Cover Crops at WYE 2007/08

Michael Newell
Horticultural Crops Program Manager

Hairy Vetch from Australia

Last year I informed meeting participants about the importance of "origin" of seed when purchasing cover crop seed. In 2006, I had purchased Hairy Vetch seed (variety not stated) from my usual seed dealer and it turned out the seed was from Australia. What part of Australia is unclear. The crop grew very well through the fall and late into a very mild winter before an eventual cold/wet period in late February killed 100% of the vetch. In 2007, I was able to secure Hairy Vetch seed from Oregon (the usual source) and with left-over seed from Australia; I planted the two seed sources in a side-by-side observational plot, with and without a companion of spring oats. Although the Australian vetch was a little more prolific in the fall and it did not Winter-kill during the winter of 2007/08, a very minor color difference between the two vetch sources was observed but there was no difference in time of flowering or in accumulated biomass. There was also no difference observed in the plots that had spring oats as a companion. New varieties of Hairy Vetch are available now and more will be available in the future. Dr. Tom Devine of the USDA-ARS at Beltsville is currently breeding new Hairy Vetch selections for the Northeast and we look forward to the results. It is important that we plant varieties adapted to our regional climate. Choosing varieties developed in climatic areas similar to where the crop will be planted is very important for reliable success.

Hairy Vetch or Rye?

I have always been a big proponent of Hairy Vetch for pumpkin production. It fits well with the timing of pumpkin planting, produces a lot of biomass (>three dry ton/a) and can provide all the nitrogen needed. However it does need to be planted in September to achieve enough growth for over-wintering. This September planting time may conflict with other farm activities and for some growers it can not be used for this reason.

Rye is a non-legume alternative that can be planted well into November, produces plenty of biomass and is much less expensive than Hairy Vetch. It is used extensively as a winter cover crop for grain production. However, for use in pumpkins care must be taken not to let it grow too long into the spring as it can become a challenge to manage. I had that challenge this past spring. I had planted it in fall 2007 for a no-till IPM trial. I had intended to kill the rye the first week in May when it was about three feet in height. However a wet period delayed all field activities for two weeks and the rye was six feet tall and flowering before I could get back in the field. I did manage to spray it with glyphosate but it was already a jungle and lodging. Fortunately, I had access to a flail type mower which does an excellent job in even distribution of the chopped debris. Although I prefer to leave the cover crop attached to the roots by rolling it, I had few problems with the mowed crop. I also had the foresight to plant the rye at a slight angle to the anticipated planted rows of pumpkins. This off-set kept the pumpkin planter from

following a row of rye which can (especially if the rye gets rank) make planting more difficult.
We also need to be sure that enough nitrogen is allocated for the pumpkin crop in addition to what the rye may tie up. I always band some nutrients at planting and apply the remainder before the vines begin to run. If the soil is low in fertility a broadcast application of about 30 lbs of nitrogen prior to planting may help prevent any nitrogen deficiency.

Cover Crop Mixes

Combinations of different cover crop types can provide additional benefits. In many years I will plant spring oats in addition to hairy vetch. The oats germinate and grow quickly in the fall and usually die over the winter months. This provides cold protection and can help hairy vetch survive in the absence of a snow cover. However, if the oats are planted too early, they may not winter kill. A low seeding rate of rye (15-30lbs/a) can also be combined with hairy vetch to provide winter protection and it gives the vetch a chance to grow vertically in the Spring as the rye starts to grow increasing the total biomass of the cover crop. A mixture of vetch, rye and crimson clover, sometimes called the “Pennsylvania mix”, has produced in excess of 4 ton dry biomass per acre in trials at Wye. This type of combination also releases nitrogen over a longer period during the summer because of the different lignin composition of the three plant types. But a word of caution, you need to be sure that your planter can work with a mulch depth of three inches.

Keedysville Research Center Pumpkin Trials Timeline

2007

Mid October	Planted Rye cover crop at 2 bushels/acre (Vetch seed was not obtained at that point)
Mid November	Planted Hairy Vetch into rye cover at a rate of 25 lbs/acre

2008

May 14	Applied Credit Extra (Glyphosate) to the rye/vetch cover at a rate of 1 Qt/acre. Rye was in head and about 5 feet tall. Vetch was climbing the rye and the cover crop was beginning to lodge.
May 19	Rolled the cover crop
May 31	Applied Prefar 4E (5 Qt/acre) plus Gramoxone Inteon (1 Qt/acre) with 30 lb/acre Nitrogen
May 20	Pumpkins planted in greenhouse
June 10	Transplanted and drenched with Nuprid 2F (imidacloprid) insecticide
June 30	Applied Endosulfan 3EC
July and August	Vines turned weekly in to keep plots separate
July 9	Bravo Weather-Stik plus Endosulfan 3EC
July 14	Roundup applied between rows
July 16	Bravo Weather-Stik plus Endosulfan 3EC
July 31	Bravo Weather-Stik plus Rally 40W
August 7	Bravo Weather-Stik plus Pristine
August 14	Bravo Weather-Stik plus Rally 40W
August 25	Bravo Weather-Stik plus Pristine
September 2	Bravo Weather-Stik plus Rally 40W
September 10	Begin Harvest

Rainfall from planting to harvest was 12.47”

June 1, 3, 4, 10, 14, 16, 18, 20, 23 (w/hail), 30
July 6, 9, 13, 14, 22, 23, 24, 26 (w/hail), 30
August 2, 6, 7, 10, 13, 29
September 6, 9

Wye Research Center Pumpkin Trials Timeline

2007

Sept. 19	Drill cover crops - Hairy Vetch @ 37 lb/a. 75% germination + hard seed = 28 lb/a + Spring oats @ 47 lb/a

2008

May 19	Roll and spray cover crop with Glyphosate
June 9	Start seeds in jiffy 7 peat pellets
June 18	Spray herbicide Prefar + Gramoxone and insecticide Baythoid
June 19	Transplant with starter fertilizer and overhead irrigate
July 4	Band apply Gramoxone
July 9	Spray insecticide Thiodex for squash bug and squash vine borer
July 19	Begin fungicide spray program Bravo 2 pint/a + Kocide 2000 1.5 lb/a
July 28	Bravo 3 pint/a + Pristine 18.5 oz/a
August 9	Bravo 3 pint/a + Procure 8 oz/a + Kocide 2000 1.5 lb/a
August 20	Bravo 3 pint/a + Pristine 18.5 oz/a + Kocide 2000 1.5 b/a
August 30	Bravo 3 pint/a + Sulfur 80w 4 lb/a + Kocide 2000 1.5 lb/a
Sept. 8	Bravo 3 pint/a + Sulfur 80w 4 lb/a + Pristine 18.5 oz/a
Sept. 15	Begin harvest

Rainfall from planting to harvest was 8.65”
June 21, 24, 28, 29
July 1, 4, 5, 6, 8, 10, 14, 15, 23, 24, 28
August 2, 15, 29
September 5, 6

Overhead irrigations totaled 8.25”
June 18, 23, July 2, 15, 24, August 4, 8, 13, 19, 26, September 4 (3/4” each time)

Sprays applied with a cannon type air-blast sprayer @ 60 gallons per acre

Fruit Rot on Pumpkin

(NOT including Phytophthora blight - *Phytophthora capsici*)

Dr. Kate Everts, University of Maryland and University of Delaware
Professor and Extension Specialist, Plant Pathology

There are many fungi that cause fruit rot on pumpkin. Some examples are white speck caused by *Plectosporium* (formerly known as *Microdochium*), which causes white or tan "pimples" on the fruit (Fig.1); black rot is caused by the same fungus that causes gummy stem blight on the foliage (*Didymella bryoniae*), and results in large grey lesions (Fig. 2); and anthracnose, which causes smaller grey lesions on fruit (Fig. 3). Fusarium fruit rot (Fig. 4) is a relatively dry fruit rot that initially looks white or pink, but frequently becomes black or tan because of saprophytic growth. Other fruit rots include scab and Southern blight (Fig. 6).

Because many different fungi cause fruit rots, no single strategy will be sufficient to manage them. However the following are good practices that, when used together, can minimize damage.

1. Select well-drained fields for pumpkin production.
2. Select cultivars (varieties) that are less susceptible to fruit rot. For example, there are some cultivar differences in susceptibility to white speck.
3. Grow pumpkins on a no-till cover crop. No-till pumpkin production reduces several fruit rots and the reduction in rot is related to the amount of soil coverage that the cover crop provides. A hairy-vetch and rye mixture would provide nutrient benefits and improve fruit quality by reducing rot and edema.
4. Follow a good fungicide management program in the field. The same fungi that cause white speck, black rot and anthracnose also cause lesions on the leaves. If the leaves are protected from disease, the fruit will be less likely to become diseased. A good fungicide program also will maintain foliage health and keep sunscald at a minimum.
5. Harvest mature fruit as soon as possible.
6. Discard damaged and diseased fruit.
7. Avoid wounding the fruit during harvest and transport.
8. Store fruit in a cool, shaded and dry location.

I'm often asked "*What about washing fruit?*" Because many fungi infect fruit in the field (preharvest) or are seedborne (Fusarium fruit rot), washing the fruit won't eliminate the pathogens. Also, the wash water is an excellent way to spread the pathogen from fruit to fruit. However, previous research has shown that for cantaloupe, a field fungicide program combined with a one minute immersion of fruit in 135^{o} F water was successful in reducing rot. Unfortunately no one has looked at this treatment on pumpkins and we don't know if it will harm the fruit.

Figure 1. White speck (caused by *Plectosporium*, formerly *Microdochium*).

Figure 2. Black rot (caused by *Didymella bryoniae*)

Figure 3. Anthracnose fruit rot (caused by *Colletotrichum* spp.)

Figure 4. Fusarium fruit rot (caused by *Fusarium solani*)

Figure 5. Southern blight on pumpkin fruit (*Sclerotinia rolfsii*)

Figure 6. Phytophthora blight (caused by *Phytophthora capsici*)

Fungicides for late season management of foliar and fruit diseases of pumpkin

If you do not plan to harvest pumpkins for several weeks, it is important to continue to protect pumpkin foliage. High levels of downy mildew and powdery mildew are present in the mid-Atlantic. Downy mildew can cause very rapid defoliation and result in sunscald, and powdery mildew will damage handle and fruit quality. Heavy localized rainfall may result in pockets of Phytophthora blight.

Managing these three diseases is a challenge. Management of Phytophthora blight should be based on cultural practices that minimize standing water on the crop. This means planting only in fields with good drainage, not planting in low areas, subsoiling fields before planting, avoiding over-irrigation, etc. The foundation of these "good management practices" will determine how successful fungicide sprays are. Several fungicides are registered for managing Phytophthora blight. While the labels may say "control", it is more accurate to say these fungicides will "suppress" Phytophthora blight (because the control is easily overcome if the weather favors disease development). The organism that causes Phytophthora blight is related to the one that causes downy mildew, therefore some of the fungicides can be used to target both diseases.

Below is a table that indicates which products are effective on downy mildew, and have some suppression on Phytophthora blight. Relative efficacy is not listed for Phytophthora blight because little comparison data exists.

Fungicide efficacy (downy mildew) and registration status (Phytophthora blight).

Product	FRAC Code	Efficacy on downy mildew	Registered for Phytophthora *suppression*	Comments
Ranman	21	Very Good	Yes	Use 2.75 fl. oz./A for Phytophthora blight
Presidio	43	Very Good	Yes	
Previcur Flex	29	Very Good	No	
Tanos	11+27	Good - Very Good	Yes	Use higher rate 8 to 10 oz./A for Phytophthora
Forum	40	Poor	Yes	
Revus	40	Inconsistent	Yes	
Prophyt/Phostrol	33	Poor	Yes	Has not been effective on Phytophthora or downy mildew
Curzate	27	Good	No	
Ridomil Gold combinations	4	Resistance	Foliar formulations not labeled	Soil applications can be used for Phytophthora suppression where no resistance occurs

To manage **powdery mildew** apply a protectant such as chlorothalonil *plus* Rally or chlorothalonil *plus* Procure in *alternation* with either Sulfur 80W at 4 lb/A or chlorothalonil *plus* Pristine. Sulfur can cause phytotoxicity, so use caution and read the label. Remember that coverage of foliage is important for optimum results.

Squash Vine Borer in Pumpkins

Jerry Brust
IPM Vegetable Specialist

Introduction*: The squash vine borer (SQVB),* Melittia cucurbitae *is a clear-winged moth that is becoming more of a problem in vine crops in Maryland each year. This year the moth has been an especially bad pest in many pumpkin fields. Its preferred vine crops are winter squash, summer squash, and pumpkins. They will attack cucumbers and melons much less frequently. Unlike many moths, they are fast daytime flyers that are sometimes mistaken for wasps.*

Biology and Life cycle*: Squash vine borers have stout bodies about ½ inch in length with a wingspan from 1¼ to 1½ inches. The adult body is reddish with black bands encircling the abdomen (Fig. 1). The front wings are a metallic green. The hind wings are clear with dark veins and fringed with reddish brown hairs. The larvae are white to cream-colored caterpillars with brown heads which grow to about one inch in length (Fig. 2). The adults emerge from June through July from cocoons that overwintered in the soil. They typically lay their small (1/25"), oval, brown eggs singly on stems or leaf stalks at the base of the plant. Eggs hatch in 7-10 days. Upon hatching, the larvae immediately bore into the stem, leaving small almost invisible entrance holes and yellowish frass. After feeding for about a month the borers exit from the stem and burrow into the soil. They overwinter in a cocoon and pupate in the spring. There are 1-2 generations per year in the mid-Atlantic.*

Fig. 1 SQVB adult moth, plant with SQVB in stem and one leaf showing yellowing and necrosis

Damage: *Larvae damage plants by cutting the water and nutrient conducting lines. As a result, the plants start to wilt or leaves begin to turn yellow and eventually brown around the leaf margins (Fig. 1). Other pests also cause wilting symptoms such as squash bugs, aphids, bacterial wilt which is vectored by the striped cucumber beetle or several root diseases (which we had a great number of problems with this year). In order to determine if the squash vine borer is causing the wilting, look for a large swollen stem and large amounts of yellowish-green frass extruding from holes. If these symptoms exist, split the stems apart with a sharp knife to look for the larvae. If several larvae have infested a plant, the plant may collapse and die (Fig. 2).*

Fig 2 SQVB damage to pumpkin stems-rotting the inside and 6 larvae found at base of plant

Management: *You must control the newly hatching larvae (first instars) before they enter the plant. Once the larvae attack the stem, little can be done. Research I have conducted over the last three years demonstrates that the best strategy is to walk through the field once a week and look for the adult moth flying around young pumpkin plants early in the year just as plants are beginning to run (~ 3rd week). If any SQVB moth is observed a spray of insecticide directed at the base of the plant should be made within 5 days. After this initial insecticide application pheromone traps can be used to monitor the moth. Pheromone traps and lures attract male moths, and are available from commercial suppliers (see below). Two traps should be placed on opposite sides of a field at 4-6 ft in ht, 20-50 ft. away from the edge of the field. When two SQVB moths are caught in the traps a spray should go out in 2-5 days. Pyrethroids (Capture (bifenthrin), Warrior (lambda cyhalothrin) should be sprayed at the base of the plant for control.*

Cultural Control**:** Do not locate your pumpkin field within 400 yards of a previous pumpkin field especially if there were SQVB problems in the field the year before. If no SQVB problems the year before this year's pumpkin field can be located as close to last year's field as wanted. If a field has a borer infestation, destroy infected crops and disk the soil in early fall exposing cocoons that are buried 1-6 inches deep.

Resistant Varieties**:** Butternut squash exhibits a higher level of resistance than Hubbard and Acorn squashes, which are highly susceptible to borer damage.

Mechanical Control**:** Floating row covers placed over the crops prevent the moths from laying eggs. Place the floating row covers over the plants as they start to vine or when you notice any squash vine borers in the area. Firmly anchor the row covers to the ground or the moths will crawl under it. In addition, remove row covers during flowering to permit maximum pollination.

Pheromone trap and lure supplier: Great Lakes IPM
10220 Church Rd. NE
Vistaburg, MI 48891-9746
Tel: 517-268-5693 or 517-268-5911
http:///www.greatlakesipm.com

BT SWEET CORN: A MORE TARGETED AND SUSTAINABLE TOOL

Galen P. Dively, Professor Emeritus
Department of Entomology, University of Maryland
College Park, MD

The demand for quality sweet corn requires growers to frequently apply insecticides to control insects. In the Mid-Atlantic area, European corn borer and corn earworm are the primary ear invaders, followed by fall armyworm and sap beetles as occasional pests. The degree of ear infestation varies with the year, time of season, and location. Infestations typically cause damage on 5 to 25% of the ears in early season plantings, and often greater than 50% ear damage in late plantings if not controlled.

Insecticide control programs are costly, potentially pose exposure risks to the applicator and farm workers, and require considerable time and management to implement. Typically, 2 to 4 sprays per processing crop or 3 to 8 sprays per fresh market crop are applied at an application cost of $12-$16 per acre. European corn borer and fall armyworm also infest the whorl and tassel stages requiring additional sprays prior to silking to prevent yield losses.

Until recently, the only control option available for sweet corn growers was broad-spectrum insecticides. Pyrethroids such as Warrior and Baythroid are most commonly used but substantial amounts of Lannate and Sevin are used as well. Newer reduced risk chemistries such as indoxacarb (Avaunt) and spinosad (SpinTor) are also available but have not replaced the industry standards. Insecticides are certainly not a guaranteed way to achieve good ear quality. Improper timing, inadequate spray coverage, weather effects on residual activity, and increasing insect resistance are all reasons contributing to control failures.

The newest and most potent bioinsecticide available today for insect control is Attribute® Insect Protected sweet corn expressing the *Bacillus thuringiensis* cry1Ab endotoxin. This technology was registered by EPA and commercialized by Syngenta Seeds in 1998. Similar to Bt field corn, when the target insect consumes plant tissue from these transgenic hybrids, the Bt protein binds to the insect's midgut, causing cessation of feeding, pores to form in the midgut wall, infection, and eventual death within 48 hours. Initially, the first transgenic varieties were developed primarily for processing and restrictions on seed purchases limited their availability to fresh market growers. However, there are now 7 Roger Brand Bt varieties for shipping and local markets and many of these are available in smaller 25k seed units. The varieties include 4 supersweets GSS0966 (78 day yellow, similar to PrimePlus), BSS0977 (78 day mid-season bicolor), WSS0987 (81 day white), and BSS0982 (80 day bicolor, high end shipper); and 3 TripleSweets® BC0805 (82 day bicolor, similar to Providence), BC0808 (73 day early bicolor), and WH0809 (white, similar to Avalon).

Adoption of Bt sweet corn has been limited due to concerns over consumer acceptance of GMO foods, particularly in Europe. However, consumer attitudes are changing as shown in a recent survey by Purdue University, which indicated that most consumers would purchase Bt sweet corn if it reduces their potential exposure to

pesticides. Adoption of Bt sweet corn has increased in recent years with the availability of more fresh market varieties, totaling at least 5% of the U.S. acreage. Unlike processors who are concerned about the overseas market, fresh market growers are less worried about consumer acceptance if they sell most of their produce locally.

Clearly, Bt sweet corn provides growers with a more targeted and sustainable tool to control insect pests and can significantly reduce the number of conventional insecticides. The Bt protein is specifically active on certain caterpillar pests, so beneficial insects such as lady beetles, lacewings, and predaceous bugs are not affected and tend to thrive in Bt sweet corn fields, providing another layer of pest control. Based on field trials in Maryland, season-long insect protection of the BC0805 variety eliminates all whorl treatments for European corn borer and fall armyworm and reduced silk sprays for the ear-invading caterpillars by as much as 4 applications.

Does it pay to grow Bt sweet corn? Depending on the variety and seeding rate, seed costs in the range of $25-50 more per acre than non-Bt seed. Based on control costs, if you typically apply a whorl treatment for European corn borer and three or more applications during silking within a single crop season, Bt sweet corn will result in cost savings, assuming that your customers are provided with varieties they want. However, there is more to this question than just reducing control costs. Bt sweet corn can significantly reduce the time that growers spend in managing insect pests, as well as reduce the exposure risks from handling and applying insecticides. These benefits are valued by many growers who are willing to pay more for the Bt technology.

Are supplemental insecticides required in Bt sweet corn? Although Bt varieties provide excellent protection against the caterpillar complex, supplemental insecticide sprays may be needed to ensure fresh market quality ears. In the case of corn borers, control is virtually 100%, so insecticide sprays are not needed during the whorl or tassel stages, as well as during silking if this insect is the only pest infesting your sweet corn. The Bt trait also provides enough suppression of fall armyworm infestations during the whorl stages to eliminate pre-silk sprays for these caterpillars in most situations.

For corn earworm, growers typically initiate sprays on non-Bt sweet corn at the onset of silking and then repeat sprays at intervals to maintain insecticide residues on fresh silks as they emerge. With Bt sweet corn, however, fresh green silk tissue is very toxic to corn earworms, providing near 100% control of the larvae and significantly reducing the extent of kernel injury. However, when moth activity is high, a portion of eggs are still deposited on degrading wilted or brown silk tissue, which expresses less active Bt protein. At the same time, the ear is filling out and the tip may be more exposed, allowing easier access to the developing kernels. Both corn earworms and fall armyworms are cannibalistic, and this behavior may also allow more tolerant larvae to escape exposure by eating weaker larvae that become intoxicated by the Bt protein. All this means that earworms hatching within 10 to 14 days from harvest have a greater chance of surviving and invading the Bt ear.

Moreover, if larvae reach the ear tip, they are exposed to a mixture of Bt expression because only three-fourths of the kernels express the Bt protein. These larvae become sick, develop very slowly, and cause only minor injury on the ear tip.

However, the presence of small earworms (usually less than ½ inch in length) and noticeable kernel injury still poses a quality problem for fresh market outlets. Under very high moth activity (levels that would require two day spray schedules in non-Bt corn), it is not uncommon to find 20-30% of the Bt ears infested or showing minor tip damage. Even higher levels of damage have been observed in ears with poor tip coverage if plants are stressed by drought, fertility or high temperatures.

For best protection with Bt sweet corn, maintaining good growing conditions with timely irrigation and proper plant nutrition helps to ensure tighter and longer ear tip coverage in most varieties. This effectively reduces the damage caused by ear-invading insects, particularly sap beetles. Also, the timing of insecticide application in Bt sweet corn is different from non-Bt corn because most surviving larvae hatch and enter the ear after fresh silking. The first supplemental spray should be directed at the ear zone at full silk (usually 4-5 days later than the timing of the first silk spray in non-Bt corn). A second spray should be applied 4 days later if heavy moth activity continues, and sometimes a third treatment is necessary. Fall armyworms are more tolerant to the expressed Bt protein and can damage husk leaves and/or enter the ear. The timing of supplemental sprays recommended for corn earworm should control these caterpillars as well.

The Attribute Bt hybrids are not effective on other sweet corn pests, such as sap beetles which can invade the ear. These insects are not a problem in every field and are less likely to infest ears without worm damage; however, they can seriously reduce ear quality on farms with a history of sap beetle problems. In most situations, these beetles can be controlled with one insecticide application at wilted silk when adult females start to lay eggs on silk tissue. This usually coincides with the first supplemental spray for earworms. Also, varieties with good ear tip coverage, like BC0805, can significantly prevent sap beetles from causing economic ear damage. The Bt protein is also not active against seed or seedling pests such as seed maggots, grubs, wireworms, and flea beetles. If fields are at risk to these pests, seed treatments of Gaucho, Cruiser or Poncho should provide protection during germination and systemic activity above ground for 3-4 weeks.

To buy and plant Attribute sweet corn, growers must sign a stewardship agreement but, unlike field corn, there is no refuge requirement. Growers must agree to destroy the Bt stalks within 30 days after harvest by plow down or other methods. They also must agree to scout fields, report damage from target pests, keep accurate records, and judiciously use conventional insecticides to control non-target pests.

The next generation of Bt sweet corn varieties containing stacked genes with much improved resistance to corn earworm and fall armyworm should be available by 2010 for fresh market growers. Also, other seed companies besides Syngenta Seeds have developed Bt sweet corn varieties which may be registered in the near future. Clearly, Bt sweet corn has found a place in fresh market production. It ideally fits the IPM philosophy of combining host plant resistance with supplemental insecticides based on moth activity thresholds, rotating insecticide modes of action to facilitate resistance management, and using a reduced risk bioinsecticide for worker and environmental safety. It works best and results in greater cost-savings if used in plantings subjected to

higher insect pressure. However, Bt sweet corn varieties are relatively new and have not been comprehensively evaluated under a wide range of growing conditions. While performance may vary under more adverse weather or high insect pressure, the bottom line is that Bt varieties help growers reduce sprays and control costs in an environmentally responsible way.