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

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Kimberly sugar beet germplasm evaluated for rhizomania and storage rot resistance in Idaho, 2015.

Eleven sugar beet (*Beta vulgaris* L.) lines from the USDA-ARS Kimberly sugar beet program and four check cultivars were screened for resistance to *Beet necrotic yellow vein virus* (BNYVV), the causal agent of rhizomania, and to storage rot. The rhizomania (RZ) 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 fall plowed and in the spring, fertilized (90 lb N and 110 lb P_2O_5/A) and roller harrowed on 9 Apr 15. The germplasm was planted (density of 142,560 seeds/A) on 21 Apr. The plots were one row 10-ft long with 22-in. row spacing and arranged in a randomized complete block design with 4 replications. The crop was managed according to standard cultural practices for southern Idaho. The plants from both fields were mechanically topped and harvested on 7 Oct. Plant populations were thinned to 47,500 plants/A on 29 May. Nine of the lines were also grown in a neighboring field treated with Telone II at 18 gpa in Oct 2014. The planting time, plot design, and management for the Telone field were the same as the RZ field. The trials relied on endemic field inoculum for rhizomania and storage rot development. The RZ field plots were rated for foliar symptom (percentage of plants with yellow, stunted, upright leaves) development on 8 and 20 Jul. At harvest, roots in the RZ field plots were rated for 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 placed in an indoor commercial storage facility (temperature set point 34°F) in Paul, ID on 8 Oct. On 11 Feb 16, after 126 days in storage, the roots were evaluated for the percentage of root surface area covered by fungal growth. Data were analyzed in SAS (Ver. 9.4) using the general linear models procedure (Proc GLM), and Fisher's protected least significant difference ($\alpha = 0.05$) was used for mean comparisons.

Rhizomania symptom development was uniform and other disease problems were not evident in the plot area for the RZ field. In the neighboring field treated with Telone, there were still trace levels of rhizomania despite treatment and some roots were infested with *Rhizoctonia solani*. However, only roots healthy in appearance were selected for storage evaluation from the Telone field. In the RZ field, the BNYVV susceptible check plots (Check 1) had 78 to 90% foliar symptoms and a high root disease severity rating. The three BNYVV resistant checks (2, 3, and 4), had 0 to 10% foliar symptoms and low root ratings. All Kimberly entries except for KEMS9-600 had some level of BNYVV resistance based on both foliar and root ratings. K19-17 and K19-19-600 had levels of resistance similar to the resistant checks. If roots lacked storability, they will rot in storage as indicated by fungal growth on the root surface. The primary fungal growth on roots was an *Athelia*-like basidiomycete (Mycologia 104:70-78), but *Botrytis* sp. and *Penicillium* sp. were also present at times. K19-17 was the best ranking entry in storage from the RZ field, but there was no difference between entries from the Telone field. The nine entries from the Telone treated field averaged 60% (± 21%) of the root surface covered by fungal growth, while the same entries from the RZ field only averaged 11% (± 9%). Both standard error and ANOVA with Proc GLM ($P = 0.0015$) indicated roots from these fields differed. The reasons for the increase in the percentage of roots covered by the *Athelia*-like basidiomycete in the Telone field are unknown. It is interesting that *R. solani*, also a basidiomycete, was evident in some roots from the Telone field. Some of these entries may serve as a starting point for identifying additional sources of resistance to BNYVV and storage rots.

		Fungal growth in storage (%)[y]		Rhizomania ratings		
				Foliar rating (% susceptible plants)		Root rating[x]
Entry[z]	Description	Telone	RZ	8 Jul	20 Jul	
Check 3	BTSSALCHK3 (*Rz1Rz1Rz2Rz2*) resistant check	ND	68a	0 c	0 c	10 d
K19-17	S2 generation from mass selection from PI663873	ND	2c	2 c	4 c	13 d
Check 2	BTSSALCHK (*Rz2Rz2*) resistant check	ND	62a	0 c	0 c	15 d
Check 4	BTSSALCHK4 (*Rz1Rz1*) resistant check	ND	64a	10 c	10 c	15 d
K19-19-600	S2 mutant due to Gamma irradiation (600 Gy)	60	7bc	0 c	0 c	17 cd
KEMS12-450	S2 mutant due to Gamma irradiation (450 Gy)	68	8bc	0 c	5 c	24 bc
KEMS8	Mutant line (S6) from EMS treatment	48	8bc	8 c	2 c	26 b
K19-19	Line from mass selection from PI663873	50	8bc	5 c	8 c	27 b
KEMS8-600	S2 mutant from KEMS8 irradiated at 600 Gy	ND	7bc	0 c	0 c	27 b
KEMS12	PI672570	60	14bc	0 c	0 c	27 b
KEMS 12-600	S2 mutant from PI 672570	65	21b	0 c	0 c	28 b
KEMS6-600	S2 mutant from KEMS8 irradiated at 600 Gy	58	9b	0 c	0 c	28 b
KEMS9	PI 672569	68	7bc	0 c	0 c	28 b
KEMS9-600	Mutant from PI 672569 irradiated at 600 Gy	68	17bc	39 b	52 b	29 ab
Check 1	BTSSALCHK1 (*rzrz*) susceptible check	ND	62a	78 a	90 a	36 a
Overall mean		60	24	9	11	23
$P > F$[w]		0.8972	<0.0001	<0.0001	<0.0001	<0.0001
LSD		NS	16	18	16	7

[z] All lines were *Beta vulgaris* subsp. *vulgaris*.

[y] Fungal growth in storage = the percent of root surface area covered by fungal growth. Most of the fungal growth was by a recently described *Athelia*-like basidiomycete (Mycologia 104:70-78). Telone = Telone II (active ingredient 97.5% 1,3 dichloropropene) was applied at 18 gpa in Oct 2014 to control rhizomania. RZ = soil in this field was naturally infested with BNYVV so plants were likely to develop rhizomania. ND = no data since entry was not planted in this field.

[x] Ten roots per plot were evaluated 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 ($\alpha = 0.05$). Within a column, means followed by the same letter did not differ significantly based on Fisher's protected LSD. NS = not significant.