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

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**Commercial sugar beet cultivars evaluated for rhizomania resistance and storability in Idaho, 2014.**

Thirty-three commercial 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 2013. 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 11 Apr 14. The plots were planted on 21 Apr to a density of 142,560 seeds/A, and thinned to 47,520 plants/A on 31 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. The plots were rated for rhizomania foliar symptom (percentage of plants with yellow, stunted, upright leaves) development on 23 Jul. The plants were mechanically topped and the center two rows were dug with a mechanical harvester on 24-25 Sep. At harvest, the roots were evaluated for rhizomania using a scale of 0 to 9 (0 = healthy and 9 = dead) in a continuous manner. 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 25 Sep set to hold 34°F. On 9 Feb 15, roots were retrieved after 138 days in storage and evaluated for surface root rot (% of root surface area), weight, and percent sucrose (via gas chromatography). 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), and Fisher's protected least significant difference (LSD; $\alpha = 0.05$) was used for mean comparisons.

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 (96 to 98% susceptible) in the susceptible checks, B-54 and C-209. Most cultivars exhibited good rhizomania resistance, with the worst foliar rating being only 3% susceptible. Five entries (B-48, B-57, B-58, C-40, and HM126457) ranked higher for rhizomania root rating, but were still significantly better than the susceptible checks. Root yield averaged 38.38 t/A, which was similar to Idaho's average of 37.5 t/A (USDA-National Ag. Stat. Service) and also indicates rhizomania resistance was adequate. The primary fungal growth was an *Athelia*-like Basidiomycete (Mycologia 104:70-78), but *Botrytis cinerea*, *Penicillium* spp., and *Phoma betae* were also frequently present. After 138 days in storage, surface root rot ranged from 7 to 82%, weight loss ranged from 9.4 to 19.1%, sucrose losses ranged from 23 to 85%, and estimated recoverable sucrose (ERS) after storage ranged from 931 to 8,798 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.

| Cultivar[z] | Rhizomania rating[y] Foliar (%) | Rhizomania rating[y] 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-58 | 0 e | 2.6 cd | 16 h-j | 11.3 e-h | 41.45 a-e | 11,259 a-d | 23 n | 8,798 a |
| SX021 | 0 e | 2.2 g-k | 15 h-j | 9.7 gh | 40.85 b-f | 11,355 ab | 23 n | 8,748 a |
| B-48 | 0 e | 2.6 c-e | 7 ij | 10.1 f-h | 37.85 g-m | 10,760 b-h | 25 mn | 8,058 ab |
| SX027 | 0 e | 2.2 g-k | 14 h-j | 10.1 f-h | 40.33 b-g | 10,983 a-e | 29 k-n | 7,790 a-c |
| C-41 | 0 e | 2.3 f-j | 29 f-h | 11.8 d-h | 42.56 a-d | 11,815 a | 35 h-n | 7,727 a-c |
| B-56 | 0 e | 2.3 f-i | 14 h-j | 10.3 f-h | 38.50 e-m | 10,496 b-j | 27 k-n | 7,656 a-c |
| C-29 | 0 e | 2.2 g-k | 31 e-h | 11.4 e-h | 39.62 d-k | 10,563 b-j | 29 k-n | 7,554 a-d |
| B-57 | 0 e | 2.6 c-e | 18 h-j | 9.4 h | 37.10 i-m | 10,252 d-k | 27 k-n | 7,518 a-d |
| SX026 | 0 e | 2.2 g-k | 15 h-j | 10.5 f-h | 40.52 b-g | 11,296 a-c | 34 h-n | 7,496 a-e |
| SV022 | 2 cd | 2.4 d-g | 28 f-i | 11.9 d-h | 38.50 e-m | 11,256 a-d | 33 h-n | 7,456 a-e |
| B-46 | 0 e | 2.3 f-j | 14 h-j | 10.1 f-h | 38.70 e-m | 10,666 b-i | 30 j-n | 7,451 a-e |
| C-34 | 0 e | 2.3 f-i | 44 d-g | 11.3 e-h | 38.77 e-m | 10,693 b-h | 32 i-n | 7,199 a-f |
| SX019 | 2 cd | 2.3 f-i | 7 j | 11.5 e-h | 35.81 mn | 9,679 i-k | 26 l-n | 7,178 a-f |
| SV010 | 1 de | 2.3 f-j | 29 f-h | 12.9 d-h | 38.44 f-m | 10,376 b-k | 33 h-n | 6,934 b-g |
| SX015 | 0 e | 2.4 d-g | 14 h-j | 12.1 d-h | 39.05 e-l | 10,325 c-k | 34 h-n | 6,758 b-g |
| SV016 | 0 e | 2.2 g-k | 23 h-j | 11.8 d-h | 39.22 e-l | 10,975 a-e | 39 f-m | 6,657 b-g |
| C-36 | 0 e | 2.4 d-f | 29 f-h | 15.5 a-d | 40.33 b-g | 10,454 b-j | 37 g-n | 6,598 b-g |
| HM12SYN003 | 0 e | 2.4 d-f | 17 h-j | 9.6 gh | 37.32 h-m | 9,562 jk | 33 i-n | 6,589 b-g |
| HM103425 | 1 de | 2.4 f-h | 23 g-j | 10.7 e-h | 40.23 b-h | 10,347 b-k | 36 h-n | 6,575 b-g |
| SV012 | 2 cd | 2.4 e-h | 25 g-j | 11.4 e-h | 38.07 f-m | 10,532 b-j | 42 f-k | 6,129 c-h |
| C-204 | 0 e | 2.1 k | 30 f-h | 9.5 gh | 43.17 ab | 10,873 a-g | 45 e-j | 5,932 d-i |
| B-7 | 2 cd | 2.4 d-f | 33 e-h | 14.4 b-e | 36.64 k-n | 9,793 h-k | 40 f-l | 5,864 d-i |
| C-39 | 0 e | 2.2 i-k | 41 d-g | 12.4 d-h | 42.62 a-c | 11,275 a-c | 48 d-i | 5,857 d-i |
| B-110 | 1 de | 2.4 e-h | 33 e-h | 12.5 d-h | 36.36 l-n | 9,442 k | 38 g-n | 5,814 e-i |
| HM 118711 | 1 de | 2.3 f-i | 48 c-f | 13.1 d-h | 40.52 b-g | 10,674 b-i | 48 d-i | 5,578 f-i |
| C-40 | 0 e | 2.7 c | 28 f-j | 13.8 b-f | 34.06 n | 9,410 k | 41 f-l | 5,564 f-i |
| HM10038080 | 0 e | 2.3 f-j | 56 b-d | 13.7 b-f | 36.76 j-n | 10,189 e-k | 48 d-h | 5,364 g-j |
| SV011 | 1 de | 2.2 g-k | 51 b-e | 13.3 c-g | 39.90 c-i | 10,352 b-k | 53 c-g | 4,766 h-k |
| HM126457 | 3 c | 2.6 c | 67 a-c | 17.1 a-c | 36.42 l-n | 9,880 g-k | 54 c-f | 4,578 h-k |
| HH016 | 1 de | 2.2 h-k | 48 c-f | 12.8 d-h | 40.38 b-g | 10,125 e-k | 58 c-e | 4,265 i-k |
| HM123367 | 1 de | 2.1 k | 71 ab | 14.4 b-e | 42.62 a-c | 10,928 a-f | 66 bc | 3,670 j-l |
| HM125891 | 0 e | 2.2 g-k | 55 b-d | 13.3 c-g | 39.68 c-j | 9,945 f-k | 62 b-d | 3,651 lk |
| B-43 | 2 cd | 2.1 jk | 81 a | 15.5 a-d | 43.88 a | 10,720 b-h | 76 ab | 2,554 lm |
| B-54 | 96 b | 3.4 b | 82 a | 17.4 ab | 27.86 o | 6,264 l | 85 a | 1,057 m |
| C-209 | 98 a | 4.2 a | 71 ab | 19.1 a | 19.32 p | 4,390 m | 78 ab | 931 m |
| Overall mean | 6 | 2.4 | 34 | 12.4 | 38.38 | 10,225 | 42 | 6,066 |
| *P* > *F*[t] | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| LSD (α = 0.05) | 1 | 0.2 | 21 | 3.8 | 2.99 | 1,011 | 16 | 1,701 |

[z] For more information on coded cultivars, contact the following companies: B = Betaseed Inc., C = ACH Seeds Inc., HH = Holly Hybrids, HM = Hilleshog, SV = SESVanderHave, and SX = Seedex. Rhizomania susceptible check cultivars (bold) were B-54 and C-209.

[y] Foliar = percentage of foliage in plot with rhizomania symptoms on 23 Jul. 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 (%) = $(1-(((\%\ Sucrose_{storage\ sample} - 1.395) \times Weight_{storage\ sample})/(\%\ Sucrose_{harvest\ sample} \times Weight_{harvest\ sample}))) \times 100$.

[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; α = 0.05).