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

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Commercial sugar beet cultivars evaluated for rhizomania resistance and storability in Idaho, 2018.

Thirty commercial sugar beet (*Beta vulgaris* L.) cultivars and two rhizomania susceptible check cultivars were evaluated in a sprinkler-irrigated sugar beet field near Kimberly, ID where barley was grown in 2017. The trial was conducted in a field that contained Portneuf silt loam soil and relied on natural infection for rhizomania development. The field was plowed and fertilized (60 lb N and 110 lb P_2O_5/A) and roller harrowed on 5 Apr 18. The plots were planted on 24 Apr to a density of 142,560 seeds/A, and thinned to 47,520 plants/A on 25 May. Plots were four rows (22-in. between-row spacing) and 24-ft long. Treatments were arranged in a randomized complete block design with six replications. The crop was managed according to standard cultural practices in southern Idaho. Plots were rated for incidence of rhizomania foliar symptoms (percentage of plants with yellow, stunted, upright leaves) on 5 Sep. Plants were mechanically topped and the center two rows were dug with a mechanical harvester on 26-27 Sep. At harvest, the roots were evaluated for rhizomania symptoms using a scale of 0 to 9 (0 = healthy and 9 = dead) in a continuous manner (Plant Dis. 93:632-638). The percent sucrose at harvest was established based on two eight-root samples from each plot. The samples were submitted to The Amalgamated Sugar Co. Tare Lab for analysis of percent sucrose, conductivity, nitrates, and tare. At harvest, eight roots per plot were also placed in a mesh onion bag, weighed, and placed in an indoor commercial sugar beet storage facility in Paul, ID on 28 Sep set to hold 34°F. On 11 Feb 19, roots were retrieved after 136 days in storage and evaluated for surface root rot (% of root surface area), weight, and percent sucrose using high performance liquid chromatography (Plant Dis. 92:581-587). Only samples from the same plot were compared when establishing percent reduction in sucrose at harvest versus storage. Data were analyzed using the general linear models procedure (Proc GLM-SAS 9.4), and Fisher's protected least significant difference (LSD; $\alpha = 0.05$) was used for mean comparisons. The foliar data were arc-sine square root transformed and root rating data were rank transformed prior to analysis; non-transformed means are presented in the table.

Root rots and diseases other than rhizomania were not evident in the plot area. There were significant differences among cultivars for all variables. Rhizomania was uniform based on foliar symptoms (100%) in the susceptible checks, BTS4D20 and C-209. Most cultivars exhibited rhizomania resistance based on foliar symptoms, except for SV012, HM103425, and HM118711 which had 100% susceptible plants. These three cultivars also had root ratings that were not significantly different from the susceptible checks. The highest average root yield for any cultivar was 37.6 t/A, which was similar to Idaho's average of 40.7 t/A (USDA-National Ag. Stat. Service). The primary fungal growth in storage was an *Athelia*-like basidiomycete (Mycologia 104:70-78), but *Botrytis cinerea* Pers. and *Penicillium* spp. (*P. expansum* Link and *P. cellarum* C.A. Strausb. & Dugan) were also frequently present. After 136 days in storage, surface root rot ranged from 17 to 81%, weight loss ranged from 21.7 to 32.2%, sucrose reduction ranged from 44 to 87%, and estimated recoverable sucrose (ERS) after storage ranged from 803 to 7,207 lb/A. Given these response ranges, selecting cultivars for rhizomania resistance and combining this resistance with storability will lead to considerable economic benefit for the sugar beet industry. If cultivars with the highest sucrose reduction are considered for production in the future, they should only be directly processed (early harvest cultivars) and not stored based on data for root rot and sucrose reduction.

Cultivar [z]	Rhizomania rating[y]		Surface root rot (%)[x]	Weight reduction (%)[w]	Root yield (t/A)	ERS at harvest (lb/A)[v]	Sucrose reduction (%)[u]	ERS after storage (lb/A)
	Foliar (%)	Root						
C-54	0 i	1.4 m-p	34 h-k	23.7 d-g	37.5 ab	12,714 ab	44 p	7,207 a
C-49	0 hi	1.4 n-p	36 h-j	21.7 g	37.4 a-c	12,842 a	51 m-p	6,340 ab
SV033	2 ef	1.8 j-m	38 g-i	25.2 b-g	36.0 a-f	12,288 a-d	50 n-p	6,203 a-c
B-69	0 i	1.8 j-n	38 g-i	22.5 e-g	36.8 a-d	12,599 ab	53 l-o	5,848 b-d
C-36	0 hi	2.2 g-j	17 l	24.0 d-g	34.1 f-h	11,166 e-h	49 po	5,767 b-e
B-71	0 i	2.4 e-i	36 h-j	25.7 b-g	32.9 g-i	11,444 d-g	52 l-p	5,516 b-e
C-48	1 hi	2.0 j-l	61 d-f	25.7 b-g	35.4 a-f	11,738 c-f	53 l-o	5,474 b-f
B-66	1 gh	1.7 l-p	26 i-l	23.2 e-g	36.7 a-e	12,399 a-c	57 j-o	5,342 b-g
B-74	0 hi	1.9 j-n	57 ef	21.8 fg	35.6 a-f	12,364 a-c	58 i-o	5,209 b-g
SV032	6 c	1.4 op	37 h-j	22.8 e-g	37.5 ab	12,589 ab	59 i-m	5,106 c-g
SV025	2 ef	2.1 i-k	39 gh	23.7 d-g	35.4 a-f	12,254 a-d	59 i-n	5,078 c-g
B-46	0 i	2.3 d-h	40 gh	25.0 b-g	34.4 f-h	11,946 b-e	59 i-n	4,994 d-g
SX021	11 b	2.6 c-g	36 h-k	24.7 c-g	32.7 hi	10,903 f-h	54 k-o	4,974 d-g
SX026	2 fg	2.1 j-l	37 g-j	23.0 e-g	35.1 c-g	12,051 a-d	59 i-n	4,940 d-g
SX034	5 cd	1.8 j-n	62 c-e	24.5 d-g	35.4 a-f	12,174 a-d	61 h-l	4,734 d-h
B-48	1 gh	2.6 c-f	25 j-l	22.3 fg	32.2 hi	10,691 gh	57 j-o	4,674 e-i
SX030	11 b	1.9 j-n	38 g-i	24.0 d-g	35.0 d-g	11,674 c-f	64 g-k	4,331 f-j
SV028	5 cd	2.1 h-k	38 g-i	25.2 b-g	34.4 e-h	11,706 c-f	64 g-j	4,279 g-j
SV026	9 b	1.9 j-l	30 h-k	21.7 g	35.30 a-f	11,701 c-f	64 f-j	4,208 g-j
C-204	1 gh	1.7 k-o	49 fg	22.2 fg	36.4 a-f	12,044 a-d	70 d-h	3,582 h-k
HM126457	2 ef	3.1 a-d	81 a	25.2 b-g	29.5 jk	9,783 ij	65 f-j	3,505 i-l
SV012	100 a	3.0 a-c	53 ef	26.2 b-f	29.8 jk	9,804 ij	66 e-i	3,269 j-m
C-34	1 hi	2.7 b-e	24 kl	29.0 a-c	31.4 ij	10,522 hi	70 d-h	3,188 j-m
HM103425	100 a	2.7 a-e	76 ab	28.0 a-d	32.2 hi	9,662 jk	69 d-h	3,008 k-m
C-47	2 ef	2.6 c-g	63 b-e	24.0 d-g	32.5 hi	10,372 h-j	73 b-f	2,818 k-m
HM12SYN003	0 hi	2.0 h-k	72 a-d	29.3 ab	35.3 b-f	10,910 f-h	75 b-e	2,736 k-n
HM118711	100 a	3.1 a-c	79 a	26.8 b-e	28.8 k	8,866 k	73 c-g	2,413 k-o
C-39	3 de	2.3 f-j	58 ef	24.0 d-g	34.2 f-h	10,922 f-h	78 a-d	2,373 l-o
HM125891	1 hi	1.9 j-n	75 a-c	25.7 b-g	36.2 a-f	11,156 e-h	80 a-c	2,240 m-o
BTS4D20	100 a	4.3 ab	72 a-d	27.7 b-d	22.4 l	6,570 l	76 b-d	1,602 n-p
B-65	0 hi	1.3 p	55 ef	26.2 b-f	37.6 a	12,342 a-c	87 a	1,555 op
C-209	100 a	4.8 a	79 a	32.2 a	14.55 m	4,226 m	82 ab	803 p
$P > F$[t]	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001
LSD ($\alpha = 0.05$)	Trans	Trans	13	4.4	2.3	845	9	1170

[z] For more information on coded cultivars, contact the following companies: B = Betaseed Inc., C = ACH Seeds Inc., HM = Hilleshog, SV = SESVanderHave, and SX = Seedex. Rhizomania susceptible check cultivars were BTS4D20 and C-209 (Bold).

[y] Foliar = percentage of foliage in plot with rhizomania symptoms on 21 Aug. Root = roots were evaluated for rhizomania using a scale of 0 to 9 (0 = healthy, 9 = dead; Plant Dis. 93:632-638) in a continuous manner at harvest.

[x] Surface root rot = percentage of root surface area discolored in storage.

[w] Weight reduction = difference in weight from harvest to the end of storage.

[v] ERS = estimated recoverable sucrose was calculated as extraction x 0.01 x gross sucrose and extraction = 250 + [1255.2 x (conductivity -15000) x (percent sucrose - 6185)]/(percent sucrose x [98.66 - (7.845 x conductivity)]).

[u] Sucrose reduction (%) = (1-(((% $\text{Sucrose}_{\text{storage sample}}$ − 1.395) x $\text{Weight}_{\text{storage sample}}$)/(% $\text{Sucrose}_{\text{harvest sample}}$ x $\text{Weight}_{\text{harvest sample}}$))) x 100.

[t] $P > F$ was the probability associated with the F value. Within each variable, means followed by the same letter did not differ significantly based on Fisher's protected least significant difference (LSD; $\alpha = 0.05$). Trans = the foliar data were arc sine square root transformed and the root rating data were rank transformed prior to analysis, but the non-transformed means are presented in the table.