KDH13/K39-33 (F_5 families)	12 ef	97 a	44 d
6	KEMS8 (Inbred mutant)	13 ef	0 f	44 d
2	KDH13/KEMS9 (F_5 families)	6 f	92 ab	48 cd
5	KDH39-33	21 c-e	95 ab	48 cd
8	KEMS12/KPS25 (F_2 population)	22 c-e	55 c	48 cd
4	KDH39-16	71 b	88 ab	57 bc
Check 1	BTSSALCHK1 (*rzrz*) = susceptible sugar beet check	25 cd	100 a	67 ab
RB	Early Wonder (*rzrz*) = susceptible red beet check	86 a	100 a	76 a
P > F[w]		<0.0001	<0.0001	<0.0001
LSD		11	17	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*.

[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. Trans = the root ratings were rank transformed prior to analysis, but the non-transformed means have been presented in the table.

[w] *P* > F was the probability associated with the F value. LSD = Fisher's protected least significant difference value ($\alpha = 0.05$). Within a column, means followed by the same letter did not differ significantly based on Fisher's protected LSD.