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

C. A. Strausbaugh, USDA-ARS NWISRL, 3793 N. 3600 E., Kimberly, ID 83341 and K. Dorn and A. Fenwick, USDA-ARS Sugar Beet Res. Unit, Crops Res. Lab, 1701 Centre Ave., Ft. Collins, CO 80526

Ft. Collins sugar beet germplasm evaluated for rhizomania and storage rot resistance in Idaho, 2019.

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 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. We were unsuccessful in establishing plants for entry 24, so only 29 entries are presented in the table. The BNYVV susceptible check plots (Check 1 and Red beet) had 100% foliar symptoms and high root disease ratings. Resistant check 3 had 0% 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 14 to 24% indicating single gene resistance is not completely effective, but the root ratings were still good. Four entries (4, 8, 13, and 23) 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 4, 8, and 13 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 2	BTSSALCHK2 (*Rz2Rz2*) = *Rz2* resistant check	21 e-g	14 jk	26 a
Check 3	BTSSALCHK3 (*Rz1Rz1 Rz2Rz2*) = *Rz1* + *Rz2* resistant check	5 j-l	0 k	26 ab
8	FC1742 BI re-sel rz1rz1 rz2rz2; SNP/SCAR sel C37 w/Rz2	2 l	23 h-k	27 a-c
9	FC1743 BI re-sel Rz1Rz1 rz2rz2; SNP/SCAR sel C37 w/Rz2	2 l	28 h-j	28 a-c
13	20081016PF-54 -46 -34 -33 -31 -30; FC1037 - sel 1/2 sib family EL	3 kl	8 jk	28 a-c
21	20121018HO-x - Bulk selected for rhizoctonia 2014	21 e-g	41 f-i	30 a-c
23	20121018HO-119pf & 20121018HO-187pf20121018HO-187pf	16 e-j	17 i-k	31 b-e
30	20151033, B.I. of 20131002pfHO, T2 [R1741 Pop (rz1rz1Rz2Rz2)]	5 k-l	32 f-j	32 a-d
Check 4	BTSSALCHK4 (*Rz1Rz1*) = *Rz1* resistant check	21 e-g	24 h-k	32 b-e
4	03-124 FC123 derivative	9 g-l	10 jk	32 b-e
26	20141020; Increase F3 of CN12-446 x FC708 [SBCN x RhzcR/LSR]	5 k-l	32 g-j	33 c-g
5	03-124 CMS equivalent	24 d-f	54 d-g	33 c-f
14	07-FC1015-403 - Combine mod. CR, Rz1, with mm, T-O, %S	6 j-l	25 h-j	37 d-h
27	20111019-x; BI 20071009H2 (Iso 6) - LSR	15 f-k	32 g-j	37 e-h
6	(Best FC LSR x Best EL LSR) - mm seed balls Increased	11 g-l	100 a	38 d-h
18	20101015HO1-x/20131012MS; 20101015HO1-x/20101015HO-xs	5 k-l	0 k	38 f-i
3	FC712/MonoHy A4 - CMS equivalent	9 g-l	97 ab	38 e-i
11	20111030; 20091030PF; 20071004HO-xs; LSRMM	18 e-i	92 ab	38 f-j
20	20121019HO & HO1 - Increase 03-FC1015HO & HO1	3 kl	17 i-k	39 f-k
22	20071005H2; Bulk Z325 x 20011037 [961005 x 94A080]	28 de	80 a-c	42 h-l
25	20141035; 20121055; 20081012PF-23, -29 - LSRsel Bvm x S%MM	35 cd	73 b-d	42 h-l
16	Bulk 0931 & 9933 x BCN Resistant, Iranian sugar beet landrace	28 de	39 g-i	42 g-k
28	20111019-x; BI 20071009H2 (Iso 6) - (Z325aa x [20011045MS])	20 e-h	57 c-f	43 h-l
15	FC221 = {[(4918aa x (FC902, FC607)] F2; (2915 x FC709-2)}	6 i-l	66 c-e	44 i-l
29	20111019-x; BI 20071009H2 (Iso 6) - (Z325aa x [20011045MS])	28 de	67 c-e	44 h-l
7	Increase 5 highest CLR families 20071004HO-xs; LSRMM	45 bc	100 a	45 j-m
10	FC221-1; ({4918, 2915aa} x {FC902, FC607, FC709-2})-hs-blk-hs	13 f-l	100 a	46 k-m
1	FC607, LSR/CTR, easy bolting, O-type, 2X, mm, self sterile	11 g-l	100 a	48 l-n
2	FC712/MonoHy A4	8 h-l	95 ab	51 l-n
19	20101016HO1-xs/20101016HO-x; selfed fam (07-FC1015-420)	9 g-l	43 e-h	51 lm
17	20101013-xs; BI 20101013-95 (Z325aa x {BGRC 45511 x SucMM})	56 b	100 a	59 m-o
Check 1	BTSSALCHK1 (*rzrz*) = susceptible sugar beet check	25 d-f	100 a	67 no
12	B.v. vulgaris Poland REKORD POLY 2010i PI 535827 2010I SD	50 b	100 a	70 no
Red beet	Early Wonder (*rzrz*) = susceptible red beet check	86 a	100 a	76 o
P > F[w]		<0.0001	<0.0001	<0.0001
LSD		13	24	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. 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.