

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 B. Hellier, USDA-ARS Western
Regional Plant Introduction Station, 59 Johnson Hall, Pullman,
WA 99164

Rhizomania and storage rot resistance in USDA-ARS Plant Introduction Lines evaluated in Idaho, 2018.

Thirty sugar beet (*Beta vulgaris* L.) Plant Introduction (PI) Lines from the USDA-ARS National Plant Germplasm System (NPGS), 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 evaluation was conducted at the USDA-ARS North Farm in Kimberly, ID which has Portneuf silt loam soil and had been in barley in 2017. In the spring the field was plowed and then fertilized (60 lb N and 110 lb P₂O₅/A) and roller harrowed on 5 Apr 18. The germplasm was planted (density of 142,560 seeds/A) on 25 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 26 May. 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 7 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 placed in an indoor commercial storage facility (temperature set point 34°F) in Paul, ID on 16 Oct. On 11 Feb 19, after 119 days in storage, the roots were evaluated for the percentage of root surface area (0 to 100%) covered by fungal growth and 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. 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 check (Check 1) had 97% foliar symptoms and a high root disease severity rating. The three resistant checks (2, 3, and 4) had 0 to 6% foliar symptoms and the lowest root ratings. Although the root ratings for entries 5 and 7 were not significantly different from the resistant checks, none of the PI Line entries had acceptable root ratings. Entries 3, 23, and 24 had foliar ratings that were better than the other PI Line entries indicating they may contain some level of resistance to BNYVV. The root ratings for these three entries may have been affected by poor inherent root shape and may not necessarily represent a lack of resistance to BNYVV. Entry 3 was the only entry that performed well for all three variables. Some of the 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)	Root rating ^x
Check 4	BTSSALCHK4 (<i>Rz1Rz1</i>) = <i>Rz1</i> resistant check	10 l-o	6 e	22 p
Check 3	BTSSALCHK3 (<i>Rz1Rz1 Rz2Rz2</i>) = <i>Rz1</i> + <i>Rz2</i> resistant check	6 no	0 e	22 p
Check 2	BTSSALCHK2 (<i>Rz2Rz2</i>) = <i>Rz2</i> resistant check	9 m-o	3 e	26 p
5	CS 42, NSL 141986 2010i SD, United States, California	11 l-o	97 a	46 op
7	Yugo 5, NSL 176410 2010i SD, Former Serbia and Montenegro	19 j-n	92 ab	48 n-p
3	Thurles I, Ames 8447 2009i SD, Ireland	12 k-o	27 d	52 k-n
22	AD-2, PI 518780 98i SD, United States, Colorado	8 no	96 a	53 m-o
4	Janasz, NSL 141985 2010i SD, United States, California	7 no	93 ab	55 l-o
20	FC 707(4x), PI 506238 98i SD, United States, Colorado	3 o	100 a	55 m-o
Check 1	BTSSALCHK1 (<i>rzrz</i>) = susceptible check	12 l-o	97 a	56 h-n
24	WB 871, PI 540617 2009i SD, France	28 g-j	3 e	56 j-n
25	FC 702/6, PI 590703 98i SD, United States, Colorado	2 o	100 a	57 i-n
27	F1004, PI 590763 97i SD, United States, North Dakota	2 o	97 a	59 g-n
6	R & G Pioneer, NSL 142025 2010i SD, United States, California	16 j-o	100 a	59 e-m
15	Kocabas, PI 176432 2012i SD, Turkey	75 bc	98 a	59 f-n
16	IDBBNR 5377, PI 206407 2012i SD, Turkey	52 ef	83 bc	60 e-m
17	Lablaboo, PI 220509 98i SD, Afghanistan	72 b-d	98 a	60 e-m
26	FC 702/7, PI 590755 98i SD, United States, Colorado	3 o	100 a	60 e-m
1	WIR 2293, Ames 19159 2003i SD, Russian Federation	22 h-m	97 a	61 e-l
2	IDBBNR 9496, Ames 8279 2011i SD, United Kingdom, England	73 b-d	93 ab	62 e-k
23	WB 870, PI 540616 2009i SD, France	35 gh	28 d	62 d-i
8	72/4-4-2-0, NSL 86577 2003i SD, United States, Colorado	21 i-n	82 bc	62 d-k
9	Choghondar, PI 142812 98i SD, Iran	26 h-k	97 a	63 d-h
28	A77-50, PI 608798 97i SD, Chile	35 g-i	78 c	63 d-j
18	Laboo, PI 222233 99i SD, Iran	95 a	100 a	63 d-g
21	F1008, PI 510669 2014i SD, United States, North Dakota	24 h-l	100 a	64 c-f
30	A80-17, PI 608803 97i SD, Chile	42 fg	90 a-c	65 c-f
12	IDBBNR 5297, PI 172735 98i SD, Turkey	85 ab	100 a	65 c-f
11	IDBBNR 5271, PI 169027 2010i SD, Turkey	75 bc	100 a	65 b-e
29	A78-30, PI 608799 97i SD, United States, Colorado	29 g-j	98 a	67 b-e
19	Chogondar, PI 222768 2011i SD, Iran	59 de	100 a	70 a-d
13	IDBBNR 5310, PI 174059 95i SD, Turkey	96 a	98 a	74 a-c
10	Palak, PI 164806 87ncab01 SD, India	65 c-e	100 a	75 ab
14	Kocabas, PI 176426 2002i SD, Turkey	61 c-e	100 a	76 a
$P > F^w$		<0.0001	<0.0001	<0.0001
LSD		14	12	Trans

^z Four commercial cultivars were included as checks (bold). The description for the non-check entries includes the name, inventory number, and origin.

^y Root rot in storage = the percent of root surface area covered by fungal growth and rot. Fungal growth was dominated by an *Athelia*-like basidiomycete (Mycologia 104:70-78), *Penicillium expansum*, and *Penicillium cellarum*. Some 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.