Beans and Peas

Wednesday morning 9:00 am

Where: River Overlook (upper level) Room E & F
MI Recertification credits: 2 (1B, COMM CORE, PRIV CORE)
OH Recertification credits: 1 (presentations as marked)
CCA Credits: SW(0.5) PM(1.5)
Moderator: Ben Phillips, Vegetable Extension Educator, MSU Extension, Saginaw, MI

9:00 am — White Mold, Phytophthora, Root Rot Complex (OH: 2B, 0.5 hr)
- Kathryne Everts, Vegetable Plant Pathology, Univ. of Maryland

9:40 am — Weed Control Update (OH: 2C or 3p, 0.5 hr)
- Mark VanGessel, Plant and Soil Sciences, Univ. of Delaware

10:20 am — Tillage and Cover Crops in Snap Beans / Peas
- Gordon Johnson, Carvel Research and Education Center Univ. of Delaware

11:00 am — Session Ends

White Mold, Phytophthora, and Root Rot Complex

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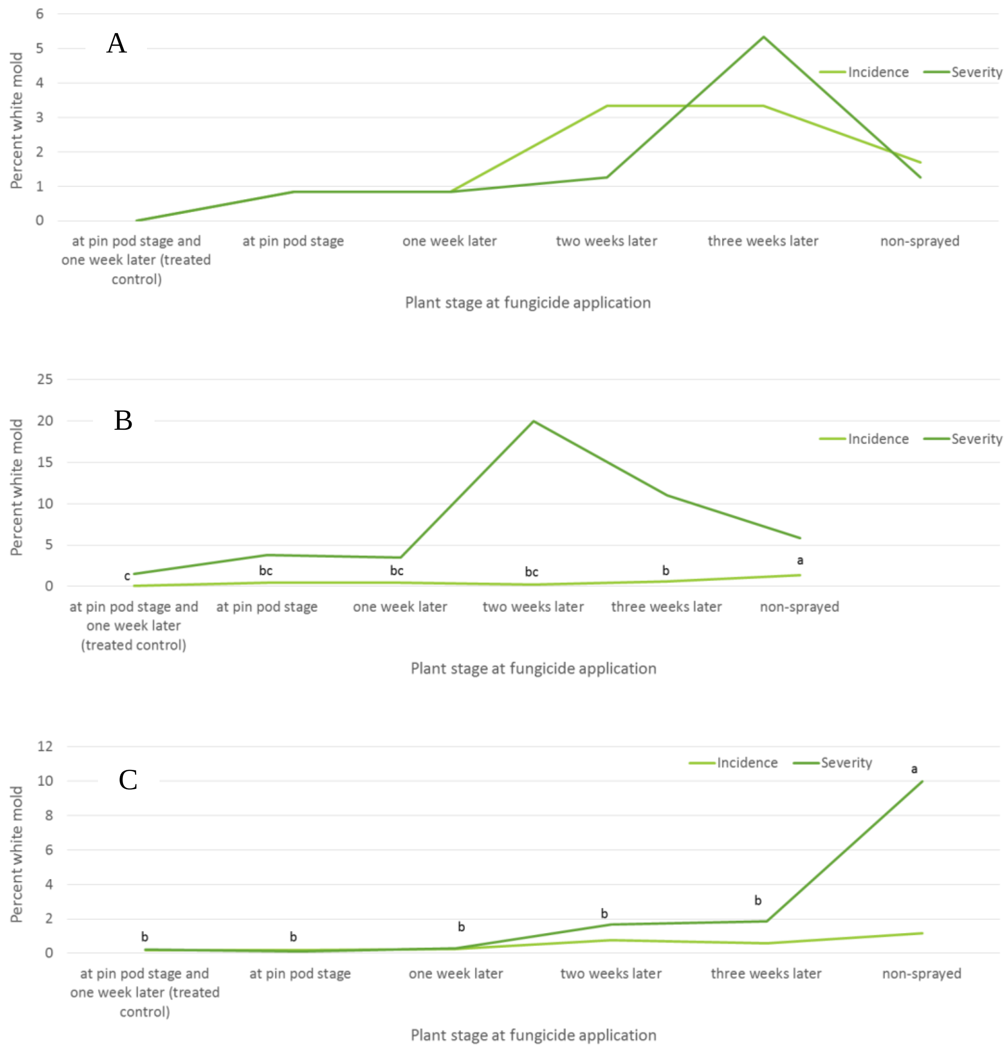
Legume crops such as bean and pea are susceptible to many soil-borne diseases that damage the roots, stems, and pods. Root rot complex can result from many pathogens, including Aphanomyces, Pythium, and Fusarium, Thielaviopsis, Ascochyta and related species, along with Phoma, Rhizoctonia, and Sclerotinia. General conditions that favor infection by these pathogens include soil compaction and poor drainage. The temperatures that favor these diseases vary with the pathogen. For example, Pythium often causes extensive damage in July and August during periods of warm, humid weather, while optimum conditions for white mold caused by Sclerotinia occur during the cooler months of May or September. Management of these soil borne diseases must begin with cultural practices that reduce compaction and the presence of standing water or water logged soils. In addition, optimize plant spacing so that the pods do not touch the soil, which favors Pythium on pods. However, spacing should also allow the soil surface to dry out to reduce conditions that favor white mold development. After the implementation of good production practices, disease may still occur and fungicides are warranted to best manage disease.

We have conducted field research on several diseases of legumes in the mid-Atlantic region of the United States. This talk will cover several research trials that we have conducted and the recommended management of white mold, pod rot on lima bean, and Rhizoctonia root rot.

White mold: The fungus *Sclerotinia sclerotiorum* causes disease on hundreds of plant species including peas and beans. It can persist in the soil for many years. Rotation to non-hosts (corn or small grains) for at least 3 years may help reduce disease levels but will not eliminate the pathogen. There are several fungicides that are effective for managing white mold. In addition, a biofungicide Contans, which is a formulation of the fungus *Coniothyrium minitans*, parasitizes the survival structures of *S. sclerotiorum*. In trials throughout the U.S. it generally works well at reducing white mold severity. Contans has been effective in our trials on lima bean white mold. The label recommends that it be applied 3 to 4 months prior to disease onset to allow adequate time for the active agent to reduce levels of sclerotia in the soil. The depth of incorporation will influence the rate (for up to 4 inches of incorporation, use 2-4 lbs. Contans/A). For example, in lima beans we incorporated 2 lbs Contans/A just prior to planting. Following application, incorporate to a depth of 1 to 2 inches but do not plow before seeding beans to avoid moving untreated sclerotia in lower soil layers from infesting the upper soil layer.

Fungicide sprays are needed only when the soil surface has been moist for 6 to 10 days before or during bloom. (These conditions favor the germination of the sclerotia and disease spread in the crop.) For snap beans, a fungicide should be applied at 10-20% bloom. A second spray should be made 7- 10 days after the first spray if the soil remains wet and blossoms are still present. For lima beans, later fungicide applications have been beneficial if favorable environmental conditions persist (Figure 1).

Figure 1. The white mold incidence and severity on lima beans sprayed with fungicides at different growth stages in 2014 (A), and 2015 (B and C).



Pod rot on lima bean: Pod rot, caused by *Phytophthora capcisci*, is a newly described disease of lima bean (*Phaseolus lunatus*). In the mid-Atlantic region, total crop loss is possible when conditions that favor the disease, such as heavy rains and flooded fields, occur during pod development. Signs of the disease begin with white sporangia development on the pods, which leads to necrosis and pod abortion. *Phytophthora capsici* has a very broad host range and can survive in the soil for several years, which means that rotation may not be effective in managing this disease. Good practices include avoiding soil compaction and minimizing excessive soil moisture during pod set.

Because pod rot was newly described, few fungicides were originally available for management. To improve the availability of fungicide options, we evaluated fungicides for efficacy on pod rot on lima bean. These trials were conducted at the University of Delaware's Carvel Research and Education Center (UD REC). The trials were conducted in fields that had different disease pressure. Trial 1 was conducted in a field that had a history of *P. capsici* on cucumber and lima bean. To increase disease prevalence in this field, cucumbers were direct seeded and inoculated by spraying a *P. capsici* sporangial suspension during fruit-set in early spring, prior to planting lima beans. The infected cucumber plants were flail chopped and disked into the soil 14 days after inoculation to increase inoculum for the subsequent fungicide trial. Plots were direct seeded with lima bean 'Maffei 15' on July 15. Fungicides were applied on August 30. Additional inoculum of a *P. capsici* sporangial suspension was applied to the lima bean plants during the trial. Disease incidence was evaluated on September 24 and yield was taken ten days later.

Trial 2 was direct seeded with lima bean 'Cypress' on June 5 in a field at the UD REC that was not known to have *P. capsici*; however, scouting the field on August 25 revealed a heavy, uniform infection. Fungicide treatments were applied and disease incidence data was collected on September 18 and yield was evaluated six days later.

Many of the fungicides that we tested are not currently registered for use on beans. Check the labels for more information on legal use.

All fungicide treatments significantly reduced disease incidence when compared to the controls. Zorvec (same active ingredient as Orondis, which is not labelled on bean) achieved the best control in trial 1 and Omega and Ridomil Gold achieved the best control in trial 2 (Table 1). Trial 2, had greater disease incidence and plots that received a fungicide yielded significantly more than the controls. These trials demonstrated that, potassium phosphite formulations such as Phostrol, which were already labelled for downy mildew of lima bean, could be an effective option for pod rot.

Table 1. Efficacy of fungicides on pod rot of lima bean, caused by *Phytophthora capsici*. Note that many products are not labelled for use on beans. Read the label for current registration information.

	Field 1		Field 2	
	2014		2014	
Treatment and rate/A	Disease Incidence[x]	Final Yield (lbs/acre)	Disease Incidence	Final Yield (lbs/acre)
Actigard 1 oz	14.0 ab[y]	4497 a	47.0 cde	1499 a
Forum 6 oz	16.0 ab	3610 a	61.4 bc	1326 a
Omega 0.85 pt	15.8 ab	4211 a	27.8 e	1556 a
Phostrol 5 pt	22.2 b	3180 a	41.8 cde	1304 a
Presidio 4 oz	17.6 ab	3628 a	39.6 de	1469 a
Previcur 1.2 pt	19.2 ab	3519 a	56.4 cd	1537 a
Ranman 2.75 oz	18.8 ab	3268 a	32.4 de	1586 a
Reason 8.2 oz	22.8 ab	3659 a	40.2 de	1733 a
Revus 8 oz	16.4 ab	2650 a	45.2 cde	1647 a
Ridomil Gold 2 lbs	12.8 ab	4058 a	30.2 e	1349 a
Tanos 10 oz	13.6 ab	3606 a	38.4 cde	1488 a
Zorvec 4.8 oz.	11.8 a	3648 a	30.4 de	1684 a
Water Control 50 gal	65.6 c	3320 a	131.2 a	599 b
Untreated Control	59.4 c	3799 a	105.4 ab	497 b
P [z]>*F*	<0.0001	0.0587	<0.0001	<0.0001

[x] Number of infected pods per 10 random plants per plot.
[y] Means within a column followed by the same letter are not significantly different according to Fisher's protected LSD (*P*=0.05).
[z] *P* values ≤ 0.05 indicate significant differences exist among treatments.

Rhizoctonia root rot: Rhizoctonia root rot is one of the most common diseases on beans in our area. We evaluated Quadris, Fontelis, and Double Nickel (with the active ingredient *Bacillus amyloliquefaciens* strain D747) for managing this disease in a field experiment. Fungicides were injected with in-line orifices at 10 gpa and 23 psi, into the furrow directly behind the seed before the seed furrow was closed. To insure the development of disease, *Rhizoctonia solani* was inoculated onto an autoclaved sand:cornmeal (4% cornmeal) substrate, which was manually applied in a 3-in. band over the row. Ten plants from each row were evaluated for the presence of lesions. Root lesion severity was rated on a scale where 1= no root rot, 2= 1-33% of roots with visible lesions of root rot, 3= 33-50% of the roots rotted or damaged, 4= 50-80% of the roots rotted, 5= no roots present, or more than 80% missing or pre-emergence damping-off and few if any roots. We took a subculture from small sections of representative lesions and plated onto PDA to identify and confirm the presence of the pathogen.

Quadris significantly reduced the Rhizoctonia rating compared to the non-treated control (Table 2). Lesion severity was moderate in plots treated with Fontelis, where the Rhizoctonia rating was not significantly different from the plots treated with Quadris, but also not significantly different from the non-treated plots. Application of Double Nickel did not reduce Rhizoctonia rating in comparison to the non-treated plots. Isolations confirmed that all lesions were caused by *R. solani*. There were no significant differences in marketable or nonmarketable pod weight among treatments.

Table 2. The efficacy of three fungicides on Rhizoctonia root rot on snap bean.

Treatment and rate	Rhizoctonia rating 18 Jul	Marketable pods/13 ft row (lb)	Unmarketable pods/13 ft row (lb)
Double Nickel 55WDG 2 qt/A	2.11 a	5.08 a	0.21 a
Fontelis 1.6SC 1.6 fl oz/1000 ft row	1.71 ab	5.05 a	0.29 a
Quadris 2.08SC 0.6 fl oz/1000 ft row	1.49 b	5.36 a	0.34 a
Non-treated	2.06 a	4.84 a	0.34 a
P value[**]	0.0304	0.3775	0.1954

[*]Means within a column followed by the same letter are not significantly different according to Fisher's protected LSD (*P*=0.05).
[**]*P* values $\leq$ 0.05 indicate significant differences exist among treatments.

The root rot complex that we observe has several causes in addition to Rhizoctonia, including Pythium, which is the most common root rot pathogen in the mid-Atlantic, and Fusarium. General recommendations and best practices to minimize root rot complex due to these pathogens is to rotate beans with non-legume crops. Other practices are to improve soil drainage, plow crop residue into soil to improve residue degradation (as opposed to discing), and minimize soil compaction. Several fungicides are also available that are efficacious on one or more of these pathogens.

Concluding thoughts: White mold, Phytophthora pod rot, and root rot complex remain difficult problems in the bean and pea crop. However adopting both cultural and chemical management practices can minimize the damage and improve the yield and quality of beans and peas.

Snap Bean Weed Control Update

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Poor weed control can lead to significant yield losses. UD Weed Science research has seen yield loss in snap bean average 65% due to uncontrolled weeds. Snap beans are not a very competitive crop and infestations of aggressively growing weeds can severely limit yield.

Commercial snap bean production in Delaware region relies on soil-applied applications of s-metolachlor and possibly a broadleaf herbicide such as Pursuit or Sandea. Most fields are treated with a postemergence herbicide for broadleaf weed control. The presence of herbicide-resistant weeds has complicated herbicide selection and driven up the cost of weed control. Herbicide-resistant Palmer amaranth, common ragweed, and smooth or redroot pigweed have forced farmers to find alternatives to Pursuit, Raptor, and Sandea. Reflex and Basagran is a postemergence combination that is widely used. They are both contact herbicides that require good spray coverage to achieve effective control.

Poor weed control is typically due to lack of rainfall to incorporate soil-applied herbicides or trying to control weeds when they are too large. Postemergence herbicides need to be applied to small weeds (less than 3 inches tall). In Delaware, this time-frame typically corresponds to 4 weeks after planting if effective soil-applied herbicides are used; otherwise the application may need to be made sooner.

Cultivation also is most effective on small plants. Delaying herbicide application or cultivation to allow more weeds to emerge often results in plants too large for effective control. Furthermore, the earlier emerging plants are the one likely to be more competitive and produce more seeds.

Tillage and Cover Crops in Snap Beans / Peas Delaware Industry

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The University of Delaware is the main institution in the Mid-Atlantic region conducting research on processing vegetable crops due to the historically large acreage in the state. The goal of this project was to provide a research base to enhance processing vegetable production in DE. Research was conducted on crop culture for yield and quality improvement and cost reduction in production for major processing crops including lima beans, sweet corn, peas, and snap beans.

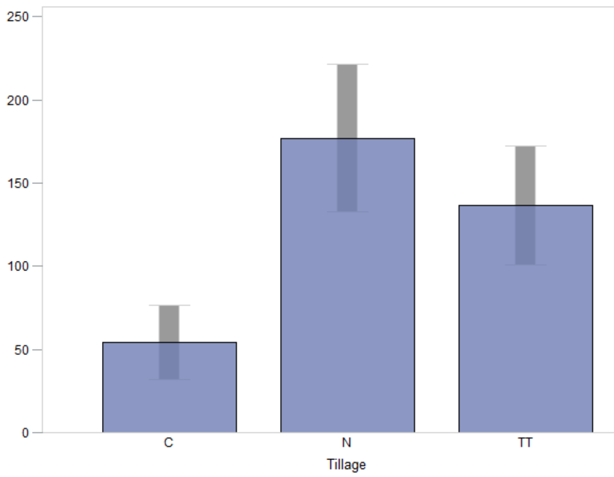
There are 31,000 acres of processing vegetables grown in Delaware with a value of $20 million dollars. The majority of processing acreage is in baby lima beans, sweet corn, green peas, snap beans and pickling cucumbers. There are over 100 farms in Delaware that contract with regional processors and more than 60 growers on the nearby Eastern Shore of Maryland that receive processing crop information from the University of Delaware vegetable research program. The UD vegetable research program interacts with 7 regional processors that source vegetables from Delaware. Maintenance of current acreage is critical for processor retention. Improved productivity and yield stability is sought by processors to reduce sourcing costs and costs associated with plant scheduling. This research was aimed at improving supplies from a yield stability and quality perspective for processors, reducing costs for processors and growers, and improving profitability of both processors and growers.

Pea Tillage Studies With Radish and Mustard Cover Crops for Compaction Mitigation

In 2012, a small plot trial with eight winter killed cover crop species was conducted and peas were no-tilled into the plots in March. Cover crop biomass, pea stand, pea yield and pea quality data was taken. In addition, a large plot pea study was conducted in a field where forage radishes were planted. The trial had three treatments – conventional tillage, vertical tillage, and no-till in the spring following the forage radish cover. Stand, biomass, yield, and quality data was collected. Results showed that forage radish, oilseed radish, and Kodiak mustard treatments provided the best yields. Tillage studies showed that no-till peas into winter killed forage radish may be a viable option for growers and had better yields than conventional treatments.

In 2013 the trials were repeated. A small plot trial with eight winter killed cover crop species was conducted and peas were no-tilled into the plots in March. Cover crop biomass, pea stand, pea yield and pea quality data was taken. In addition, a large plot pea study was conducted in a field where forage radishes were planted. The trial had three treatments – conventional tillage, vertical tillage, and no-till in the spring following the forage radish cover. Stand, biomass, yield, compaction, and quality data was collected. In 2014 there was an additional trial with peas planted after winter killed forage radish. These studies also showed that peas were successfully no-till planted after forage radish. However, stand counts were lower in both no-till and vertical tillage plots and compaction was lower in conventional plots. Forage radish did not reduce compaction in this study.

Compaction in peas by tillage (psi force) at 4” 2014



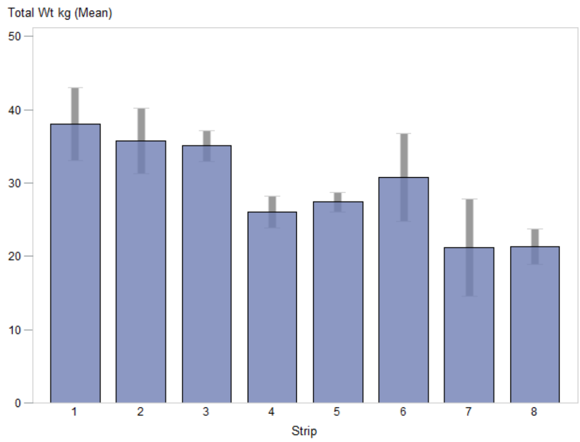
Tillage Trials

Studies were initiated in 2012 looking at tillage practices in processing vegetables. This included a pea study planted into winter killed forage radish under three tillage practices, a processing sweet corn study planted after winter cover crops under three tillage practices, and a lima bean study planted after small grain under 3 tillage practices. Results indicated that peas are successfully no-tilled, early processing sweet corn performed best under conventional tillage and lima beans performed best under conventional tillage.

Studies were conducted in 2013 and included pea, sweet corn, and snap bean studies planted into winter killed forage radish under three tillage practices and lima bean, snap bean, and sweet corn planted after wheat under 4 tillage practices – no-till, strip till, vertical tillage, and conventional tillage. In these studies there was no yield reduction with no-till in peas, sweet corn or snap beans in spring studies planted after forage radish. Summer studies planted after wheat showed no difference between tillage treatments in any crop.

Studies were conducted in 2014 and included pea, sweet corn, and snap bean studies planted into winter killed forage radish under three tillage practices and lima bean, snap bean, and sweet corn planted after wheat under 4 tillage practices – no-till, strip till, vertical tillage, and conventional tillage. In these studies there was no yield reduction with no-till in peas (see pea section above) or snap beans in spring studies planted after forage radish. Summer studies planted after wheat showed reduced yields in lima beans in no-till and vertical tillage treatments. In both spring and fall studies, no-till plots had significantly lower yields in the crops studied. Vertical tillage and strip tillage performed similarly to conventional tillage.

Spring snap bean tillage trials 2014. Strips 4 and 7 are no-till. Conventional tillage are strips 3 and 6.



Studies showed that peas can be successfully no-tilled into forage radish and mustard cover crops without a yield decrease or change in maturity. However, there was also no advantage in yields. Compaction was not reduced in no-till plots when compared to no-till into forage radish with the exception of wheel tracks. An advantage to the no-till pea/forage radish winter killed forage crop was the reduced trips across the field and reduced field tracking. This work gave enough evidence to recommend the practice to growers on a trial basis.

Studies showed that both no-till and strip-till are viable systems for producing peas with radish or mustard cover crops. Sweet corn and snap bean are more variable following forage radish due to the potential for stand losses when using no-till. Vertical tillage performed equal to the conventional tillage in these trials and can be recommended. For no-till after small grain, results were also more variable. Sweet corn performed equally well in row cleaner and vertical tillage methods but not consistently in no-till. Lima beans cannot be recommended to be no-tilled at this time due to potential yield losses as shown in 2 of 3 years of the studies.