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

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Experimental sugar beet cultivars evaluated for rhizomania resistance and storability in Idaho, 2016.

Thirty-one experimental sugar beet cultivars and two rhizomania susceptible check cultivars were evaluated in a sprinkler-irrigated sugar beet field near Kimberly, ID where barley was grown in 2015. The trial was conducted in a field that contained Portneuf silt loam soil and relied on natural infection for rhizomania development. The field was fall plowed and in the spring, fertilized (90 lb N and 110 lb P_2O_5/A) and roller harrowed on 4 Apr 16. The plots were planted on 18 Apr to a density of 142,560 seeds/A, and thinned to 47,520 plants/A on 27 May. Plots were four rows (22-in. row spacing) and 24-ft long. The experimental design was a randomized complete block design with six replications. The crop was managed according to standard cultural practices in southern Idaho. The plots were rated for rhizomania foliar symptom (percentage of plants with yellow, stunted, upright leaves) development on 19 Aug. The plants were mechanically topped and the center two rows were dug with a mechanical harvester on 4-5 Oct. At harvest, the roots were evaluated for rhizomania 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 (determined 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 6 Oct set to hold 34°F. On 13 Feb 17, roots were retrieved after 130 days in storage and evaluated for surface root rot (% of root surface area), weight, and percent sucrose using gas 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 prior to analysis, but the non-transformed means are presented in the table.

Root rots and other disease problems 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, with the worst foliar rating being only 4% susceptible plants. SYN16803 was the commercial cultivar that ranked the greatest for rhizomania root rating, but this cultivar was still significantly better than the susceptible checks. The greatest average root yield for any cultivar was 49.67 t/A, which was better than Idaho's average of 41.4 t/A (USDA-National Ag. Stat. Service). The primary fungal growth 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 130 days in storage, surface root rot ranged from 4 to 31%, weight loss ranged from 6.7 to 12.3%, sucrose losses ranged from 18 to 52%, and estimated recoverable sucrose (ERS) after storage ranged from 2,901 to 11,290 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 greatest sucrose reduction are considered for production in the future, they should only be directly processed (early harvest cultivars) and not stored based on observations for root rot and sucrose losses.

Cultivar[z]	Rhizomania rating[y] Foliar (%)	Root	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)
B-69	0 f	2.0 jk	7 f-h	9.1 c-h	45.60 bc	14,056 a-d	20 jk	11,290 a
B-71	0 ef	2.1 g-j	6 f-h	8.7 d-j	43.04 d-i	13,568 c-g	20 jk	10,881 ab
C-49	0 f	2.0 h-j	5 gh	7.1 h-j	45.62 bc	14,524 ab	26 h-k	10,837 ab
SV031	0 ef	2.0 g-j	10 d-h	8.1 d-j	45.27 b-e	14,120 a-c	24 i-k	10,705 a-c
SX030	0 ef	2.0 i-k	10 d-h	7.4 f-j	45.20 b-f	14,144 a-c	25 h-k	10,614 a-d
SV032	1 e	2.2 f-h	10 d-h	8.5 d-j	42.50 g-i	13,450 c-h	23 i-k	10,422 a-e
SV033	0 f	2.1 g-j	8 e-h	8.4 d-j	43.49 b-i	13,610 c-g	24 i-k	10,419 a-e
SV028	0 ef	2.0 g-j	7 f-h	6.9 ij	44.49 b-g	13,997 a-d	26 h-k	10,351 a-e
B-66	0 ef	2.0 i-k	11 d-h	8.9 c-j	45.70 b	14,536 ab	29 g-j	10,245 a-f
B-75	0 f	2.0 g-j	11 d-h	8.4 d-j	44.36 b-h	13,873 b-f	27 h-k	10,083 a-g
B-74	0 f	1.9 jk	16 b-f	9.1 c-h	45.53 b-d	14,576 ab	31 e-i	10,034 a-g
B-70	0 ef	2.0 jk	12 c-h	8.4 d-j	45.59 bc	14,125 a-c	30 g-j	9,955 a-g
SX031	0 f	2.0 g-j	13 c-h	8.2 d-j	44.57 b-g	14,157 a-c	31 f-i	9,820 a-h
C-52	0 ef	1.8 k	31 a	11.0 a-c	49.67 a	14,856 a	35 d-h	9,684 b-i
C-55	1 de	2.3 d-f	17 b-e	9.7 b-e	39.85 jk	12,634 hi	23 i-k	9,676 b-i
B-73	0 ef	2.0 g-j	14 c-g	8.3 d-j	44.17 b-h	13,958 b-d	31 e-i	9,593 b-i
SX034	0 ef	2.1 g-j	11 d-h	7.7 e-j	43.41 b-i	13,936 b-e	32 e-i	9,518 b-i
B-76	0 f	2.0 g-j	14 c-g	10.1 b-d	44.06 b-h	13,520 c-g	32 e-i	9,263 c-i
SX033	0 ef	2.2 f-i	7 f-h	9.5 c-f	41.97 h-j	12,977 g-i	29 g-j	9,174 d-j
SYN16602	0 ef	2.4 de	9 d-h	7.3 g-j	37.92 kl	11,632 jk	22 i-k	9,063 e-k
C-54	0 f	2.0 g-j	14 c-g	8.3 d-j	44.38 b-h	14,139 a-c	38 c-g	8,761 f-l
SX035	0 ef	2.1 g-j	13 c-h	11.0 a-c	42.75 f-i	13,906 b-f	37 c-g	8,700 g-l
SYN16803	2 cd	2.7 c	11 d-h	7.3 g-j	34.13 m	10,253 l	18 k	8,397 h-m
SV029	0 ef	2.1 g-j	10 d-h	8.6 d-j	43.51 b-i	13,070 f-i	37 c-g	8,181 i-m
B-65	0 ef	2.1 g-j	21 bc	8.7 d-j	42.95 e-i	13,096 e-i	41 b-e	7,729 j-n
SYN16601	4 b	2.5 d	12 d-h	8.4 d-j	36.68 l	11,171 k	32 e-i	7,630 k-n
C-53	0 f	2.1 g-j	21 bc	8.9 c-i	43.17 c-i	13,215 d-h	42 a-d	7,616 k-n
B-77	0 f	2.3 d-f	4 h	9.3 c-g	39.75 jk	12,340 ij	39 c-g	7,531 l-n
SYN16804	1 e	2.2 e-g	18 b-d	9.6 b-e	41.24 ij	12,932 g-i	45 a-c	7,120 mn
SYN16802	0 ef	2.5 d	6 f-h	6.7 j	37.03 l	11,424 k	39 c-g	7,002 mn
SYN16801	2 c	2.5 d	13 c-g	8.9 c-j	36.47 lm	11,076 kl	40 b-f	6,655 n
BTS4D20	100 a	3.8 b	25 ab	11.7 ab	29.47 n	8,029 m	52 a	3,822 o
C-209	100 a	4.1 a	31 a	12.3 a	21.03 o	5,744 n	50 ab	2,901 o
$P > F$[t]	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
LSD ($\alpha = 0.05$)	Trans	0.2	9	2.2	2.51	860	10	1,515

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

[y] Foliar = percentage of foliage in plot with rhizomania symptoms on 19 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 × 0.01 × gross sucrose and extraction = 250 + [1,255.2 × (conductivity -15,000) × (percent sucrose – 6,185)]/(percent sucrose × [98.66 - (7.845 × conductivity)]).

[u] Sucrose reduction (%) = $(1-(((\%\ Sucrose_{storage\ sample} - 1.395) \times Weight_{storage\ sample})/(\%\ Sucrose_{harvest\ sample} \times Weight_{harvest\ sample}))) \times 100$.

[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 prior to analysis, but the non-transformed means are presented in the table.