SUGAR BEET (*Beta vulgaris*)
Rhizomania; *Beet necrotic yellow vein virus*
Basidiomycete

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Transgenic sugar beet cultivars evaluated for rhizomania resistance and storability in Idaho, 2007.

Thirty-two transgenic (glyphosate resistant) and six conventional commercial sugar beet cultivars were evaluated in a commercial sprinkler-irrigated sugar beet field near Rupert, ID where winter wheat was grown in 2006. The field trial relied on natural infection for rhizomania development. The plots were planted on 3 Apr 07 to a density of 142,560 seeds/A, and thinned to 47,520 plants/A on 23 May. Plots were four rows (22-in. row spacing) and 24 ft long. The experimental design was a randomized complete block design with four replications per entry. The crop was managed according to standard cultural practices. The roots were mechanically topped and the center two rows were collected with a mechanical harvester on 26 Sep. At harvest the roots were evaluated for rhizomania (using a scale of 0-9, 0 = healthy and 9 = dead). The percent sucrose at harvest was established based on two 8-root samples from each plot. The samples were submitted to the Amalgamated 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 on 27 Sep 07 set to hold 35°F. On 1 Feb 08, the roots were evaluated for the percentage of surface area covered by fungal growth (an undescribed basidiomycete that correlates with sucrose loss in storage). On 4 Mar 08 roots were retrieved after 160 days in storage and evaluated for weight and percent sucrose (via gas chromatography). To establish percent reduction in sucrose at harvest versus storage only samples from the same plots were compared. Data were analyzed using the general linear models procedure (Proc GLM-SAS), and Fisher's protected least significant difference was used for mean comparisons.

Rhizomania was uniform throughout the plot area and there was no evidence of resistance breakdown (blinkers) in surrounding commercial cultivars. Root rots and other disease and pest problems were not evident in the plot area. The root yield and recoverable sucrose were typical for this growing area. There were significant differences among cultivars for all parameters except weight reduction. All cultivars had a significantly lower Rz rating than the susceptible check (HM070005) which was expected, since they all possess at least the *Rz1* gene for resistance to *Beet necrotic yellow vein virus* (BNYVV). Surface fungal growth by an undescribed basidiomycete was evident already in Nov 07 on some transgenic cultivars while growth on conventional cultivars was not observed until Dec 07. By the end of the storage season, fungal growth and rot on the root surface was substantial. Likewise, sucrose reduction was substantial by the end of the storage season. A number of the transgenic cultivars performed as well as B31, the conventional storage check cultivar, for sucrose reduction during the storage season. With 80% or more of our production area in Idaho infested with rhizomania, resistance to BNYVV and storability in sugar beet cultivars will continue to require attention.

Cultivar[z]	Rz rating[y]	Surface fungal growth (%)[x]	Surface root rot (%)[w]	Weight reduction (%)[v]	Root yield (tons/A)	ERS at harvest (lb/A)[u]	Sucrose reduction (%)[t]	ERS after storage (lb/A)
C10	2.2 d-h	31 f-k	34 k-o	14.7	47.9 a-h	13130 a	55 l	5850 a
HM070016	2.2 d-h	11 jk	18 o	14.7	47.0 c-i	12610 a-f	58 kl	5294 ab
HM070023	2.6 cd	3 k	29 l-o	15.3	46.2 e-j	12336 a-i	57 kl	5292 ab
HH015	2.2 d-h	76 a-d	36 i-o	13.1	46.0 f-j	12628 a-f	59 j-l	5119 a-c
B31	2.2 dh	15 h-k	35 j-o	19.6	41.4 kl	11216 jk	58 kl	4799 a-d
HM070022	2.8 bc	25 g-k	28 m-o	14.0	46.5 d-j	12928 ab	65 i-l	4492 a-e
HM070013	2.1 e-i	12 i-k	23 no	14.8	46.2 f-j	12632 a-f	68 h-l	3984 a-f
HM090025	2.4 c-f	48 c-i	32 k-o	16.7	46.5 d-j	12470 a-f	73 f-l	3403 b-g
C19	2.0 f-i	49 b-h	62 a-j	18.7	47.4 a-h	12845 a-c	74 e-k	3339 b-g
HH001	1.7 i	85 ab	75 a-d	17.9	45.1 h-j	10977 k	70 g-l	3336 b-g
C9	2.4 c-f	58 a-g	44 f-o	20.6	44.2 i-k	11454 i-k	73 f-l	3143 b-h
B26	2.0 f-i	39 e-k	44 e-o	18.3	41.7 kl	11507 h-k	74 e-k	2982 c-h

HH004	1.9 g-i	65 a-f	76 a-c	22.0	47.6 a-h	12438 a-g	76 e-j	2974 c-h
HM070009	2.4 c-f	83 a-c	34 k-o	16.2	46.6 d-i	12372 a-h	77 d-i	2867 d-h
B22	2.2 d-h	38 f-k	56 b-l	17.2	45.2 g-j	12384 a-h	78 c-i	2615 d-i
HM070017	2.2 d-h	51 b-h	38 h-o	15.6	43.5 jk	11975 c-j	78 c-i	2612 d-i
B14	2.0 f-i	42 d-j	58 b-k	19.2	45.0 h-j	11919 e-j	79 b-i	2366 e-i
HM070006	2.0 f-i	58 a-g	41 h-o	14.7	50.3 a	12983 ab	82 a-i	2352 e-i
C4	2.4 c-f	49 b-h	72 a-e	16.5	48.1 a-g	12880 ab	83 a-h	2268 f-i
HM090026	2.3 d-g	64 a-f	49 d-n	17.9	45.8 f-j	12480 a-f	82 b-i	2229 f-i
B21	2.1 e-i	68 a-f	64 a-i	18.2	49.3 a-d	13057 ab	85 a-h	2080 f-j
C12	1.8 hi	66 a-f	79 a-c	20.1	48.2 a-g	12258 a-i	83 a-h	2040 f-j
B35	2.4 c-f	40 e-j	58 b-k	18.2	45.2 g-j	11870 e-k	85 a-h	1895 f-j
B7	1.7 i	65 a-f	76 a-d	16.3	49.2 a-e	12628 a-f	85 a-h	1875 f-j
HM070020	2.2 d-h	68 a-f	57 b-k	15.9	47.4 a-h	12604 a-f	85 a-h	1868 f-j
HH017	2.5 c-e	79 a-d	70 a-f	17.9	46.8 c-i	12853 a-c	87 a-g	1531 g-j
B34	2.1 e-i	79 a-d	80 ab	20.7	46.6 d-i	11558 g-k	87 a-g	1514 g-j
B11	2.1 e-i	65 a-f	66 a-g	18.5	47.0 c-i	11835 f-k	87 a-g	1513 g-j
HM070010	2.6 cd	38 f-k	42 g-o	17.5	45.8 f-j	12158 b-i	88 a-g	1483 g-j
B13	3.1 b	68 a-f	82 ab	18.9	47.0 c-i	11905 e-j	88 a-f	1432 g-j
HH016	2.5 c-e	78 a-d	65 a-h	17.8	47.3 b-i	12813 a-d	90 a-f	1319 g-j
B23	1.9 g-i	75 a-e	68 a-g	16.1	45.4 g-j	12534 a-f	90 a-f	1311 g-j
HM070019	2.3 d-g	58 a-g	51 c-m	21.7	50.2 ab	12274 a-i	90 a-f	1288 g-j
C11	2.4 c-f	92 a	86 a	18.7	43.5 jk	11747 f-k	92 a-e	954 h-j
HM070008	2.6 cd	33 f-k	66 a-h	19.1	48.8 a-f	12243 a-i	95 a-c	566 ij
HM070014	3.0 b	50 b-h	69 a-g	22.1	39.3 l	9847 l	95 a-d	500 ij
B5	1.7 i	82 a-c	81 ab	19.8	49.7 a-c	12769 a-e	97 ab	430 ij
HM070005	4.8 a	52 b-g	82 ab	26.6	28.8 m	6558 m	100 a	0 j
$P > F$[s]	<0.0001	<0.0001	<0.0001	0.0531	<0.0001	<0.0001	<0.0001	<0.0001
LSD ($P \leq 0.05$)	0.5	37	28	NS	3.0	900	18	2215

[z] For more information on coded cultivars contact the respective companies: B = Betaseed, C = ACH Seeds Inc., HH = Holly Hybrids, and HM = Hilleshog. Rhizomania susceptible conventional check cultivar was HM070005. Rhizomania resistant conventional check cultivars were HH001, HH004, B26, B31 (storage resistant check), and HM070014.

[y] Rz rating = roots were evaluated for rhizomania using a scale of 0-9 (0 = healthy, 9 = dead) at harvest.

[x] Surface fungal growth = percentage of root area covered by fungal growth from an undescribed basidiomycete.

[w] Surface root rot = percentage of root surface area discolored.

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

[u] ERS at harvest = estimated recoverable sucrose at harvest based on tonnage, nitrates, conductivity, tare, and percent sucrose. ERS after storage also accounted for percent reduction in sucrose.

[t] 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.

[s] $P > F$ was the probability associated with the F value. LSD = Fisher's protected least significant difference value. Within each parameter, means followed by the same letter did not differ significantly based on Fisher's protected least significant difference. NS = not significantly different.