

**Report to the Agricultural Research Foundation
for
Oregon Processed Vegetable Commission
2005**

Title: Cultivar Evaluation for Control of Common Smut in Sweet Corn and High Plains Virus in the Columbia Basin of Oregon and Washington.

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Project Status:

First funded 1999:

OSU Agricultural Research Foundation	\$ 4,000
Ore. Processed Vegetable Comm.	\$ 1,500

Funding in 2000:

Ore. Processed Vegetable Comm.	\$ 5,000
Columbia Basin Proc. Veg. Council	\$ 3,700
Pacific Northwest Vegetable Assoc.	\$ 3,350
Vegetable Seed Companies	\$ 3,000

Funding in 2001:

Wash. State Comm. Pesticide Registration	\$15,000
Chemical Companies	\$ 8,000
Ore. Processed Vegetable Comm.	\$ 5,000
Vegetable Seed Companies	\$ 3,800
Columbia Basin Proc. Veg. Council	\$ 3,900

Funding in 2002:

Wash. State Comm. Pesticide Registration	\$17,300
Chemical Companies	\$16,000
Vegetable Seed Companies	\$ 4,000
Ore Processed Vegetable Commission	\$ 5,000

Funding in 2003:

Wash. State Comm. Pesticide Registration	\$ 9,000
Ore Processed Vegetable Commission	\$ 4,800
Vegetable Seed Companies	\$ 4,000

Funding in 2004:

Ore Processed Vegetable Commission	\$ 5,000
Vegetable Seed Companies	\$ 4,000

Continuation and Expansion of the Proposal, February 1, 2005 to December 31, 2005

Funding request	\$13,000
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Common smut

Planting date/cultivar evaluation: Thirty-six sweet corn cultivars were evaluated for resistance to natural infection by common smut (Table 1). Plots were seeded to 30,800 plants/acre on May 16 and Jun 23 on the Hermiston Agricultural Research and Extension Center on Adkins fine sandy loam (pH 6.7, 0.9% organic matter). The four 30 ft rows/plot were spaced 30 inches apart. The experimental design was a randomized complete block, with four replications.

Normal commercial production practices were followed. At ear maturity, plant stand was recorded, and the number and location (at base, between base and ear, on ear, between ear and tassel, on tassel) of smut galls were noted for each plant. Some plants had more than one infection location. Data were analyzed with the SAS GLM procedure following arcsine transformation. Duncans multiple range test was used for mean separation.

Results

Planting date/cultivar evaluations:

In general, disease pressure was reduced in 2005 as compared to the previous years (Table 2). Over the seven years of this trial, the percentage of plants with smut infections at the different plant locations increased from the early to later planting (Table 2). In 2005, however, the percent plants with infections on the upper stalk were similar for the two times of planting (Table 4).

Table 3 reports the percent infected ears for the most and least susceptible cultivars of the 48 which were tested in at least two of the seven growing seasons this program has been conducted. Ninety-two cultivars have been entered into this trial series, but many were evaluated for less than two years.

The different cultivars responded somewhat differently to planting date (Tables 5-9). The varieties most susceptible to infection of the ear over both planting dates included Jubilee (13.1%), Supersweet Jubilee (9.4%), Accession (7.8%), ACX 726BC (7.6%), GSS 2914 (7.4%), and Summer Sweet 500 (7.2%) (Table 7). The least susceptible group, which had 1% or less infected ears, included GH 2547, GH 2690, CSUY2-28, Maestro, GH 6462, and Sockeye.

Table 1. Sweet corn cultivars evaluated for common smut resistance, Hermiston, OR. 2005.

Cultivar	Source
su:	
CSUYP2-28	Crookham
GH 1703	Syngenta
GH 2547	Syngenta
GH 2690	Syngenta
GH 6462	Syngenta
Harvest Gold	Seminis**
Intrigue	Crookham
Jubilee	Syngenta
Legacy	Harris Moran
Maestro	Crookham
Sockeye (FMX 516)	Harris Moran
se/su:	
Chase	Seminis
Cinch	Seminis
CSEYP1-3	Crookham
EX08716607	Seminis**
Powerhouse	Seminis
sh ₂ :	
ACX 642AW	Abbott & Cobb
ACX 726BC	Abbott & Cobb
ACX 820Y	Abbott & Cobb
ACX 900Y	Abbott & Cobb
Accession (ACX 1073)	Abbott & Cobb
Basin	Seminis
Crisp n Sweet 710	Crookham
EX08705808	Seminis**
GSS 2914	Syngenta
GSS 3287	Syngenta
Krispy King	Syngenta
Marvel	Crookham
Max	Harris Moran
Obsession	Seminis
Passion	Seminis**
Shaker	Seminis
Sheba	Seminis
Summer Sweet #500	Abbott & Cobb
Summer Sweet #610	Abbott & Cobb
Supersweet Jubilee	Syngenta

** Second planting only.

Table 2. Effect of year and planting date on development of common smut of sweet corn, Hermiston, OR, 1999-2005.

	Gall location					
	Base	Base-Ear	Ear	Ear-Tassel	Tassel	Plant
	<i>Percent (%)</i>					
<u>Year^z</u>						
1999	6.1 c	3.7 c	15.4a	9.3a	23.3 bc	43.8 c
2000	8.2 b	18.6ab	6.2 cd	7.1 b	21.1 bc	44.8 bc
2001	11.5a	22.9a	8.3 bc	5.8 bc	41.8a	61.4a
2002	7.1 bc	20.1a	8.9 b	5.8 bc	24.0 b	50.3 b
2003	5.4 c	20.9a	4.4 d	5.0 c	15.4 d	44.0 c
2004	2.8 d	15.8 b	5.4 d	4.3 c	19.5 c	36.5 d
2005	1.5 d	7.1 c	6.7 bcd	1.9 d	2.7 e	19.4 e
	****	****	****	****	****	****
<u>Planting date^z</u>						
Apr/May	3.1	8.9	7.1	4.8	9.7	28.0
May/Jun	9.1	22.2	8.6	6.3	32.2	57.8
	****	****	***	****	****	****

^z Means of seven cultivars trialed in all 7 years.

, * Effect of year or planting date significant at P#0.001 or P#0.0001, respectively.

Means followed by different letters significantly different at P#0.05 (Duncans multiple range test).

Table 3. Susceptibility of sweet corn cultivars^z to common smut infection of the ear, Hermiston, OR., 1999-2005

Cultivar	Ears infected	Years tested
	(%)	(No.)
<u>Most susceptible</u>		
1861	16.1	3
Jubilee	13.4	7
2684	12.5	3
Challenger	11.0	3
Supersweet Jubilee	10.6	7
ACX1703	10.5	3
Krispy King	8.7	7
Accession	8.4	2
<u>Least susceptible</u>		
GSS8357	2.0	2
Legacy	2.0	6
HMX7384	2.0	3
GH2690	1.8	3
Shaker	1.7	5
Elite	1.6	3
Powerhouse	1.6	2
Diva	1.5	2
Cinch	1.1	4
ACX232	1.1	5
Intrigue	1.0	3
Eliminator	0.9	3
GH2547	0.8	6
Marvel	0.8	6
Conquest	0.6	3
Maestro	0.6	2
Sockeye	0.5	5
GH2148	0.3	2

^z Of the 48 cultivars evaluated in at least 2 of the 7 trial years.

Table 4. Effect of planting date and type on development of common smut of sweet corn, Hermiston, OR., 2005.

	Gall location					Plant
	Base	Base-Ear	Ear	Ear-Tassel	Tassel	
	<i>Percent (%)</i>					
<u>Planting date</u>						
May	0.1	2.6	2.7	0.7	0.7	6.7
Jun	2.0	6.7	5.1	0.7	3.3	17.1
	****	****	****	NS	***	****

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^z Means of 43 cultivars evaluated in 2005.

NS, ***, **** Effect of planting date not significant or significant at P#0.001, or P#0.0001, respectively.

Table 5. Susceptibility of sweet corn cultivars to common smut infection of the base, Hermiston, OR., 2005.

Cultivar	Planting date		Average
	May	June	
			□□□□
<u>su type</u>		Percent (%)	
CSUYP2-28	0.0 b	0.0 d	0.0 c
GH 1703	0.0 b	4.4 bcd	2.2 bc
GH 2547	0 b	0.5 cd	0.3 c
GH 2690	0 b	1.4 cd	0.7 c
GH 6462	0.0 b	0.8 cd	0.4 c
Harvest Gold	-	0.3 cd	0.3 c
Intrigue	0.0 b	0.3 cd	0.2 c
Jubilee	0.1 b	1.8 bcd	1.0 c
Legacy	0 b	0.8 cd	0.4 c
Maestro	0.1 b	0.0 d	0.1 c
Sockeye	0.3 b	0.6 cd	0.5 c
<u>se type</u>			
Chase	0.4 b	3.4 bcd	1.8 bc
Cinch	0.2 b	0.7 cd	0.4 c
CSEYP1-3	0.2 b	0.4 cd	0.3 c
EX08716607	-	1.0 cd	1.0 c
Powerhouse	0.0 b	0.3 cd	0.2 c
<u>sh₂ type</u>			
ACX 642AW	0.0 b	1.0 cd	0.5 c
ACX 726BC	0.3 b	2.5 bcd	1.4 bc
ACX 820Y	0.0 b	0.9 cd	0.4 c
ACX 900Y	0.1 b	4.8 bcd	2.5 bc
Accession	0.2 b	2.2 bcd	1.2 c
Basin	0.0 b	1.3 cd	0.7 c
Crisp n Sweet 710	0.0 b	5.3 bc	2.6 bc
EX08705808	-	1.0 cd	1.0 c
GSS 2914	0.0 b	3.2 bcd	1.6 bc
GSS 3287	0.3 b	15.1a	7.7a
Krispy King	1.2a	6.6 b	3.9 b
Marvel	0.0 b	1.6 bcd	0.8 c
Max	0.0 b	2.2 bcd	1.1 c
Obsession	0.2 b	1.4 cd	0.8 c
Passion	-	0.7 cd	0.7 c
Shaker	0.0 b	0.6 cd	0.3 c
Sheba	0.0 b	0.3 cd	0.2 c
Summer Sweet #500	0.0a	0.7 cd	0.3 c
Summer Sweet #610	0.0 b	2.2 bcd	1.1 c
Supersweet Jubilee	0.2 b	1.5 cd	0.9 c
	**	****	****
			□□□□

** , **** Cultivar effect significant at P#0.01 or P#0.0001, respectively.
 Means followed by different letters significantly different at P#0.05(Duncans multiple range test).

Table 6. Susceptibility of sweet corn cultivars to common smut infection of the lower stalk, Hermiston, OR., 2005.

Cultivar	Planting date		Average	
	May	June	May	June
□ □ □ □				
□				
	<u>su type</u>		Percent (%)	
CSUY2-28	1.4 gh	2.2 de	1.8 fg	
GH 1703	2.5 efgh	8.4 bcde	5.5 efg	
GH 2547	1.3 gh	2.0 de	1.6 fg	
GH 2690	2.2 fgh	6.1 cde	4.2 efg	
GH 6462	1.5 gh	2.0 de	1.7 fg	
Harvest Gold	-	0.8 e	0.8 g	
Intrigue	2.0 gh	3.5 de	2.8 fg	
Jubilee	8.0 b	10.8 bcde	9.4 bcde	
Legacy	2.6 efgh	4.2 de	3.4 fg	
Maestro	2.5 efgh	2.2 de	2.3 fg	
Sockeye	0.6 h	3.6 de	2.1 fg	
	<u>se type</u>			
Chase	3.1 defgh	3.7 de	3.4 fg	
Cinch	0.8 h	1.4 e	1.1 fg	
CSEYP1-3	5.2 bcdef	5.3 cde	5.2 efg	
EX08716607	-	4.7 cde	4.7 efg	
Powerhouse	2.4 efgh	0.8 e	1.6 fg	
	<u>sh₂ type</u>			
ACX 642AW	1.6 gh	3.1 de	2.3 fg	
ACX 726BC	0.8 h	6.0 cde	3.4 fg	
ACX 820Y	0.2 h	1.6 e	0.9 g	
ACX 900Y	1.1 gh	7.1 bcde	4.1 efg	
Accession	1.8 gh	4.8 cde	3.3 fg	
Basin	0.9 h	1.3 e	1.1 fg	
Crisp n Sweet 710	6.8 bc	15.4 bc	11.1 bcd	
EX08705808	-	6.0 cde	6.0 defg	
GSS 2914	5.4 bcde	16.6 b	11.0 bcd	
GSS 3287	6.0 bcd	43.4a	24.7a	
Krispy King	11.6a	11.1 bcde	11.4 bc	
Marvel	0.4 h	6.6 bcde	3.5 fg	
Max	0.9 h	4.0 de	2.5 fg	
Obsession	1.1 gh	8.5 bcde	4.8 efg	
Passion	-	12.6 bcd	12.6 b	
Shaker	1.8 gh	5.1 cde	3.5 fg	
Sheba	4.2 cdefg	2.8 de	3.5 fg	
Summer Sweet #500	0.2 h	3.0 de	1.6 fg	
Summer Sweet #610	0.6 h	10.3 bcde	5.5 efg	
Supersweet Jubilee	2.1 gh	11.6 bcde	6.9 cdef	
	****	****	****	

**** Cultivar effect significant at P#0.0001.
Means followed by different letters significantly different at

P#0.05 (Duncans multiple range test).

Table 7. Susceptibility of sweet corn cultivars to common smut infection of the ear, Hermiston, OR., 2005.

Cultivar	Planting date		
	May	June	Average
	Percent (%)		
<u>su type</u>			
CSUY2-28	0.3 ef	0.6 g	0.4 k
GH 1703	4.2 bcde	8.3 bcdef	6.3 cdefgh
GH 2547	0 f	0.4 g	0.2 k
GH 2690	0 f	0.4 g	0.2 k
GH 6462	0.4 ef	1.5 g	1.0 k
Harvest Gold	-	2.2 efg	2.2 ijk
Intrigue	0.6 ef	2.0 fg	1.3 k
Jubilee	7.8ab	18.5a	13.1a
Legacy	0 f	3.8 defg	1.9 jk
Maestro	0.5 ef	0.8 g	0.6 k
Sockeye	0.1 f	1.9 fg	1.0 k
<u>se type</u>			
Chase	9.0a	4.1 defg	6.5 cdefgh
Cinch	0.6 ef	2.2 efg	1.4 jk
CSEYP1-3	1.4 ef	4.0 defg	2.7 hijk
EX08716607	-	8.5 bcde	8.5 bcd
Powerhouse	1.3 ef	1.8 g	1.5 jk
<u>sh₂ type</u>			
ACX 642AW	2.4 def	3.3 defg	2.9 hijk
ACX 726BC	6.1abcd	9.1 bcd	7.6 cdef
ACX 820Y	2.2 ef	5.7 cdefg	3.9 fghijk
ACX 900Y	1.4 ef	5.3 cdefg	3.3 hijk
Accession	6.0abcd	9.6 bcd	7.8 bcde
Basin	1.8 ef	5.0 cdefg	3.4 ghijk
Crisp n Sweet 710	6.1abcd	6.1 cdefg	6.1 cdefghi
EX08705808	-	11.3 bc	11.3ab
GSS 2914	4.2 bcde	10.5 bc	7.4 cdef
GSS 3287	0.7 ef	5.3 cdefg	3.0 hijk
Krispy King	7.1ab	3.7 defg	5.4 hijk
Marvel	0.2 ef	5.6 cdefg	2.9 hijk
Max	1.3 ef	4.1 defg	2.6 hijk
Obsession	2.2 ef	3.7 defg	3.0 hijk
Passion	-	2.0 fg	2.0 jk
Shaker	2.7 cdef	5.5 cdefg	4.1 efghijk
Sheba	2.1 ef	5.7 cdefg	3.9 fghijk
Summer Sweet #500	8.2a	6.2 cdefg	7.2 cdefg
Summer Sweet #610	0.5 ef	3.6 defg	2.1 jk
Supersweet Jubilee	6.3abc	12.5 b	9.4 bc
	****	****	****

**** Cultivar effect significant at P#0.0001.

Means followed by different letters significantly different at P#0.05 (Duncans multiple range test).

Table 8. Susceptibility of sweet corn cultivars to common smut infection of the upper stalk, Hermiston, OR., 2005.

Cultivar	Planting date		June		Average	
	May					
			Percent (%)			
<u>su type</u>						
CSUY2-28	0.3	e	0.2	d	0.2	f
GH 1703	0.6	e	0.2	d	0.4	ef
GH 2547	0	e	0.2	d	0.1	f
GH 2690	0	e	0.0	d	0	f
GH 6462	0.0	e	0.2	d	0.1	f
Harvest Gold	-		0.5	d	0.5	ef
Intrigue	0.3	e	1.0	cd	0.6	def
Jubilee	2.0	cd	0.8	cd	1.4	de
Legacy	0.1	e	0.0	d	0.1	f
Maestro	0.1	e	0.0	d	0.1	f
Sockeye	0.0	e	0.5	d	0.3	f
<u>se type</u>						
Chase	2.4	bc	2.3	bc	2.3	c
Cinch	0.3	e	0.5	d	0.4	ef
CSEYP1-3	0.2	e	0.0	d	0.1	f
EX08716607	-		1.6	bcd	1.6	cd
Powerhouse	0.6	e	0.3	d	0.5	ef
<u>sh₂ type</u>						
ACX 642AW	0.0	e	0.4	d	0.2	f
ACX 726BC	0.0	e	0.5	d	0.2	f
ACX 820Y	0.4	e	0.3	d	0.3	ef
ACX 900Y	0.0	e	0.3	d	0.2	f
Accession	0.0	e	0.5	d	0.2	f
Basin	0.0	e	0.0	d	0.0	f
Crisp n Sweet 710	0.0	e	0.6	d	0.3	ef
EX08705808	-		0.5	d	0.5	def
GSS 2914	1.1	de	1.6	bcd	1.3	de
GSS 3287	0.0	e	0.4	d	0.2	f
Krispy King	8.3a		2.6	b	5.4a	
Marvel	0.6	e	1.0	cd	0.8	def
Max	0.6	e	0.8	cd	0.7	def
Obsession	0.1	e	0.2	d	0.2	f
Passion	-		0.2	d	0.2	f
Shaker	0.0	e	0.5	d	0.2	f
Sheba	0.0	e	0.2	d	0.1	f
Summer Sweet #500	0.8	e	1.4	bcd	1.1	def
Summer Sweet #610	0.1	e	0.7	cd	0.4	ef
Supersweet Jubilee	3.2	b	5.3	a	4.2	b
	****		****		****	

**** Cultivar effect significant at P#0.0001.

Means followed by different letters significantly different at P#0.05 (Duncans multiple range test).

Table 9. Susceptibility of sweet corn cultivars to common smut infection of the tassel, Hermiston, OR., 2005.

Cultivar	Planting date		Average
	May	June	
		Percent (%)	
<u>su type</u>			
CSUYP2-28	0.0 c	1.0 defg	0.5 fgh
GH 1703	2.1 bc	14.5a	8.3 b
GH 2547	0 c	0.0 g	0 h
GH 2690	0 c	0.0 g	0 h
GH 6462	0.0 c	0.4 efg	0.2 gh
Harvest Gold	-	1.0 defg	1.0 fgh
Intrigue	0.1 c	2.8 defg	1.5 efgh
Jubilee	0.1 c	8.3 c	4.2 cde
Legacy	1.4 bc	1.5 defg	1.4 efgh
Maestro	0.0 c	0.4 efg	0.2 gh
Sockeye	1.1 bc	6.1 dc	3.6 cdef
<u>se type</u>			
Chase	2.5ab	9.0 bc	5.9 c
Cinch	0.5 bc	2.8 defg	1.6 efgh
CSEYP1-3	0.0 c	1.9 defg	0.9 fgh
EX08716607	-	13.0ab	13.0a
Powerhouse	0.3 c	1.6 defg	0.9 fgh
<u>sh₂ type</u>			
ACX 642AW	0.9 bc	1.8 defg	1.4 efgh
ACX 726BC	0.2 c	4.6 cdefg	2.4 defgh
ACX 820Y	0.8 bc	3.0 defg	1.9 defgh
ACX 900Y	0.8 bc	4.5 cdefg	2.6 defgh
Accession	0.9 bc	3.0 defg	1.9 defgh
Basin	0.9 bc	0.2 fg	0.5 fgh
Crisp n Sweet 710	0.8 bc	4.2 cdefg	2.5 defgh
EX08705808	-	1.3 defg	1.3 efgh
GSS 2914	1.1 bc	2.3 defg	1.7 efgh
GSS 3287	0.8 bc	0.6 efg	0.7 fgh
Krispy King	4.1a	5.7 cde	4.9 cd
Marvel	0.1 c	3.1 defg	1.6 efgh
Max	0.9 bc	2.5 defg	1.7 efgh
Obsession	0.1 c	0.9 defg	0.5 fgh
Passion	-	0.0 g	0 h
Shaker	0.6 bc	3.2 defg	2.9 defgh
Sheba	0.0 c	0.5 efg	0.2 gh
Summer Sweet #500	0.4 bc	2.7 defg	2.5 efgh
Summer Sweet #610	0.3 c	5.5 cdef	2.9 cdefgh
Supersweet Jubilee	0.6 bc	6.1 cd	3.4 cdefg
	****	****	****

**** Cultivar effect significant at P#0.0001.

Means followed by different letters significantly different at P#0.05 (Duncans multiple range test).

High Plains Virus

To determine if there is High Plains virus resistance in commercial processing sweet corn cultivars, trials were conducted at the Hermiston Agricultural Research & Extension Center, and in two commercial sweet corn production fields near Othello, WA. Four 30' rows/plot, 30" apart, with 9" between plants, were seeded on Jun 8 and Jun 10 with overhead center pivot irrigation at the HAREC and Friehe Farms sites, respectively (Table 10). The experimental design was a randomized complete block, with four replications. Data were analyzed using SAS GLM procedures, with Duncan's multiple range tests for mean separation.

Table 10. Cultivars evaluated for High Plains virus susceptibility, 2005.

Cultivar	Source	Type
Chase	Seminis	se/su
Cinch	Seminis	se/su
GH 2547	Syngenta	su
Jubilee	Syngenta	su
Krispy King	Syngenta	sh ₂
Marvel	Crookham	sh ₂
Shaker	Seminis	sh ₂
Sheba	Seminis	sh ₂
Sockeye	Harris Moran	su
Supersweet Jubilee	Syngenta	sh ₂

Plants were observed for symptom development during the growing season (Figs 1-3). At each observation, leaf samples of new symptomatic plants were taken for lab confirmation of infection. Almost 100% of plants identified in the field as symptomatic were verified by ELISA and PCR to have High Plains virus. In addition, leaves from 20 asymptomatic plants of each of the ten varieties were tested. All 200 samples were negative by ELISA. However, by PCR 5% of Sockeye and Chase samples were positive, as were 20% of Jubilee and 45% of Sheba samples. This symptomless infection may be a reservoir for spread of the virus.

Sheba and Shaker exhibited symptoms to a greater degree than the other varieties at all locations. At the off-station sites, Chase and Marvel were intermediate; the other six varieties were similar, with very little symptom expression. At the HAREC location, most plants infected before July 8 died,

while those which exhibited symptoms of HPV infection after that date but prior to the Aug 2 observation date, which generally coincided with silking, did not develop ears. Similar observations were made at the off-station sites.

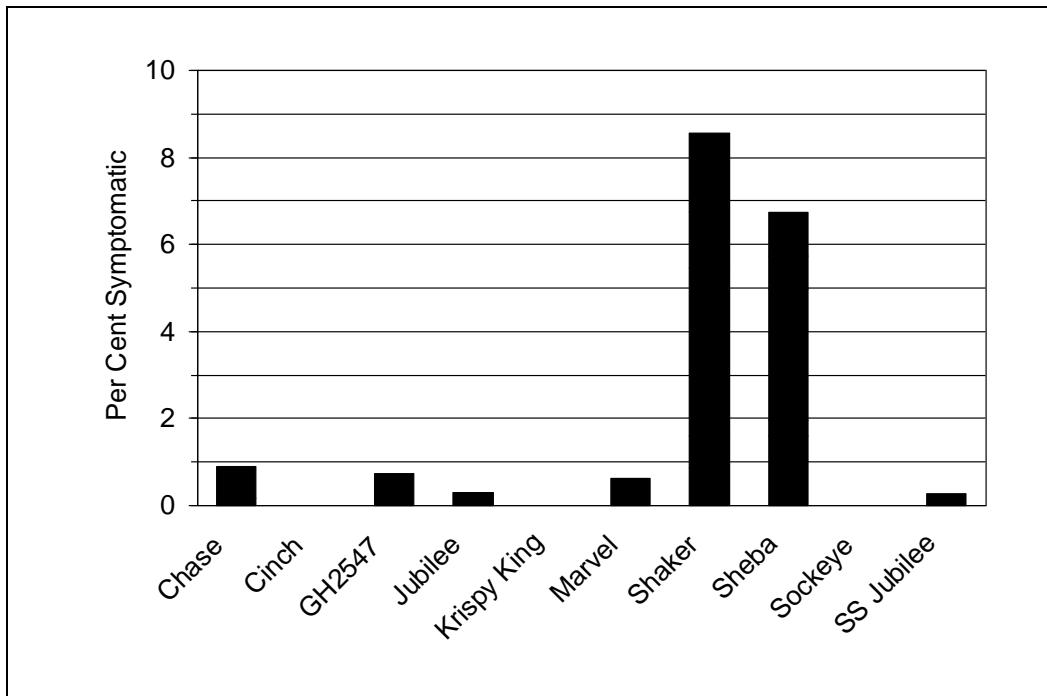


Figure 1. Cumulative HPV symptom development, HAREC, 2005.

A sweet corn field was found in the upper basin which was adjacent to two wheat fields. Aerial photography revealed a distinct pattern of diseased plants downwind from the wheat. Transects were established across the field, and percent infected plants was determined at 250 ft intervals. There is a clear linear relationship ($R^2=0.9079$) between the downwind distance from the virus source (wheat), and the percent plants infected with High Plains virus (Fig 4).

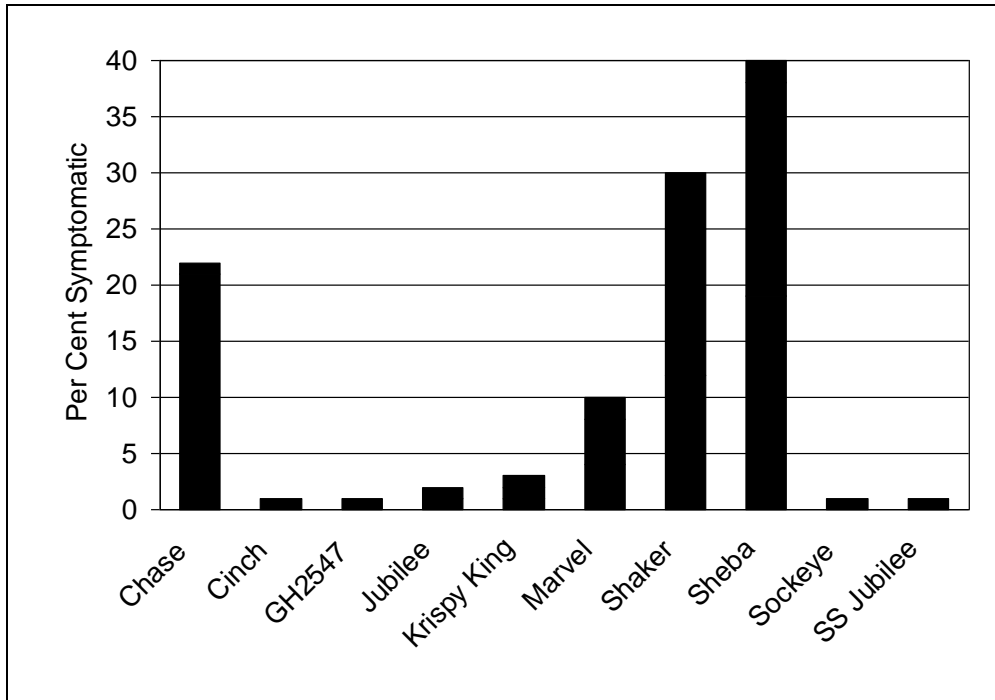


Figure 2. Cumulative HPV symptom development, Friehe Farms, Site 1, 2005.

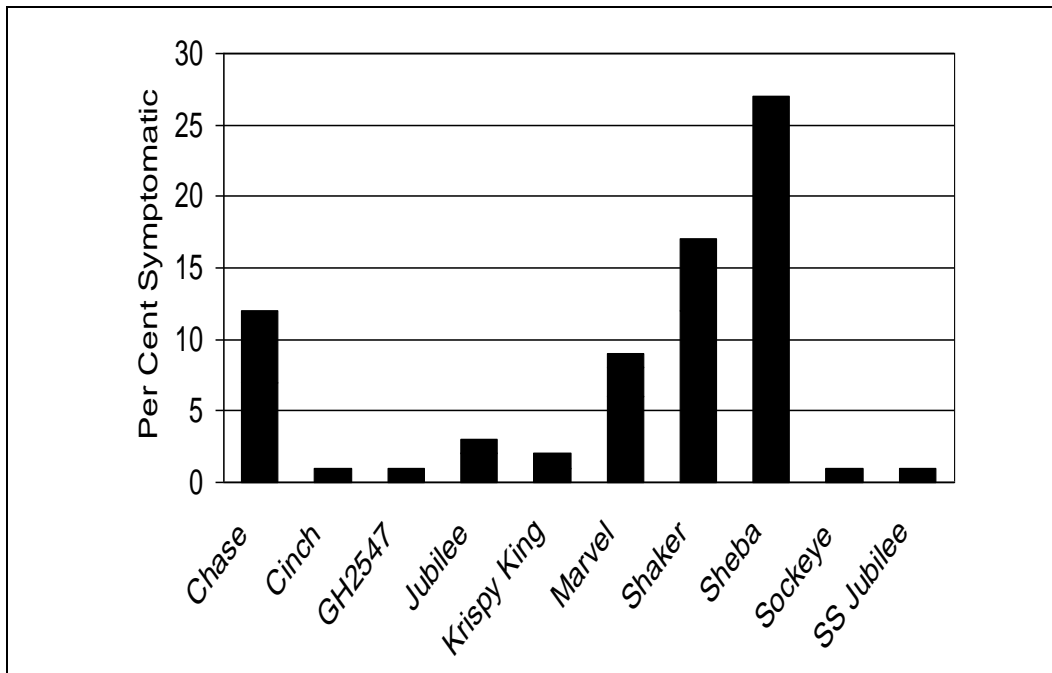


Figure 3. Cumulative HPV symptom development, Friehe Farms, Site 2, 2005.

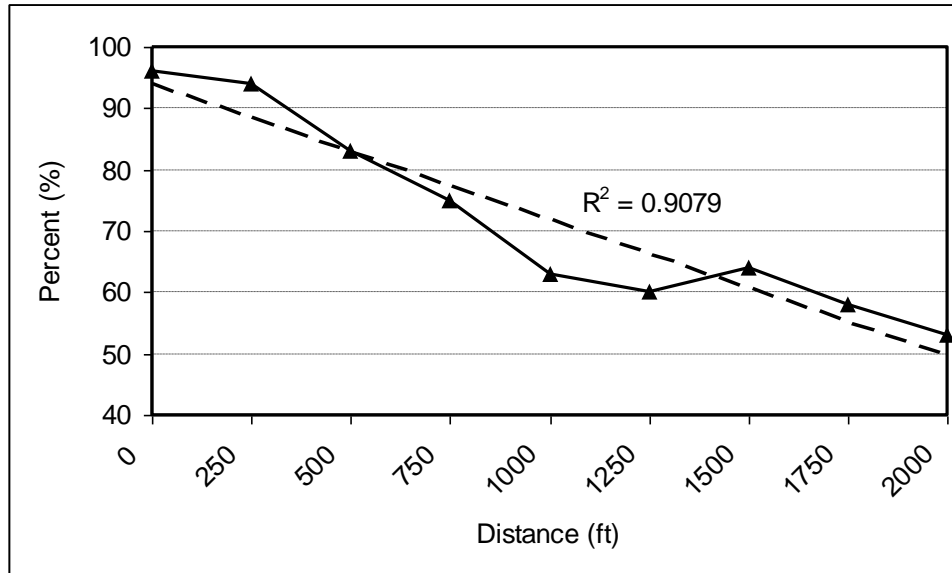


Figure 4. Effect of distance from source of infection on High Plains virus incidence in sweet corn.