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

**Experimental sugar beet cultivars evaluated for rhizomania resistance and storability in Idaho, 2020.**

Fourteen experimental 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 2019. 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 (110 lb N and 120 lb $P_2O_5$/A) and roller harrowed on 27 Mar 20. The plots were planted on 20 Apr to a density of 51,840 seeds/A. Plots were four rows (22-in. between-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 24 Aug. The plants were mechanically topped and the center two rows were dug with a mechanical harvester on 5-6 Oct. At harvest, the roots were evaluated for rhizomania symptoms using a scale of 0 to 9 (0 = healthy and 9 = dead; 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 7 Oct set to hold 34°F. On 23 Feb 21, roots were retrieved after 140 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. Except for root ratings, 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. The root ratings were rank transformed prior to analysis with mixed linear models (Proc MIXED) and mean separation was based on PDIFF ($\alpha = 0.05$). For transformed data, the non-transformed means have been 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, but all the entries were resistant (0.0 to 1.0%). All entries also had root ratings (2.1 to 2.4) that were significantly better than the susceptible checks (4.2 to 5.3). The highest average root yield for any cultivar was 43.2 t/A, which was similar to Idaho's average of 40.5 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 140 days in storage, surface root rot ranged from 12 to 67%, weight loss ranged from 20.9 to 36.1%, sucrose reduction ranged from 34 to 63%, and estimated recoverable sucrose (ERS) after storage ranged from 1,572 to 9,526 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 | | | | | | |
| SX039 | 0.4 c-f | 2.1 g | 18 d-g | 25.2 c-f | 42.58 a | 14,393 ab | 34 f | 9,526 a |
| SV036 | 1.0 b | 2.1 g | 15 e-g | 22.9 ef | 43.17 a | 14,764 a | 36 ef | 9,465 a |
| SV037 | 0.7 b-d | 2.1 fg | 12 g | 30.6 b | 41.89 ab | 14,349 a-c | 40 b-e | 8,583 b |
| SX040 | 0.1 f | 2.2 ef | 15 fg | 26.1 b-e | 40.20 bc | 13,578 cd | 38 d-f | 8,399 b |
| SV038 | 0.3 c-f | 2.1 fg | 15 e-g | 25.2 c-f | 41.22 ab | 13,983 bc | 41 b-e | 8,220 b |
| MA 715 | 0.6 b-e | 2.3 de | 26 c-e | 23.8 d-f | 38.42 cd | 12,726 ef | 36 ef | 8,163 bc |
| SX037 | 0.2 ef | 2.3 b-d | 25 c-f | 24.8 c-f | 37.88 de | 13,037 de | 40 b-e | 7,784 b-d |
| HIL 2204NT | 1.0 bc | 2.4 b-d | 31 bc | 29.0 bc | 37.01 de | 12,669 ef | 42 b-d | 7,364 c-e |
| HIL 9919NT | 0.3 d-f | 2.3 de | 16 e-g | 25.7 b-f | 38.64 cd | 12,831 de | 43 b-d | 7,363 c-e |
| SX038 | 0.4 c-f | 2.4 b | 12 g | 26.9 b-e | 36.06 e | 12,021 f | 39 c-f | 7,304 de |
| C-59 | 0.1 f | 2.4 b-d | 24 c-f | 27.9 b-d | 37.22 de | 12,659 ef | 43 b-d | 7,154 de |
| C-60 | 0.1 f | 2.4 bc | 13 g | 23.8 d-f | 36.82 de | 12,520 ef | 44 b-d | 7,028 de |
| B-80 | 0.0 f | 2.4 b-d | 27 cd | 20.9 f | 37.68 de | 12,475 ef | 44 bc | 6,952 e |
| HIL 2301NT | 0.7 b-d | 2.3 c-e | 31 bc | 23.9 d-f | 37.57 de | 12,320 ef | 45 b | 6,791 e |
| BTS4D20 | 100.0 a | 4.2 a | 39 b | 29.4 bc | 23.02 f | 6,685 g | 63 a | 2,465 f |
| C-209 | 100.0 a | 5.3 a | 67 a | 36.1 a | 14.68 g | 4,104 h | 61 a | 1,572 g |
| $P > F$[t] | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| LSD (α = 0.05) | Trans | Trans | 11 | 5.0 | 2.03 | 776 | 6 | 814 |

[z] For more information on coded cultivars, contact the following companies: B = Betaseed Inc., C = ACH Seeds Inc., HIL = Hilleshög, MA = Maribo, SV = SESVanderHave, and SX = Seedex. Rhizomania susceptible check cultivars were BTS4D20 and C-209.

[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) 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 (except for root ratings), means followed by the same letter did not differ significantly based on Fisher's protected least significant difference (LSD; α = 0.05). Mean separation for the root ratings was based on PDIFF (α = 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.