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

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Ft. Collins sugar beet germplasm evaluated for rhizomania and storage rot resistance in Idaho, 2020.

Thirty sugar beet (*Beta vulgaris* L.) lines from the USDA-ARS Ft. Collins 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 2019. In the spring the field was plowed and fertilized (110 lb N and 120 lb P_2O_5/A) and roller harrowed on 27 Mar 20. The germplasm was planted (density of 51,840 seeds/A) on 20 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. 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 24 Aug. The plants were mechanically topped and hand harvested on 13-14 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 15 Oct. On 22 Feb 21, after 131 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 ($\alpha = 0.05$) was used for mean comparisons. The 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.

Rhizomania symptom development was uniform and other disease problems were not evident in the plot area. The BNYVV susceptible check plots (Check 1 and Red beet) had 100% foliar symptoms and high root disease ratings. Resistant check 3 had 1% foliar symptoms and a low root rating which indicates that resistance based on two genes is holding up. Single gene resistance (Checks 2 and 4) had foliar ratings ranging from 8 to 13% indicating single gene resistance is not completely effective, but the root ratings were still good. Three entries (13, 19, and 25) had a level of BNYVV resistance similar to resistant check 3 based on both foliar and root ratings. A number of the entries had resistance to fungal rots in storage, but only entries 13 and 19 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	5 mn	1 k	17 r
Check 2	BTSSALCHK2 (*Rz2Rz2*) = *Rz2* resistant check	18 e-j	8 jk	21 qr
25	20171021	15 f-l	12 i-k	21 qr
19	20161004HO1	5 mn	16 i-k	21 q-r
13	20151014HO	10 h-n	8 jk	22 p-r
Check 4	BTSSALCHK4 (*Rz1Rz1*) = *Rz1* resistant check	11 h-n	13 i-k	22 o-r
10	20141007	10 h-n	8 jk	24 n-q
23	20171015PF	6 k-n	7 jk	25 m-p
9	20141004	19 e-h	79 b-d	25 m-p
5	20061005HO1	18 e-i	67 d-f	25 l-o
11	20141009	6 l-n	12 i-k	26 k-n
24	20171020	4 n	3 k	26 k-n
8	20131012PF	12 f-n	10 jk	27 k-n
7	20121013PF	6 l-n	76 cd	27 j-m
15	20151044PFHO	16 e-k	25 ij	27 j-m
12	20141018	5 mn	15 i-k	27 i-m
30	20191002	21 e-g	61 d-g	27 i-m
26	20171023HO	21 e-g	87 a-c	28 h-m
28	20171027PF	10 h-n	68 c-f	28 g-l
21	20161023PF	33 cd	56 e-g	28 g-l
16	20161003pf	39 bc	62 d-g	29 f-k
17	20161017	9 i-n	29 hi	29 e-j
6	20101008	7 k-n	87 a-c	30 e-j
29	20181025HO	8 j-n	7 jk	30 e-i
14	20151016	11 g-n	52 fg	30 e-h
22	20161028PF	22 ef	12 i-k	31 e-h
27	20171023HO1	14 f-m	68 c-f	31 e-g
1	1997A050	26 de	78 b-d	32 d-f
20	20161016PF	68 a	46 gh	33 c-e
4	20041010HO1	6 k-n	73 c-e	33 c-e
18	20161004HO	13 f-n	10 jk	36 c-e
3	20041010HO	6 l-n	79 b-d	38 a-d
Check 1	BTSSALCHK1 (*rzrz*) = susceptible sugar beet check	21 e-g	100 a	39 a-c
2	2013A081	48 b	97 ab	42 ab
Red beet	Early Wonder (*rzrz*) = susceptible red beet check	ND	100 a	48 a
P > F[w]		<0.0001	<0.0001	<0.0001
LSD		10	19	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. ND = no data.

[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 with the mixed linear models procedure, 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.