Report to the Oregon Processed Vegetable Commission
2005–2006

1. Title: Identification of High Yielding, Root Rot Tolerant Sweet Corn Hybrids

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4. Project Status: Terminating 30 June, 2006

5. Project Funding: $10,000 total

Funds were used for a major portion of the support of a vegetable technician, student labor, supplies, evaluation of moisture content, and research farm expenses.

6. Objective: Identify sweet corn hybrids released for the processing market for high and stable yields under heavy and light root rot pressure.

7. Report of Progress:

We conducted trials at two locations for root rot resistance of sweet corn hybrids in 2005. While both sugar/se and supersweet sweet corn hybrids were evaluated, the emphasis was on identifying supersweet hybrids with improved tolerance to root rot. The two locations used (Vegetable Research Farm and Botany Farm) had moderately high root rot incidence. Continuous corn had been grown on both for at least the past four years. While the Vegetable Farm field had no additional inoculum added, direct *Fusarium* inoculation and roots from infected growers' fields had been added to the Botany Farm plot.

At the Vegetable Research Farm, only supersweet hybrids were grown to avoid cross pollination among endosperm types so that ears could be evaluated for quality. At the Botany Farm, supersweet and su/se types were intermingled, and only yield was evaluated. The Vegetable Farm trial consisted of four replicates with two row plots 30 feet in length, while only one row per plot was established at the Botany Farm. At the Vegetable Farm, one row of each plot was used to determine yield and processing evaluation, while the other row will be used for root rot evaluation and determining ear moisture. Hybrids were planted in both trials on June 23 using a belt planter, then thinned to normal stand about 10 d later. Root data collected at harvest maturity included root rot on the primary, mesocotyl and adventitious roots, browning of the nodes, crown rot and root worm damage. Horticultural characteristics included plant stand silking date, harvest date, kernel moisture, and ear number and weight (including both cull and net weight). Kernel moisture was determined at the OSU Pilot Plant. Raw product evaluation was conducted on those hybrids for which seed company funding was obtained.

Hybrids evaluated in trials are show in table 1. Nine were supersweet and five were su/se. One supersweet was a synthetic population thought to have potential for root rot resistance. Performance over the two locations was remarkably uniform with no genotype by environment interaction present (data not shown). As such, entries showed similar rank for yield and root rot parameters. Average yields were 7.6 and 7.4 T/A, respectively for the Vegetable and Botany Farms.

The moderately low average trial yield was associated with a high root rot incidence at both locations. Among supersweet hybrids, GSS 1477 stands out as having highest net yield in both trials (Tables 2 & 4, Figures 1 & 2) with ear quality equivalent to Supersweet Jubilee (Table 3).

Primary root rot was very high at both locations in most hybrids (Tables 5-7 Figures 3 & 4). In many cases, the radicle was missing (presumably entirely rotted), leading to a substantial amount of missing data for this trait. A larger spread among hybrids was observed at both locations for mesocotyl and adventitious root rot (Tables 5-7, Figure 4). At the Vegetable Farm, no significant difference was found among hybrids for any trait except brown node (Table 5). CSH YP2-57, Marvel, and GSS 1477 all had reduced levels of brown node compared to Supersweet Jubilee. At the Botany Farm and in the combined analysis, significant differences from Jubilee and Supersweet Jubilee were observed for all parameters. Among the lowest for mesocotyl and adventitious root rot at the Botany Farm (and significantly different from Supersweet Jubilee) were GSS 8812 and GH 8267. The Syn 99 material did not show any particular resistance to root rot. Several entries had significantly less node browning and crown rot compared to the checks (Table 6). From the analysis across locations, similar patterns to the Botany Farm were observed. From tables 6 and 7, it is quite apparent that brown node and crown root are associated. Pearson's correlation coefficient revealed that have a highly significant correlation of $r = 0.39$ (Table 8). While crown rot was also significantly correlated with mesocotyl and adventitious root rot, brown node was not correlated with these root rot parameters. As might be expected, primary root rot showed moderate significant correlation to mesocotyl and adventitious root rot. Root worm feeding was positively and significantly associated with mesocotyl and adventitious root rot, but not brown node, crown rot, or primary root rot. While yields were reduced in these trials, none of the disease parameters showed an association with yield except for brown node, which showed a fairly weak negative association of $r = -0.21$ (Table 8).

Conclusions: Trials at the OSU research farms were successful in evaluating yield of sweet corn hybrids in the presence of root rot. As harvest approached, firing of lower leaves was observed, but this symptom was not extensive, and flagging ears were not observed. However, yields were reduced as would be expected for the amount of disease observed on primary roots. One supersweet hybrid (GSS 1477) stands out from the rest in terms of its ability to produce in the presence of disease with 9.7 and 10.3 T/A yields at the two locations. Raw product evaluation was acceptable although pericarp toughness is potentially an issue.

Although the two field locations have had different cropping and inoculation histories, performance and disease symptoms at both was quite similar. It is not known whether the two locations have identical disease complexes, but our results would suggest that they are very similar. There has been some discussion as to the relevance and importance of brown node in the Willamette Valley root rot complex. Our data showed that this was the only parameter statistically associated with both gross and net yield.

Table 1. List of hybrids grown in 2005.

Hybrid	Source	Endosperm type	Color
Jubilee	Syngenta	*su*	yellow
GH 6014	Syngenta	*se*	yellow
GH 8267	Syngenta	*su*	yellow
CSE YP1-3	Crookham	*se*	yellow
C583	Pure Line	*su*	yellow
Supersweet Jubilee	Syngenta	*sh2*	yellow
GSS 2914	Syngenta	*sh2*	yellow
GSS 1477	Syngenta	*sh2*	yellow
GSS 8812	Syngenta	*sh2*	yellow
GSS 4165	Syngenta	*sh2*	yellow
Marvel	Crookham	*sh2*	yellow
CSH YP2-57	Crookham	*sh2*	yellow
CSH YP3-99	Crookham	*sh2*	yellow
Syn 99	Dale Wilson	*sh2*	yellow

Table 2. Yield and ear measurements for selected supersweet corn hybrids grown in a root rot trial on the OSU vegetable research farm, Corvallis, 2005.[z]

Entry	Days to Harvest	Stand	Gross T/A	Good Ears				Cull T/A	Ear Length (in.)	Ear Di-ameter (in.)	Kernel Depth (mm)
				1000/A	T/A	Ears/ Plant	Lbs/ Ear				
GSS 4165	96	23.8	10.6	21.6	7.6	1.04	0.71	0.00	8.0	2.10	12.8
CSH YP2-57	96	27.0	12.1	25.3	7.9	1.07	0.63	0.00	7.6	2.06	12.0
Marvel	96	26.5	10.5	22.7	7.5	0.98	0.66	0.03	8.2	2.09	12.3
GSS 8812	99	25.8	11.0	20.7	6.7	0.92	0.65	0.04	7.7	2.09	12.0
CSH YP3-99	99	27.0	12.8	22.7	7.9	0.96	0.70	0.00	8.1	2.09	12.3
Supersweet Jubilee	99	25.5	11.6	25.5	7.9	1.14	0.62	0.00	8.3	2.00	12.3
GSS 1477	99	25.5	13.3	26.6	9.7	1.21	0.73	0.10	9.1	2.06	12.8
GSS 2914	99	26.3	14.1	24.6	8.8	1.08	0.72	0.00	9.5	2.00	12.0
Syn 99	102	25.3	10.1	21.1	5.0	0.96	0.45	0.33			
LSD @5%		2.6	1.2	3.7	1.8	0.17	0.13	0.21	0.2	0.04	0.1

[z]Planted June 23 in rows 30" apart, thinned to 9" between plants. Gross T/A is the weight of all harvested unhusked ears. Stand is the average number of plants per 20' of harvested row. All values shown are means of 4 replications arranged in randomized complete blocks. All data except cull T/A were obtained from typical husked good ears. For ear length and ear diameter, the value used for each replication was the average of 10 individual ear measurements. No data was taken for ear length, ear diameter and kernel depth for Syn 99 because it was so variable.

Table 3. Ear quality evaluations for selected supersweet corn hybrids grown in a root rot trial on the OSU vegetable research farm, Corvallis, 2005.[z]

Entry	Shape	Refine-ment	Row Straight-ness	Tip Fill	Ear Unif.	Mat Unif.	Kernel Unif.	Flavor	Overall Score	Row #	Pericarp Tenderness	Notes
GSS 4165	4	4	4.5	4.5	2.5	3	4	4.5	3.5	18	107	Best ears are very nice, but some variability; some slightly curved ears
CSH YP2-57	4	3	3.5	4.5	4	4	3	3.5	3	18	158	Nice looking, very uniform ears but tough; some curved ears; ears are low on plant
Marvel	3	3	2.5	3	2.5	3	3	3.5	3	18	106	Ears variable shapes & sizes, some curved, some jumbled rows; chews tough
GSS 8812	3.5	3	2	3.5	3	4	2.5	3.5	3	18	104	Ears rough looking with jumbled rows; may have been harvested slightly under mature.
CSH YP3-99	3	3	2.5	2	2.5	2.5	2.5	3.5	2.5	18-20	92	Flattened butt ends; not all plants have an ear
Supersweet Jubilee	4	3.5	4	4	3.5	3	4	4.5	4	18	103	
GSS 1477	4.5	4	3.5	2.5	3.5	4.5	3	4.5	4	16	120	Very long ears; sweet; slightly tough
GSS 2914	3	3.5	4	1.5	3.5	3	3.5	4.5	3	18-20	98	Very long ears; very tasty and tender but tendency for tapered ears and poor tip fill
Syn 99	2.5	3	2.5	2	1	2	2	var	1.5			Tall plants; very late; highly variable; some ears taste good, some don't

[z]Planted June 23. Scores based on a 1-5 scale, with 5 = best. Tenderness value is the average of 10 individual primary ear measurements, determined by a spring-operated puncture gauge; lower numbers indicate tenderer pericarp. No data was taken for Syn 99 for row number and tenderness because it was so variable.

Table 4. Yield and ear measurements for selected supersweet corn hybrids grown in a root rot trial on the OSU Botany Research Farm, Corvallis, 2005.[z]

Entry	Type	Days to Harvest	Stand	Gross T/A	Good Ears				Cull T/A	Ear Length (in.)	Ear Diameter (in.)	Kernel Depth (mm)
					1000/A	T/A	Ears/ Plant	Lbs/ Ear				
GH 8267	*su*	97	26.5	11.5	25.0	7.6	1.08	0.61	0.00	8.0	1.98	12.0
CSH YP2-57	*sh2*	97	27.0	11.5	22.2	7.1	0.95	0.64	0.13	7.7	2.05	11.8
Jubilee	*su*	97	28.8	11.3	26.1	7.6	1.05	0.58	0.03	8.1	1.91	12.8
C583	*su*	97	27.5	12.5	23.1	7.7	0.96	0.67	0.05	8.8	1.99	11.5
GSS 4165	*sh2*	97	26.0	11.1	22.2	7.1	0.98	0.63	0.00	8.3	2.14	13.8
Marvel	*sh2*	97	27.3	10.7	22.9	7.7	0.96	0.67	0.00	8.3	2.10	12.5
GSS 8812	*sh2*	99	25.5	10.7	21.6	6.9	0.97	0.64	0.00	7.9	2.00	12.8
CSH YP3-99	*sh2*	99	25.8	10.0	17.6	6.0	0.79	0.68	0.00	8.2	2.09	12.0
GH 6014	*se*	99	23.5	10.4	22.7	6.5	1.11	0.58	0.00	8.6	1.86	11.5
Syn 99	*sh2*	102	24.8	9.3	22.9	6.3	1.06	0.55	0.00			
GSS 2914	*sh2*	102	25.5	12.1	23.3	8.1	1.05	0.70	0.07	9.3	2.01	11.5
Supersweet Jubilee	*sh2*	102	25.5	10.4	23.1	7.4	1.05	0.64	0.00	8.3	1.99	12.5
GSS 1477	*sh2*	102	26.3	13.5	26.8	10.3	1.17	0.77	0.00	0.2	2.10	12.8
LSD @5%			2.7	1.3	3.2	1.4	0.12	0.09	0.10	0.2	0.05	0.9

[z]Planted June 23 in rows 30" apart, thinned to 9" between plants. Gross T/A is the weight of all harvested unhusked ears. Stand is the average number of plants per 20' of harvested row. All values shown are means of 4 replications arranged in randomized complete blocks. All data except cull T/A were obtained from typical husked good ears. For ear length and ear diameter, the value used for each replication was the average of 10 individual ear measurements. No data was taken for ear length, ear diameter and kernel depth for Syn 99 because it was so variable.

Table 5. Root disease ratings of supersweet corn hybrids grown at the Vegetable Research Farm, Corvallis, 2005[z].

Entry	Root Worm[x]	Primary Root Rot (%)	Mesocotyl Root Rot (%)	Adventitious Root Rot[w]	Brown Node Score[w]	Brown Node Compare to SS Jubilee	Crown Rot[w]
CSH YP2-57	2.1	100.0[y]	85.3	2.6	0.3	**	0.7
Marvel	1.9	93.3	89.5	3.1	0.3	*	0.6
GSS 1477	2.0	81.3	72.9	2.9	0.6	*	0.7
GSS 8812	1.8	93.3	86.7	2.7	0.8		1.5
CSH YP3-99	1.8	87.0	83.5	2.6	0.9		1.4
Syn 99	2.2	100.0[y]	100.0[y]	2.9	1.2		2.8
GSS 2914	1.8	100.0[y]	92.3	2.8	1.3		1.8
SS Jubilee	2.0	88.5	86.9	2.7	1.4		2.0
GSS 4165	2.0	93.8	67.9	2.8	2.3	*	1.8

[z]All values non-significant except brown node ratings as indicated.

[y]Value greater than 100% because LS means were calculated from entries with missing data. Value was adjusted to 100.

[x]Scale of 1-3, 1=little root worm damage.

[w]Scale of 1-4, 1=little disease or symptom.

*significant at 0.01<p<0.05; **significant at 0.001<p<0.01

Table 6. Root disease ratings of supersweet and se/su corn hybrids grown at the Botany Research Farm, Corvallis, 2005.

Entry	Root Worm			Primary Root Rot			Mesocotyl Root Rot			Adventitious Root Rot			Brown Node			Crown Rot		
	Score[y]	Jubilee[w]	SS Jubilee[w]	%	Jubilee[w]	SS Jubilee[w]	%	Jubilee[w]	SS Jubilee[w]	Score[x]	Jubilee[w]	SS Jubilee[w]	Score[x]	Jubilee[w]	SS Jubilee[w]	Score[x]	Jubilee[w]	SS Jubilee[w]
Marvel	2.5	**	*	91.8			55.4		*	3.5	+		0.7	***	**	0.9	**	***
CSH YP2-57	1.8			97.9			67.5			3.2			0.8	***	*	1.2	**	***
C583	1.3			93.1			60.4		+	2.3		*	0.9	***	*	1.3	*	**
GSS 1477	1.8		+	81.0		*	72.9			2.7			1.0	***	+	1.2	**	***
GSS 2914	1.8			93.8			73.8			2.8			1.0	***	+	1.9		
GSS 8812	1.3		+	91.3			54.2		*	2.0		**	1.0	***	+	1.3	*	**
GH 8267	1.3		+	85.2		+	57.1		*	1.7	*	***	1.3	**		1.7		*
CSH YP3-99	2.2	*		78.5	+	**	62.5		+	3.2			1.3	*		1.3	*	**
SS Jubilee	1.8			97.9			89.6			3.3			1.5	*		2.5		
GH 6014	1.7			95.0			77.5			2.8			1.8			2.2		
Syn 99	1.8			95.6			100[z]	*		2.4		+	2.1		*	1.9		
Jubilee	1.5			91.3			67.3			2.7			2.2		*	2.2		
GSS 4165	1.8			99.2			71.9			3.5	+		3.5	***	***	1.8		+

[z]Value greater than 100% because LS means were calculated from entries with missing data. Value was adjusted to 100.
[y]Scale of 1-3, 1=little root worm damage.
[x]Scale of 1-4, 1=little disease or symptom.
[w]Statistical comparison to Jubilee or Supersweet Jubilee check; +significant at 0.05<p<0.10; *significant at 0.01<p<0.05; **significant at 0.001<p<0.01; ***p<0.001.

Table 7. Root disease ratings averaged over two locations of supersweet and se/su corn hybrids, Corvallis, 2005.

Entry	Root Worm			Primary Root Rot			Mesocotyl Root Rot			Adventitious Root Rot			Brown Node			Crown Rot		
	Score[y]	Jubilee[w]	SS Jubilee[w]	%	Jubilee[w]	SS Jubilee[w]	%	Jubilee[w]	SS Jubilee[w]	Score[x]	Jubilee[w]	SS Jubilee[w]	Score[x]	Jubilee[w]	SS Jubilee[w]	Score[x]	Jubilee[w]	SS Jubilee[w]
Marvel	2.2	*		92.7			65.1		+	3.3	+		0.5	***	***	0.8	*	**
CSH YP2-57	2.0			99.7			76.0			2.9			0.5	***	***	0.9	*	**
C583	1.3		+	93.8			65.8			2.2		*	0.7	***	**	1.2		+
GSS 1477	1.9			81.1		+	72.9			2.8			0.8	***	**	0.9	*	**
GSS 8812	1.5			92.3			68.5		+	2.3		*	0.9	***	*	1.4		+
GH 8267	1.3		+	85.9			62.5		+	1.6	*	**	1.0	**		1.6		
GSS 2914	1.8			96.2			82.1			2.8			1.1	**		1.9	*	
CSH YP3-99	2.0			82.2			72.5			2.9			1.1	**		1.4		+
SS Jubilee	1.9			93.2			88.2			3.0			1.5			2.3		
GH 6014	1.7			95.7			82.9			2.7			1.5			2.1		
Syn 99	2.0			99.3			100.0[z]	*		2.7			1.6			2.4		
Jubilee	1.6			91.9			72.7			2.6			2.0			2.1		
GSS 4165	1.9			96.5			69.9			3.1			2.9	**	***	1.8		

[z]Value greater than 100% because LS means were calculated from entries with missing data. Value was adjusted to 100.

[y]Scale of 1-3, 1=little root worm damage.

[x]Scale of 1-4, 1=little disease or symptom.

[w]Statistical comparison to Jubilee or Supersweet Jubilee check; +significant at 0.05<p<0.10; *significant at 0.01<p<0.05; **significant at 0.001<p<0.01; ***p<0.001.

Table 8. Correlations among root rot and yield variables averaged over two locations of supersweet and se/su corn hybrids, Corvallis, 2005[z]

	Net T/A	Root Worm	Primary Root Rot	Mesocotyl Root Rot	Adventitious Root Rot	Brown Node	Crown Rot	Days to Harvest
Gross T/A	0.79***	-0.15	0.01	0.06	0.06	-0.21*	-0.13	-0.05
Net T/A		-0.17	-0.08	-0.06	0.04	-0.21*	-0.15	-0.05
Root Worm			0.16	0.31**	0.51***	-0.08	0.11	0.02
Primary Root Rot				0.33**	0.30**	0.12	0.18	-0.06
Mesocotyl Root Rot					0.34**	0.11	0.35**	0.29**
Adventitious Root Rot						0.17	0.22*	0.01
Brown Node							0.39***	0.00
Crown Rot								0.29**

*significant at 0.01<p<0.05; **significant at 0.001<p<0.01; ***p<0.001.

Figure 1. Yield of sh2 corn varieties grown in a root rot trial on the OSU Vegetable Farm, Corvallis, 2005

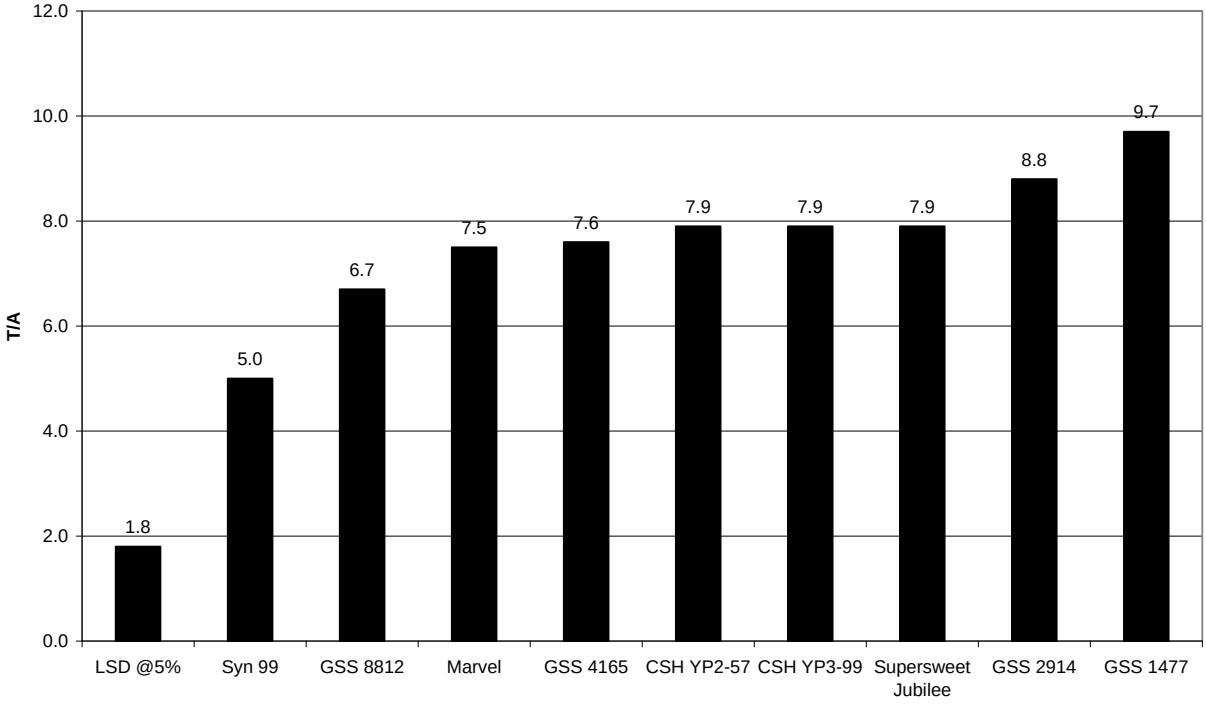

Figure 2. Yield of se/su & sh2 corn varieties grown in a root rot trial on the OSU Botany Farm, Corvallis, 2005

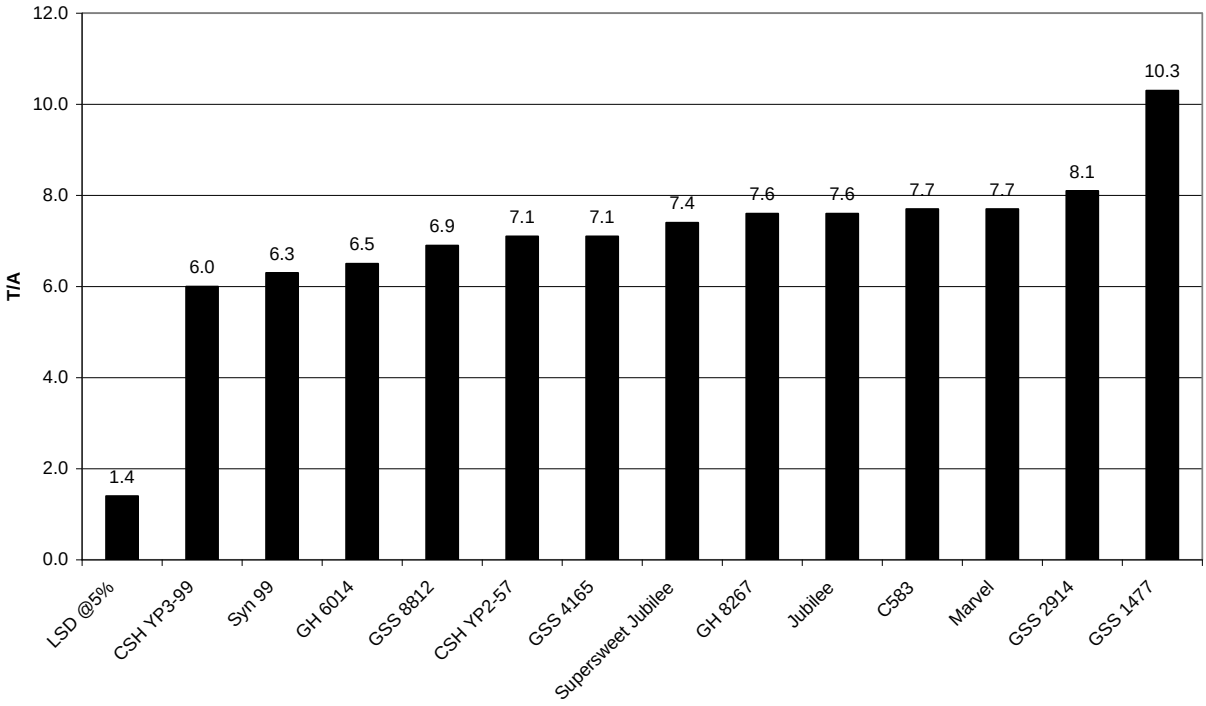

Figure 3. Disease Severity (% Primary Root Rot) For Sweet Corn Hybrids Averaged Over Two Locations, Corvallis, 2005

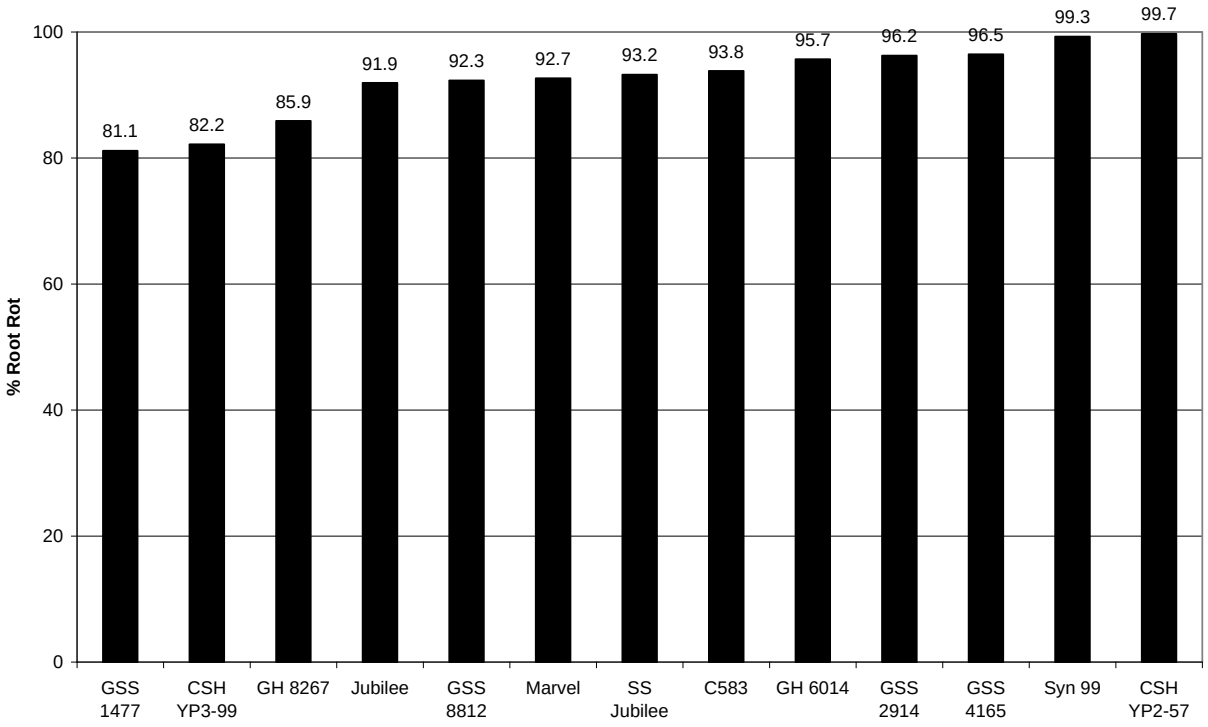

Figure 4. Disease Severity (% Mesocotyl Root Rot) For Sweet Corn Hybrids Averaged Over Two Locations, Corvallis, 2005