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, 2017.

Forty-two 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 2016. 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 17. The germplasm was planted (density of 142,560 seeds/A) on 4 May. The plots were one row 10-ft long with 22-in. 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 3 Jun. The trial relied on endemic field inoculum for rhizomania and storage rot development. The plots were rated for foliar symptom (percentage of plants with yellow, stunted, upright leaves) development on 21 Aug. The plants were mechanically topped and hand harvested on 11 Oct. At harvest, eight roots per 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 11 Oct. On 18 Feb 18, after 132 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 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. The BNYVV susceptible check plots (Check 1 and RB) had 97 to 100% foliar symptoms and high root disease severity ratings. The three resistant checks (2, 3, and 4) had 0 to 6% foliar symptoms and low root ratings. Based on root ratings, all entries except entry 20151043PF had some level of resistance since they were all better than the susceptible checks. However, 20141018 was the only entry that performed well for all variables. 20161023PF also had a good root rating, but had considerable foliar symptoms. 20151044PFHO and 20151046PFHO had no foliar symptoms and very little storage rot, so the poor root rating may be related to inherently poor root shape and not a lack of BNYVV resistance. Twenty-six of the entries had resistance to fungal rots in storage, because they were not different from 20161014HO and Check 3. 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 4	**BTSSALCHK4 (*Rz1Rz1*) = *Rz1* resistant check**	**27 g-j**	**6 q-s**	**17 t**
Check 3	**BTSSALCHK3 (*Rz1Rz1 Rz2Rz2*) = *Rz1* + *Rz2* resistant check**	**12 l-o**	**0 s**	**21 st**
Check 2	**BTSSALCHK2 (*Rz2Rz2*) = *Rz2* resistant check**	**34 e-g**	**3 rs**	**23 st**
20141018	20121036; [(FC907 × FC709-2) & 9931] x [C790-15cms × FC1036]	16 j-o	12 o-s	26 rs
20161023PF	20111018-x, (Z325 × [LSR Giant Poly (PI535826) × SucroseMM])	44 b-e	49 e-k	27 q-s
20161026PF	20111019-x; (Z325aa x [20011045MS (WB853 × SucroseMM)])	12 l-o	9 p-s	30 p-r
20101012	C790-15cms x RZM-CR-% (FC712 × 9931)F3	14 k-o	28 j-r	32 o-r
20141019PF	FC220-2; 20121037PF&MS; (FC220-1 - inc. 20051030) RhzcR	11 l-o	20 n-s	32 n-r
20151020	20101013-xs; B.I. Roots selected at EL in 2010 & 2011	16 j-o	22 m-s	32 n-r
20061005HO1	03-124 CMS equivalent	17 j-n	33 h-p	33 m-q
20151017	20121018HO-x - Bulk increase of roots selected for RhzcR	13 l-o	20 n-s	33 l-q
20161014HO1	20061005HO & 20061005HO1; 03-124 FC123 derivative and CMS	11 l-o	38 g-o	33 l-q
20151042	20101013-xs; B.I. Z325aa × (BGRC 45511 × SucroseMM)	25 g-k	29 i-q	33 l-q
20161004HO	20121018HO-119pf & 20121018HO-187pf20121018HO	9 m-o	18 n-s	34 l-p
20161004HO1	20121018HO1 - 2014 EL & Kimberly (CT) high performers	8 no	49 e-l	34 l-p
20161030HO1	20121018HO-x & 20121018HO1; 03-FC1014-22; sib 20151017	12 l-o	55 e-h	34 k-p
20151038PF	20071005H2 - Z325CMS (Salinas % sucrose) × 20011037	36 d-g	72 b-e	35 k-p
20161014HO	20061005HO & 20061005HO1; 03-124 FC123 derivative and CMS	5 o	29 i-q	35 k-p
20131011	20081016PF (Best FC LSR × Best EL LSR) × CR011 F3	14 k-o	22 m-s	35 k-p
20121013PF	FC221-1	14 k-o	52 e-j	35 k-p
20141004	FC221	11 l-o	39 f-n	36 k-p
20161029HO1	20121018HO-x & 20121018HO1; 03-FC1014-22	10 l-o	33 h-p	36 j-p
20111031	20071003H2; LSR {(BGRC 45511) × Sucrose} × Z325aa	12 l-o	27 k-r	36 j-p
20161030PFHO	20121018HO-x & 20121018HO1; 03-FC1014-22 (hs sel FC201)	9 m-o	52 e-j	37 i-o
20161017	20141020; Increase F3 of CN12-446 × FC708 [SBCN × RhzcR/LSR]	8 no	39 f-n	37 i-o
20101010	C790-15cms × 05-FC1018 [RZM-CR-% (C931 × FC709-2)F3]	31 f-h	48 e-l	37 i-o
20151016	20111024-x, [(FC907×FC709-2) & 9931] × [C790-15cms × FC1036]	10 l-o	33 h-p	37 i-o
20121012HO	FC302 = 03-FC1014-22 (half sib selection within FC201) - sel in 6R	20 h-m	77 a-e	38 h-o
20151014HO	20121019HO & HO1 - Increase 03-FC1015HO & HO1	10 l-o	25 k-s	38 h-o
20161025PF	20111019-x; (Z325aa × [20011045MS (WB853 × SucroseMM)])	26 g-k	63 c-f	39 h-n
20061005HO	03-124 FC123 derivative	12 l-o	39 f-n	40 h-m
20161029PFHO	20121018HO-x & 20121018HO1; 03-FC1014-22 (hs sel FC201)	8 no	47 e-m	40 h-l
20111028	20091028ms; CLR family (BGRC 45511 × SucroseMM)	19 i-n	54 e-h	41 g-k
20161028PF	20121014-x; (Blk Inc 05-FC1023m(iso)[2005A020], half sibs of FC301	11 l-o	23 l-s	41 g-k
20111030	Increase 5 highest CLR families 20071004HO-xs; LSRMM w/Fargo	40 c-f	97 ab	42 f-j
20151044PFHO	20101015HO1-x/20131012MS	14 k-o	0 s	43 e-i
20131012PF	07-FC1015-403 - Combine mod. CR, Rz1, CTR, with mm, T-O, %S	29 f-i	30 h-q	44 e-h
20161024PF	20111019-x; (Z325aa x [20011045MS (WB853 × SucroseMM)])	21 h-l	23 l-s	45 e-h
20161003PF	20111039MS/PF Z325 × BGRC28938	55 ab	53 e-i	47 d-g
20161027PF	20101014HO-xs; BI from 07-FC124-425	15 k-o	8 p-s	47 d-g
20141022PF	Bulk 0931 & 9933 × BCN Resistant, Iranian sugarbeet landrace	34 e-g	22 m-s	48 d-f
1997A050	FC607, LSR/CTR, easy bolting, O-type, 2X, mm, self-sterile	17 j-n	89 ab	49 de
20151046PFHO	20101016HO1-xs/20101016HO-x; Kimberly sel CTR	12 l-o	0 s	52 cd
20161016PF	20141035; 20121055; 20081012PF-23, -29 - LSRsel Bvm × S%MM pop	62 a	60 c-g	52 cd
20151043PF	20101013-xs; B.I. Z325aa × (BGRC 45511 × SucroseMM)	48 bc	85 a-c	57 bc
Check 1	**BTSSALCHK1 (*rzrz*) = susceptible check**	**47 b-d**	**97 ab**	**62 b**
RB	**Detroit Dark Red, susceptible commercial red beet cultivar**	**ND**	**100 a**	**75 a**
P > F[w]		<0.0001	<0.0001	<0.0001
LSD		12	26	7

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

[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), *Botrytis cinerea*, *Penicillium expansum*, and *Penicillium cellarum*.

[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. ND = no data.