IMPACT OF PLANTING DATE ON VIRUS INCIDENCE

Alvin J. Bussan and Mike Drilias[1]

Introduction

During the 2000 and 2001 growing season, the development and presence of virus symptoms in snap bean increased dramatically. The symptoms were primarily caused by cucumber mosaic virus and alfalfa mosaic virus. The viruses had large economic impacts by reducing yields 90% or more and causing off colored, deformed and generally poor quality beans. These viruses have been present in various weeds and crops within WI for a number of years, but were seldom seen within snap bean and never to the extent seen in 2000 or 2001. The recent invasion and establishment of the soybean aphid in the Midwestern and Eastern U.S. has been directly linked to the increased incidence of the viruses in snap bean. The midsummer migration of the soybean aphid into snap bean vectored viruses at high levels and subsequently led to the unprecedented yield and quality losses.

Recent discussions with vegetable processors from Wisconsin indicate the severity of disease symptoms is variable. Losses due to the virus complex range from not harvesting fields at all due to pod malformation or discoloration (usually black or brown) to yield reductions of 50 to 75%. The true effect of the virus on snap bean has been difficult to quantify because we have been unable to maintain a negative control or zero virus check.

A number of techniques are being employed to manage and prevent the development of virus within snap bean. These practices are being primarily targeted at the vector (soybean aphid) or resistance to the virus within snap bean varieties. Management techniques being utilized include: 1) plant earlier in the season to avoid the virus by harvesting before soybean aphid migration, 2) use aggressive management programs (including insecticide seed treatment and foliar application or stylet oils) to manage soybean aphids in snap bean and prevent within field migration, 3) development of tolerant or resistant snap bean varieties.

The goal of this research was to investigate the cumulative effect of incorporating these strategies into an integrated management system. Specifically, this research attempted to determine the critical planting date when snap bean was vulnerable to virus infection and yield or quality response. In addition, this research attempted to determine how different aphid management strategies or variety tolerance impacted the critical planting date.

Materials and Methods

Field trials were conducted on the Horticulture Farm at the Arlington Agricultural Research Station during 2002 and 2003. The experimental design was a randomized complete block with a split-split plot treatment arrangement and four replications. The whole plot was snap bean seeding date. The sub-plot was snap-bean variety. The sub-sub-plot was insecticide management treatment. Planting date was May 22, June 19, and July 15 during 2002 and June 18, July 2, and July 18 during 2003. Initial planting dates were delayed during 2002 to increase the exposure of each planting date to soybean aphid pressure. During 2002, the crop was harvested prior to aphid migration into the snap bean. Snap bean variety treatments were a virus susceptible (Hystyle) and

[1] Vegetable Production Specialist, Association Researcher, Dept. of Horticulture, Univ. of Wisconsin-Madison, 1575 Linden Dr., Madison, WI, 53706

tolerant (MV185) line. Insecticide treatments were no treatment, Gaucho seed treatment, Sylet Oil, and seed treatment plus stylet oil. All other crop husbandry practices including use of Sevin and Cruiser for leaf hopper and European corn borer control were utilized.

Snap bean were harvested on July 24 (August 1 for MV 185), August 15 and September 12 in 2002 for the 1st, 2nd, and 3rd planting dates, respectively. Snap bean were harvested August 14, August 28, and September 17 in 2003 for the 1st, 2nd, and 3rd planting dates, respectively. Data collection included aphid counts, snap bean virus severity ratings on the foliage and pods, and yield. Data analysis was completed with ANOVA. Leaf samples were collected to allow ELISA analysis to confirm presence of virus, but sampling errors have eliminated the value of the data.

Results and Discussion

High aphid populations did not materialize in the 2002 growing season. As a result, the virus pressure was dramatically reduced leading to little if any virus symptoms within this experiment. Snap bean growers benefited from this trend as little virus injury or yield reductions occurred in commercial production fields. In contrast, soybean aphid populations were heavy during 2003, which led to stunting of the crop the first 10 to 14 days after aphid migration and virus symptoms several weeks later. The initial stunting is being partially attributed to the aphid feeding. In addition to aphids and virus, the 2003 crop was impacted by drought conditions at the Arlington Ag Research Station.

Soybean aphids were initially identified on snap bean on 7/29 and few if any were identified after 8/7. Aphid density ranged from 0 to 5 per leaf. Aphids were only found on leaves of the third planting, which was in the 1-2 trifoliate stage by late July. No aphids were found on the mid snap bean planting, which flowered on July 24. Late planted snap bean flowered on 8/20.

Table 1. Yield of snap bean and aphid density (2003) averaged for 3 planting dates during 2002 and 2003. Yield is presented for different size classes (4-5 being prime) as well as total.

			2002			2003			
			Yield (ton/A)			Yield (ton/A)			Aphids/leaf
Planting Date	2002	2003	1-3's	4-5's	Total	1-3's	4-5's	Total	August 7
First	May 22	June 18	1.1	2.1	3.2	2.2	1.8	4.0	2.4
Second	June 19	July 2	1.3	2.6	3.9	1.0	1.2	2.2	4.7
Third	July 15	July 18	1.6	2.1	3.7	0.3	0.4	0.7	16.6
LSD (*P* = 0.05)			**0.3**	**NS**	**NS**	**0.2**	**0.2**	**0.3**	**4.5**

Yield of undersized beans (1 – 3) was affected by planting date in 2002 with undersize increasing at the later planting dates (Table 1). The undersized increased at later planting dates because MV185 was harvested at the same time as Hystyle for the second and third planting date treatments. The harvest of MV185 was delayed for the earliest planting date treatment. MV185 matures later hence the increase in undersized beans when the harvest dates were synchronized compared to when they were different.

In 2003, total yield was influenced by planting date for multiple reasons. The snap bean yield was reduced dramatically as the harvest date was delayed. No question, the dry conditions during much of July and August (1 to 1.5" precipitation at Arlingtion in 2003) reduced yield. However, virus also could have caused yield losses especially for the latest planting date. Symptoms were evident on the foliage and pod drop at the pin bean stage was evident. Pod drop can be caused by both virus and drought. No pod quality effects were seen within any treatments either year.

Aphid density increased dramatically with planting date. Limited evidence exists, but this data suggests aphid prefer younger plant tissue compared to older plant tissue.

Table 2. Snap bean yield and aphid density (2003) averaged for 2 varieties during 2002 and 2003. Yield is presented for different size classes (4-5 being prime) as well as total.

	2002			2003			
	Yield (ton/A)			Yield (ton/A)			Aphids/leaf
Variety	1-3's	4-5's	Total	1-3's	4-5's	Total	August 7
Hystyle	0.5	3.8	4.4	0.5	2.2	2.7	8.9
MV 185	2.2	0.7	2.8	1.8	0.1	1.9	6.9
LSD (*P* = 0.05)	**0.4**	**0.6**	**0.7**	**0.2**	**0.1**	**0.2**	**1.4**

Total yield and yield of each size class varied by variety each year (Table 2). Hystyle had larger beans and yield more than MV185 both years. Even though Hystyle should be more susceptible to virus damage it out yielded MV 185. MV 185 is a small sieve size bean thus had smaller pods.

Aphids appeared to favor Hystyle more than MV 185 during 2003. Whether the difference in aphid pressure between lines would cause differences in susceptibility to virus is uncertain. However, the density of soybean aphid present on MV 185 is high enough to spread the virus from plant to plant.

Table 3. Yield of snap bean and aphid density (2003) averaged for 4 insecticide treatments during 2002 and 2003. Yield is presented for different size classes (4-5 being prime) and total.

	2002			2003			
	Yield (ton/A)			Yield (ton/A)			Aphids/leaf
Insecticide Treatment	1-3's	4-5's	Total	1-3's	4-5's	Total	August 7
Untreated	1.2	2.2	3.4	1.2	1.2	2.4	7.1
Gaucho	1.5	2.4	3.8	1.1	1.1	2.2	7.0
Stylet Oil	1.4	2.0	3.4	1.2	1.1	2.3	8.9
Gaucho & Stylet Oil	1.4	2.5	3.8	1.2	1.1	2.3	8.6
LSD (*P* = 0.05)	**NS**	**0.3**	**0.3**	**NS**	**NS**	**NS**	**1.7**

Insecticide treatment did affect snap bean yield during 2002, but not 2003 (Table 3). Even though aphid pressure was minimal, Gaucho appeared to result in higher yields with larger beans than treatments without the seed treatment. Interestingly enough, treatments contain sylet oil appeared to have higher aphid densities than treatments without sylet oil.

Future work needs to determine the critical date at which virus infection occurs in snap bean. Observations from processors suggest a critical planting date that results in pods at a given stage during aphid migration results in black pod formation. When severity of black pods exceed 3 to 5% fields must be skipped resulting in large losses to growers and processors. Later planted beans do not have black pods but appear more prone to yield reductions due to the virus. The virus causes loss of plant vigor and thus reductions in photosynthesis and carbon assimilation and partitioning to the pods as well as pod abortion or drop.

Until tolerant or resistant lines are available that yield similar to susceptible standards, growers will only want to plant tolerant lines when the threat of virus infection is significant enough to justify the lost yield.

Little virus pressure existed within these plots during 2002, as no symptoms were present except in the last planting date. Virus injury was only 5% in the latest planted snap bean (7/15 planting date) during 2003. In contrast, virus symptoms were seen on the foliage of all three planting dates during 2003. Insecticide treatment did not affect virus symptoms at any planting date. No deformities due to virus were detected on the beans either year.

Future work is necessary to help determine what conditions are favorable for large-scale migration of soybean aphid and transmission of virus into snap bean. In addition, the critical planting date needs to be determined so that growers and processors can begin implementing management strategies when the threat for virus is real. Even though there was minimal effect in this trial, planting prior to the critical date was an effective means of preventing virus infection.