EVALUATING SNAP BEAN CULTIVARS FOR THEIR REACTION TO APHID TRANSMITTED VIRUSES

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Aphid transmitted virus diseases remain at the forefront of management concerns for the processing industry. In Wisconsin during 2000, symptoms of what turned out to be a virus complex were first noted in eastern WI in a narrow strip extending from north of Milwaukee to the Door County peninsula. Additional areas reporting plant symptoms and related yield and quality loss included Michigan, southern Ontario and New York State. The problem has reappeared in each succeeding year, although the severity of losses and the distribution of the problem is largely dependant on prevailing environmental conditions and the timing of aphid flights. Several viruses including cucumber mosaic virus (CMV), alfalfa mosaic virus (AMV) and clover yellow vein virus (CYVV) alone and in combination have been identified in symptomatic plants each of the production years since 2000. All of these viruses are transmitted by aphids in a non-persistent manner. The soybean aphid appears to be the primary vector of this complex of viruses. This past summer, a year characterized by cool temperatures coupled with the limited distribution and low numbers of the soybean aphid, we observed limited distribution of symptomatic plants and a low impact of virus on pod yield and quality.

Host resistance to virus incited problems has historically been an effective tool in crop protection for many crops. Beginning in 2001, we initiated a program for screening the susceptibility of processing bean cultivars and advanced breeding lines under field conditions. In 2001, 50 plot entries were evaluated in two plantings at the West Madison Ag Research Station. There were significant differences in the susceptibility of the plot entries and plans were laid to expand the trial in 2002. Trials were planted in early and mid July including two plantings (early and late) at the W. Madison site and one planting on a grower farm near Manitowoc. Each planting contained 150 cultivars and breeding lines replicated three times. The trials contained those lines with the lowest symptom severity in the 2001 trial along with a sizeable increase in new lines. By the end of the season, there were significant differences in symptom expression between plot entries. Based on both visual and ELISA assay, there was a wide range of susceptibility among the cultivars and breeding lines included in the 2002 trial. Data from these field trials provided valuable information to breeders for use in their pursuit of virus resistance in their varietal improvement programs. The data also assisted processor personnel in making cultivar decisions, especially for those late planted fields that appear to be at the greatest risk of virus transmission from migratory aphids.

During 2003, our evaluations continued with 50 plot entries that included the most promising entries from 2003 along with additional promising entries from breeders. Plots were planted on two dates at the W. Madison Ag Research Station and on a single date on a grower farm north of Manitowoc near Denmark, WI. Although the planting dates of the 2003 trials were within two

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weeks of one another, they provided an opportunity to evaluate the plot entries under quite different conditions. Aphid pressure at all sites was heavy and all trials exhibited virus symptoms. The severity of virus symptoms on the W. Madison plots generally followed a progression of mild severity on the first evaluation, moderate severity on the second evaluation and severe at the final evaluation. There were several plot entries in either the early or late planting where the symptom severity remained mild to moderate for the entire season. However, the severity on the final assessment of the first planting at W. Madison was not predictive of the severity on the final assessment of the second planting. At the Manitowoc site, virus symptoms were severe on some lines on the first date of assessment, the plants appeared to recover somewhat by the time of the second assessment and by the time of the third assessment, severity had increased. Symptom severity declined on a few lines as the plants matured while on other entries, symptom severity was highest on the final date of assessment. Severity at the W. Madison site was not necessarily a good predictor of severity at the Manitowoc site. While pods on both plantings at W. Madison remained symptom free, pods on several entries at the Manitowoc site exhibited a range of symptoms including internal and external pod discoloration, mosaic, curvature and suture discoloration. Pod set on the two plantings at W. Madison appeared to approximate what would be considered normal. However, pod set on the same lines at the Manitowoc site ranged from a heavy set of over 15 pods per plant to a very light set of less than 5 pods per plant. ELISA evaluation of the plot entries indicated that the predominant virus in all plants was cucumber mosaic virus (CMV), although AMV (alfalfa mosaic virus) was present as well in some lines.

During 2004, we continued field testing of the most promising entries in the 2003 trial along with additional breeding lines selected by several snap bean breeders. A total of 38 entries were planted at three locations including W. Madison, Fox Lake (30 miles northeast of Madison) and Oostburg (about 90 miles northeast of Madison) (Figure 1). Soybean aphid pressure was light throughout the trial period at all locations, but flights of other aphids were observed including the corn aphid at the Fox Lake site. In general, the incidence of symptomatic plants (Figure 2) was lower in 2004 than all previous years although distinct symptoms were present on some lines in all plots. Symptom severity declined on several lines as the plants reached maturity. Several breeding lines were virtually symptom free at each of the trial sites (Table 1) (Figure 3). Some of the plot entries such as Sirio (Syngenta/Rogers), Yukon (Pop Vriend), Arras (Harris Moran) and Romano Gold (Seminis) are among those lines with the lowest symptom severity in each of the 2002-4 trials. ELISA evaluation of all plot entries by Dr. Ben Lockhart of the University of Minnesota indicates the presence of either CMV, CYVV or AMV in a relatively few plot entries, even though significantly more of the plot entries were symptomatic of virus symptoms. There were several plot entries where these three viruses were not detected on any of the sampling dates at all three field sites (Figure 4). It appears that there is still a yet to be identified virus associated with plants at each of the locations. Studies are underway in an attempt to determine additional causal viruses so that carefully designed assays can be implemented on future plant samples.

Data from this series of field trials in Wisconsin indicates several promising pieces of information that may be helpful in reducing future losses to the virus complex affecting processing beans in the Midwest.

1) Researchers have identified at least three key viruses involved in the virus complex – cucumber mosaic virus (CMV), alfalfa mosaic virus (AMV) and clover yellow vein virus (CYVV). There are likely additional, as yet unidentified, viruses involved in this complex that are vectored by aphid species other than the soybean aphid or perhaps another type of vector.

2) The severity of symptoms appears related to the population levels of the soybean aphid and the timing of aphid influx in the season as this relates to the growth and development of snap bean plantings. The early season appearance of winged soybean aphids in high populations appears to be correlated with the widespread appearance of virus symptoms, reduced pod set, lower yields and reduced pod quality.

3) Several cultivars have consistently ranked high in terms of low symptom severity and the ability to withstand a range of aphid and virus pressure. It is likely that several of the promising breeding lines will advance in commercial breeding programs and that other lines will be developed so that there are multiple options for processors to evaluate in their management systems.

We plan to continue the evaluation of promising cultivars and advanced breeding lines during 2005 at three Wisconsin locations including W. Madison, Fox Lake and Manitowoc/Oostburg to take advantage of differences in environmental conditions, aphid pressure and cultural management practices between the three locations. We plan to limit the size of the plots to the top 10 entries from the 2004 trials plus another 10-15 entries representing promising breeding lines from commercial breeding programs. We welcome your suggestions for entries into the 2005 trial.

Figure 1. Details of the 2004 snap bean variety evaluation trials.

Snap bean variety trial – virus evaluation 2004

Three locations:

- **West Madison Agricultural Research Station**
- **Two commercial fields**

Arrangement:

- **2-row plots (UW breeding lines 1-row), 20' long**
- **3 replicates**

Data collected for each trial:

- **Leaf samples for ELISA virus assay - composite sample of 10 leaves/replicate from each trial, analyzed for AMV, CMV ClYVV.**
- **Two ratings for foliar symptom severity**

	Fox Lake	West Madison	Oostburg
Planted	7/2/04	7/13/04	7/15/04
Leaf sample 1 collected	8/17	8/23	8/24
Leaf sample 2 collected	8/31	9/7	9/8
Visual rating #1	8/17	8/23	8/24
#2	8/31	9/7	9/8

Figure 2. Virus-like symptoms (mosaic, leaf malformation, thickened leathery leaves) observed at field trial near Fox Lake, WI during 2004.

Table 1. List of lines in 2004 trials and incidence of symptoms.

UW Trt No.	Source	Entry Name	In 2002 2003 trials?	Number of plants with virus symptoms per foot of row					
				West Madison		Fox Lake		Oostburg	
				23 Aug	7 Sep	17 Aug	31 Aug	24 Aug	8 Sep
1	Harris-Moran	Hystyle	2002 2003	0.25	0.12	0.27	0.06	0.02	0.23
2	Harris-Moran	Trueblue	No	0.15	0.05	0.31	0.27	0.00	0.00
3	Harris-Moran	Arras (MV-185)	2002 2003	0.02	0.01	0.37	0.13	0.00	0.00
4	Seminis	Romano Gold (08190506)	2002 2003	0.06	0.16	0.82	0.14	0.01	0.00
5	Seminis	15330733	No	0.25	0.00	0.21	0.21	0.01	0.00
6	Seminis	R00.11142	No	0.06	0.00	0.06	0.09	0.00	0.00
7	Seminis	08120670	No	0.16	0.00	0.35	0.25	0.00	0.00
8	Seminis	R00.35558	No	0.52	0.34	0.23	0.06	0.02	0.42
9	Syngenta/ Rogers	SYNMV 85	No	0.75	0.05	0.98	0.44	0.00	0.17
10	Syngenta/ Rogers	Lexus	2002 2003	0.16	0.08	1.52	0.97	0.03	0.00
11	Syngenta/ Rogers	Redon	No	0.06	0.05	0.92	1.04	0.01	0.03
12	Syngenta/ Rogers	Mayon	2002 2003	0.05	0.00	0.98	0.38	0.00	0.00
13	Syngenta/ Rogers	Sirio	2002 2003	0.06	0.03	0.08	0.04	0.01	0.06
14	Brotherton	Orion	2002 2003	0.43	0.07	1.53	1.43	0.04	0.00
15	Brotherton	#835	No	0.24	0.29	0.15	0.01	0.00	0.01
16	Brotherton	HS 906	No	0.03	0.02	0.52	0.16	0.00	0.00
17	Del Monte	IDC IX	No	0.07	0.04	0.18	0.09	0.01	0.01
18	Del Monte	IDB 374	No	0.20	0.08	2.21	1.33	0.00	0.32
19	Del Monte	IDA 555	No	0.05	0.02	0.26	0.19	0.01	0.00
20	Pure Line Seeds	PLS 87	2002 2003	0.03	0.08	1.75	0.64	0.00	0.00
21	Pure Line Seeds	PLS 118 Romano	2002 2003	0.55	0.01	0.88	0.23	0.03	0.04
22	Pop Vriend	Yellowstone	No	0.13	0.05	0.26	0.05	0.01	0.00
23	Pop Vriend	Yukon (YKN)	2002 2003	0.09	0.03	0.18	0.09	0.01	0.00
24	Pop Vriend	Artemis	No	0.09	0.06	0.39	0.14	0.00	0.00
25	Pop Vriend	Laguna	No	0.07	0.01	0.26	0.11	0.00	0.00
26	UW Hort, J. Nienhaus, M. Sass	2292.1.200	No	0.06	0.00	0.31	0.00	0.00	0.00
27	UW Hort, J. Nienhaus, M. Sass	PI309881	No	0.12	0.00	0.06	0.00	0.00	0.00
28	UW Hort, J. Nienhaus, M. Sass	2292.2.1000	No	0.10	0.00	0.08	0.00	0.00	0.00
29	UW Hort, J. Nienhaus, M. Sass	2292.11.200	No	0.00	0.00	0.08	0.02	0.02	0.00
30	UW Hort, J. Nienhaus, M. Sass	2319.1.1000	No	0.06	0.03	0.12	0.00	0.00	0.00
31	UW Hort, J. Nienhaus, M. Sass	2313.9.3000	No	0.02	0.00	0.14	0.00	0.00	0.00
32	UW Hort, J. Nienhaus, M. Sass	2313.9.1000	No	0.02	0.00	0.02	0.00	0.00	0.00
33	UW Hort, J. Nienhaus, M. Sass	2313.4.3000	No	0.02	0.00	0.39	0.00	0.02	0.00
34	UW Hort, J. Nienhaus, M. Sass	2313.9.2000	No	0.02	0.00	0.14	0.02	0.00	0.00
35	UW Hort, J. Nienhaus, M. Sass	2313.10.3000	No	0.00	0.00	0.25	0.00	0.00	0.00
36	UW Hort, J. Nienhaus, M. Sass	2319.1.3000	No	0.00	0.00	0.08	0.00	0.00	0.00
37	UW Hort, J. Nienhaus, M. Sass	2319.4.2000	No	0.04	0.02	0.18	0.04	0.00	0.04
38	UW Hort, J. Nienhaus, M. Sass	2295.5.3000	No	0.00	0.00	0.24	0.00	0.00	0.00
Pr > F				<0.01	<0.01	<0.01	<0.01	0.72	<0.01
LSD				0.34	0.14	0.58	0.35	NS	0.09

Figure 3. Average incidence of symptomatic plants inclusive of three field locations.

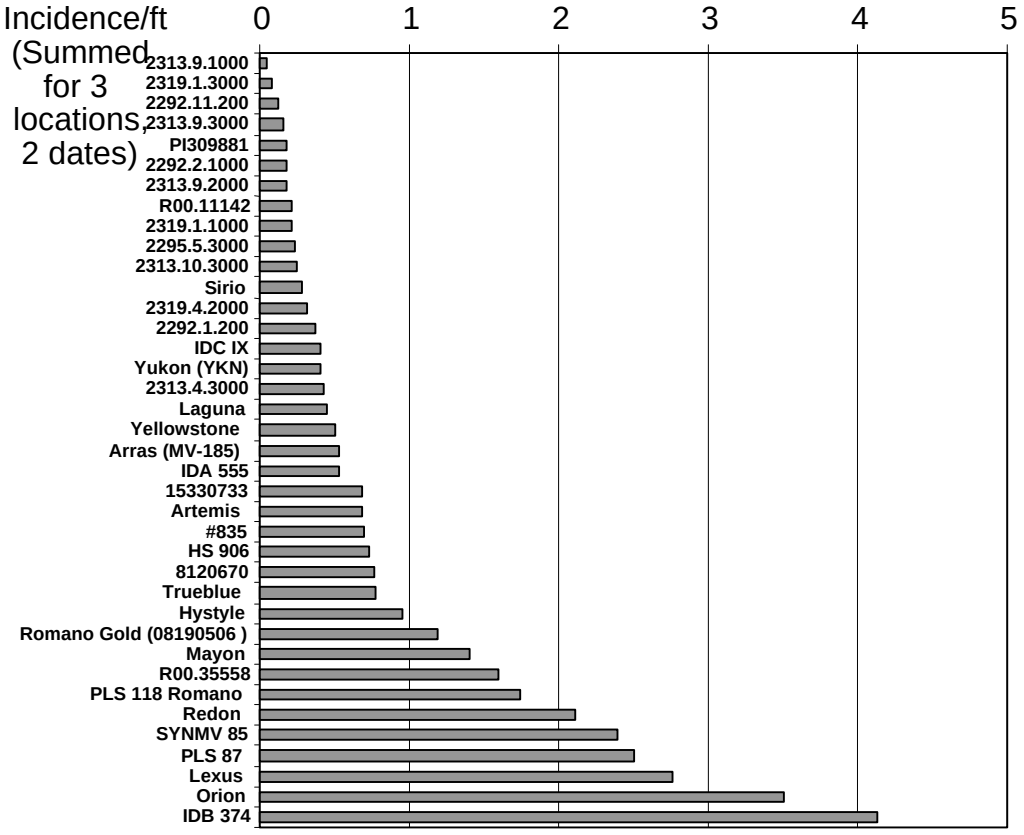

Figure 4. List of plot entries where plant viruses (AMV, CLYVV or CMV) were not detected at any of the three field plot locations.

4	Romano Gold (08190506)	**30**	2319.1.1000
7	08120670	**31**	2313.9.3000
8	R00.35558	**32**	2313.9.1000
11	Redon	**33**	2313.4.3000
20	PLS 87	**34**	2313.9.2000
25	Laguna	**35**	2313.10.3000
26	2292.1.200	**36**	2319.1.3000
27	PI309881	**37**	2319.4.2000
28	2292.2.1000	**38**	2295.5.3000
29	2292.11.200		