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Norman A. Berg Plant Materials Center Progress Report of Activities 2015

R Jay Ugiansky planting cover crops using a cone seeder

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The Norman A. Berg Plant Materials Center (MDPMC) located in Beltsville, Maryland is one of 27 Plant Materials Centers (PMCs) in the Plant Materials Program of USDA's Natural Resources Conservation Service. The mission and activities of the MDPMC are twofold: (1) to provide assistance to and coordination for the National Plant Materials Program, and (2) to assist with high-priority conservation issues in the Mid-Atlantic region of the U.S.

The MDPMC is currently participating in a national study evaluating the effects of cover crop mixes on soil health, collecting plant attribute data to refine managed grazing systems, and designing vegetative buffers to control poultry house emissions. These studies combined with our other activities support our development and distribution of up to date conservation technical information to NRCS field staff, partners, and the public.

EFFECT OF MIXED COVER CROP SPECIES ON SOIL HEALTH

Cover crop mixes can be used to improve the health and productivity of soils, but more information on species selection and seeding rates is desired. The MDPMC has completed three planting cycles of cover crop mixes followed by corn and has begun a continuation of the study for another 3 cycles. Cover crop mixes (2, 4 and 6 species at densities of 20, 40 and 60 seed/ft^2; Table 1) are no-till drilled into replicated plots in September. Cover crop treatments are terminated and corn is planted in May with one pass over the field (Figures 1-2). The roller crimper has been very effective in terminating the cover crop. The cover crops have received ample precipitation each cycle.

Figure 1. Soil Health Study plots 240 days after seeding cover crop mixes, just prior to termination

Table 1. Cool season annual cover crop species and mixes, percentages of species per mix, and seeding rate.

No cover crop control
2 species mix – cereal rye (50%) + crimson (50%) at 20, 40, 60 seeds/ft^2
4 species mix – cereal rye (45%) + crimson clover (23%) + hairy vetch (23%) + radish (10%) at 20, 40, 60 seeds/ft^2
6 species mix –cereal rye (23%) + crimson clover (23%) + hairy vetch (23%) + oats (23%) + radish (5%) + rapeseed (5%) at 20, 40, 60 seeds/ft^2

Rye has consistently provided the greatest cover over the winter. Hairy vetch cover surpassed rye within the last 30 days prior to termination, with crimson clover also providing significant cover. The radish and especially the rapeseed have consistently provided little cover prior to being winter-killed.

The 4 and 6 species mixes at 60 seeds/ft^2 had the most cover (50%) at 30 days after planting (DAP) and at Termination (240 DAP) with over 90% cover. At 30 DAP, the 2 and 6 species mixes at 20 seeds/ft^2 had the lowest cover of about 24%. At termination, the 2 and 4 species mixes had the lowest cover (74% and 76% respectively). Cover crop biomass ranged between 1892 to 2324 pounds per acre for all mixes except for the 2 species mix at 40 and 60 seeds/ft^2 with 3219 and 2860 pounds per acre respectively.

The effect of the cover crop treatments on soil health as measured by the Haney test has yet to show a significant difference between treatments after the first three cycles. Soil health is improving for all treatments, even the control. Haney Soil health numbers at the beginning of the trial were 2.3 to 3.2 and have improved to 4.8 to 6.0, with the variation showing no correlation with treatments. The overall improvement may be due the transition to no-till of all plots at the beginning of the trial and become less of a factor in the future.

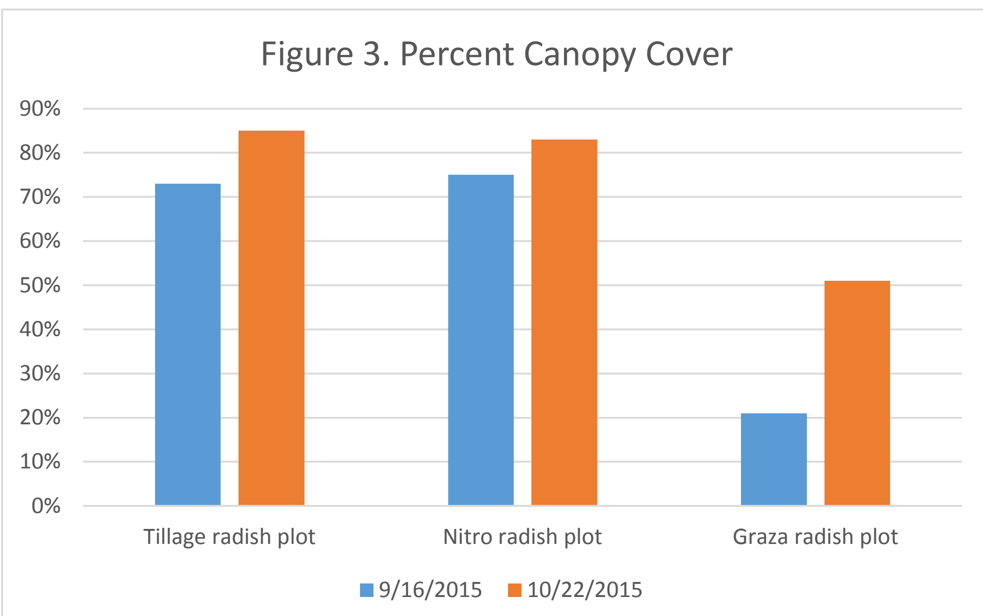
Figure 2. Rolling cover crops and planting corn in the Soil Health Study

Comparing Radishes for Remediating Severe Soil Compaction

The MDPMC is working with Cliff Bienko, Cecil/Harford County District Conservationist, Annette Ensor, Harford County Soil Conservationist, and Dean Cowherd, Assistant State Soil Scientist for Maryland to mitigate soil compaction prior to re-vegetating a cattle paddock. The purpose of this project is to evaluate three different radishes for their ability to alleviate severe soil compaction. The owner of the cattle farm is enrolled in NRCS' CREP program. He wants to increase the size of his existing CREP riparian forest buffer that is adjacent to the paddock. NRCS is trying to improve soil properties in preparation for planting hardwood trees in the paddock. In order for the trees to successfully establish in the cattle paddock, the severely compacted soil must be alleviated so that their roots can penetrate the soil to obtain the nutrients, water, and structural support they require for survival.

Tillage® radish, developed in the Mid-Atlantic, is popular with area producers. Graza radish, developed in New Zealand, tolerates multiple grazings and resists bolting. Nitro radish, a large rooted, low cost, selection of daikon (or oilseed) radish, is not the product of a formal breeding program.

Design: Nitro, Tillage®, and Graza forage radishes were broadcast seeded into separate plots approximately 2,800ft^2 in size on August 10th at 5 lbs. per acre. To ensure even distribution over the entire plot, the radish seed was mixed with Milorganite, a bio solids fertilizer (0.087 lbs. of N per 1,000 ft^2). After seeding, the plots were rolled with a cultipacker to ensure proper seed/soil contact. An area of the cattle lot was left unseeded to measure soil compaction over time where no radishes were planted. This area won't likely be planted with trees due to mower access issues. Percent canopy cover ratings were taken 30 and 60 days after planting. Soil penetrometer readings were taken on the same day that the radishes were seeded to measure the severity of compaction at the beginning of the study and again 90 days later.



Results: Percent canopy cover of Graza radish was significantly less than both Tillage and Nitro radish 30 and 60 days after seeding (Figure 3). Since the paddock is slightly sloped from the control plot (highest point) to the Tillage plot (lowest point), theoretically the germination results may have been affected by the slope of the field because the soil will retain more water at the bottom of the field (Figure 4). To test this theory, all three radish varieties were seeded in the greenhouse at equal rates to compare their germination rates. Fewer Graza radish seeds germinated compared to Nitro and Tillage radish seed indicating that the lower percent cover rating of Graza in the field was due to a lower germination rate and not the slope of the field (Figure 5). When the study is repeated next year, germination tests will be performed on all three varieties prior to seeding to ensure a more accurate comparison (i.e., seeding rates will be based on percent germination). Soil penetrometer readings taken on August 10th were approximately equal in all four plots (Figure 6). An average of four readings in each plot ranged between 270-290 psi at a depth of 3 inches. This result indicates that soil compaction in the paddock was uniform.

According to the specifications of the penetrometer, a reading of 300 psi or above indicates poor growing conditions (Table 2.). All of the plots rated fair growing conditions but the entire paddock was very close to having poor growing conditions prior to planting the radishes.

Figure 4. Radish test field layout showing establishment and canopy cover 30 days after planting the seed.

Figure 5. A tray of Nitro radish seedlings (on the left) that is completely full next to a tray of Graza seedlings (on the right) that is less than half full.

Table 2. Soil Penetrometer Dial Ratings

Green	0 - 200 psi	Good growing conditions
Yellow	200 - 300 psi	Fair growing conditions
Red	300 psi and above	Poor growing conditions

14 weeks after planting the radish seed, soil compaction readings were taken again. In all four plots the soil compaction decreased over time (Figure 6). Averages of four readings in the Tillage and Nitro plots were 130 psi at a depth of 3 inches which indicate good growing conditions. Averages of four readings in the Graza and untreated plots at 3 inches were 215 psi and 240 psi respectively, which indicate fair growing conditions in those plots.

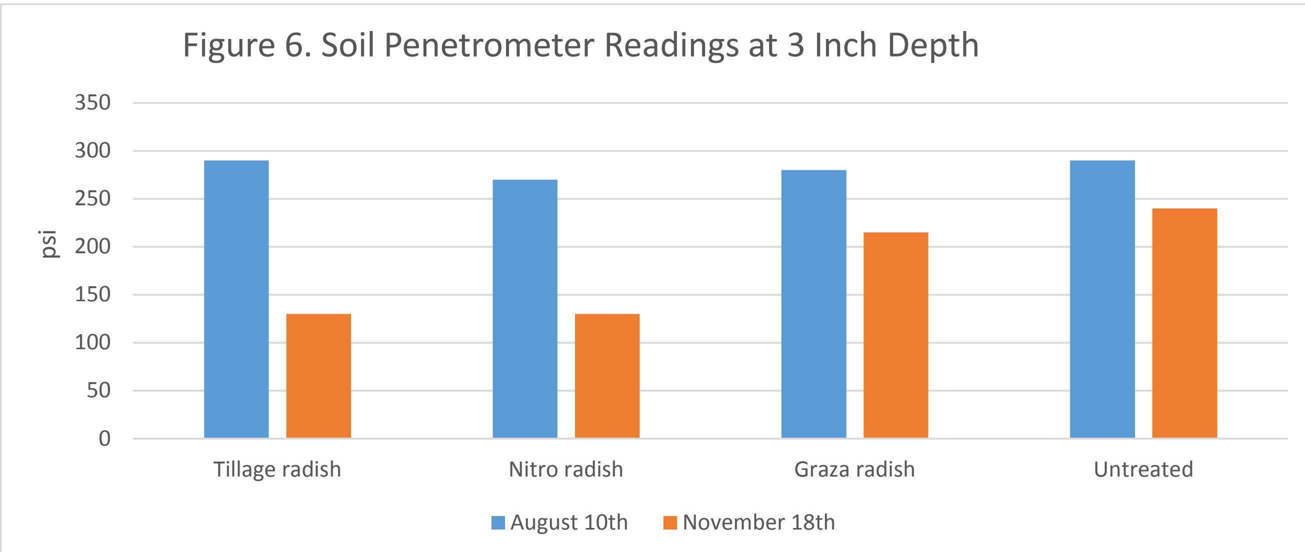


Figure 7. Tillage radish 60 days after planting struggling to penetrate the severely compacted soil.

Conclusions: Although Tillage and Nitro radishes successfully alleviated soil compaction in the top 3 inches of soil, the soil penetrometer could not be pushed into the soil beyond 3 inches. The radishes struggled to establish roots below the top 3 inches of soil (Figure 7). Because the Graza radish seed used in this project has a lower tested germination rate, there was not a high enough density of radishes in this plot to alleviate compaction. Excluding cattle from the paddock lot and allowing weeds to germinate was enough to alleviate some of the compaction in the control plot but it was considerably less than where the Tillage and Nitro radishes were planted.

In order to ensure a successful tree planting in the paddock, it will be necessary to alleviate soil compaction to a depth of at least 6 inches. A summer cover crop will be planted in May and a second season of radishes will be planted in August of 2016. Soil penetrometer readings will be taken periodically throughout 2016 to measure the reduction in soil compaction in the four plots.

Bermudagrass For High Use Areas And Hay

Bermudagrass established on high animal use areas has been successfully used to stabilize soil, reduce erosion. Bermudagrass also provides forage on sites that have poor vegetative cover due to heavy traffic and grazing. Most farmers are not familiar with the proper establishment and management of Bermudagrass. We aim through our latest plantings to further test and demonstrate the establishment and management requirements of Bermudagrass and gain experience that will be used to provide recommendations to landowners with a wide range of site conditions. Trials are being conducted cooperatively with Maryland Cooperative Extension, with assistance from forage expert and University of Maryland professor emeritus Dr. Les Vough.

Figure 8. Spreading dormant Bermudagrass sprigs onto a feeding area April 1, 2015. The horses were then allowed access to trample the sprigs into the soft manure and soil. The horses did eat some sprigs, but this only encouraged them to walk around and trample in many more sprigs.

Planting sites were selected based on need, location and unique challenges that provide good learning and demonstration opportunities. This Spring 6 additional trial/demonstrations of ‘Quickstand’ Bermudagrass were established at 6 farms in Baltimore, Cecil, and Howard Counties in Maryland and

Loudoun and Middlesex counties in VA. Including these new plantings, a total of 18 plantings on 12 farms were evaluated in 2015. Each site offered its own challenges and different solutions. One especially challenging site was the winter feeding area of a horse farm that was once a gravel mine. It wasn't feasible to plant the Bermudagrass using equipment, so we successfully used an innovative idea to use the horses themselves to tramp dormant Bermudagrass sprigs into the softened soil and manure around the feeding areas in early spring (Figures 8 and 9).

Figure 9. Feeding area August, 5 2015, showing that the goal of getting some Bermudagrass established was achieved. These patches of Bermudagrass will to continue to fill in to provide increased cover in future years.

We have concluded from our previous work that sprigged varieties (vegetatively propagated) are superior to seeded varieties in our region due to the faster and more reliable establishment that more than offsets the additional cost and effort. Of the sprigged varieties tested 'Quickstand' has become our recommended variety for its fast establishment and potential for greater growth and forage yield. For dedicated rotationally grazed pasture or hay plantings, 'Ozark' has stood out for its hardiness and excellent production of high quality thin-stemmed forage or hay.

The extreme weather of the past two years have highlighted some limits of Bermudagrass on high use areas. The Frederick county plantings suffered significant winter dieback, whereas plantings in Howard county and further east did not experience winter dieback. Combined with the unusually cold temperatures, sites that also experienced heavy tramping and soil disturbance had the least winter survival. Two summers of higher than average precipitation, resulted in substantial competition from crabgrass and goosegrass, emphasizing the need for careful management. Vigorous crabgrass growth shaded the Bermudagrass, limiting establishment and causing some dieback of even well-established stands. The best establishment or retention of stands were on sites with frequent close mowing or grazing to control overtopping weeds.

The establishment and management of Bermudagrass is very different from typical pasture plantings. It is essential that these differences are emphasized, with explicit guidance and follow up. These Bermudagrass plantings are being used to provide trainings to landowners and planners, where successes and failures are shared as the planting sites are visited, evaluated, and discussed. The most important factors that we emphasize are fertility and weed management. We stress the importance of close grazing or mowing as soon as the Bermudagrass has rooted and begun to grow to reduce weed competition. Bermudagrass is also a heavy user of nitrogen and potash, which is great for uptake of excess nutrients, but also limits growth if deficient. We recommend soil testing and the use of the manure generated on site to increase fertility. These plantings and training events have received increasing interest from landowners and planners as a valuable resource of applicable knowledge to help address the resource concerns associated with poorly vegetated high animal use areas.

POULTRY AIR AND WATER QUALITY IMPROVEMENT IN THE CHESAPEAKE BAY WATERSHED

Strategically placed trees, shrubs and grasses vegetative environmental buffers (VEBs, or shelterbelts) are a relatively low cost technology which capture ammonia, dust, odors and viruses and /or decrease their dissemination into the environment (Figure 10). MDPMC and our partners are working to expand the variety of plants, to make successful VEB's.

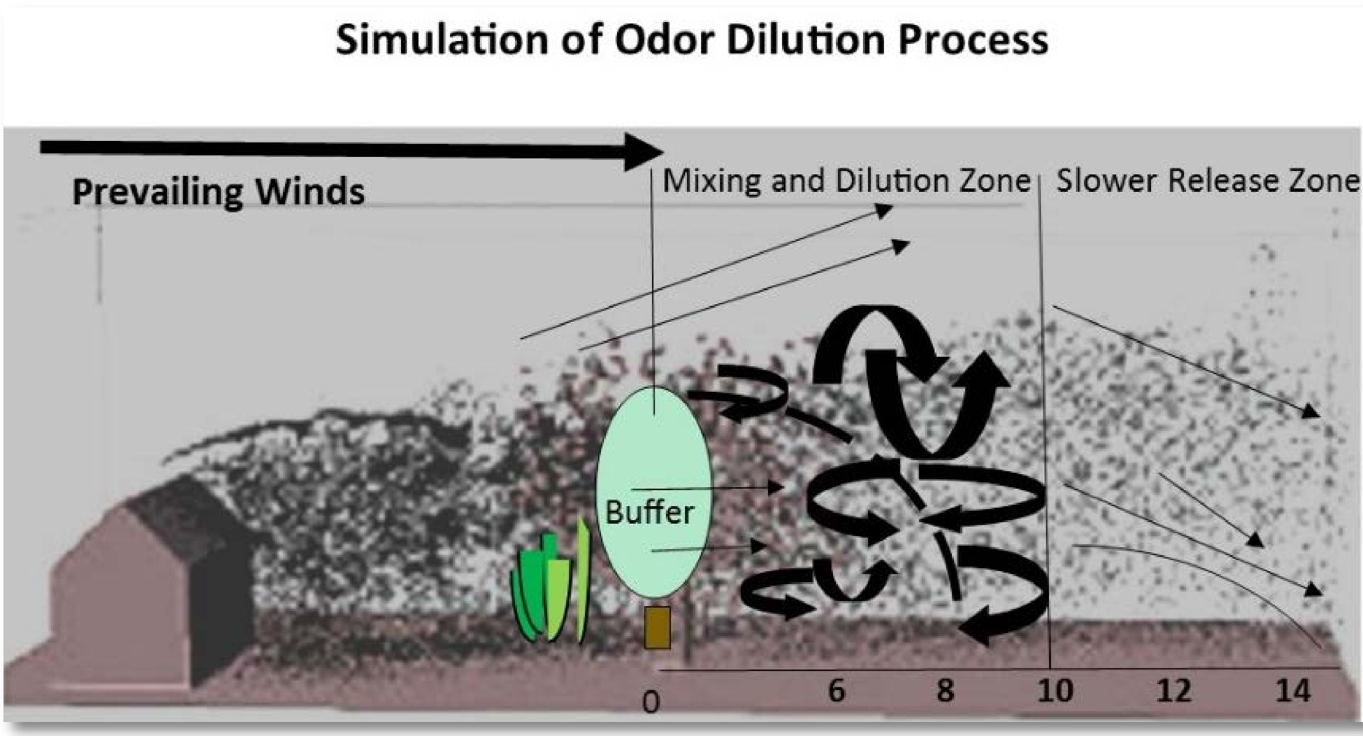


Figure 10. Simulation of the distribution of dust and odors which occurs at a distance greater than 10 times the height of the buffer. Research is underway quantifying and defining this model. (Reprinted with permission Lammers, PS, Wallenfang O, and Boeker P. 2001)

The MDPMC studied 40 different species (9 grasses, 27 deciduous shrubs/trees and 4 evergreens) on 14 different mid-Atlantic farms (Figures 11 and 12).

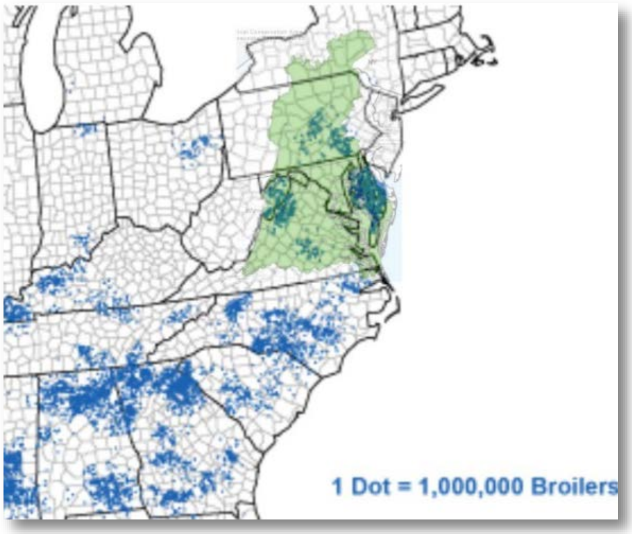


Figure 11. 2007 Broiler production in the Chesapeake Bay Watershed (highlighted in green) and eastern U.S. (National Agricultural Statistical Service).

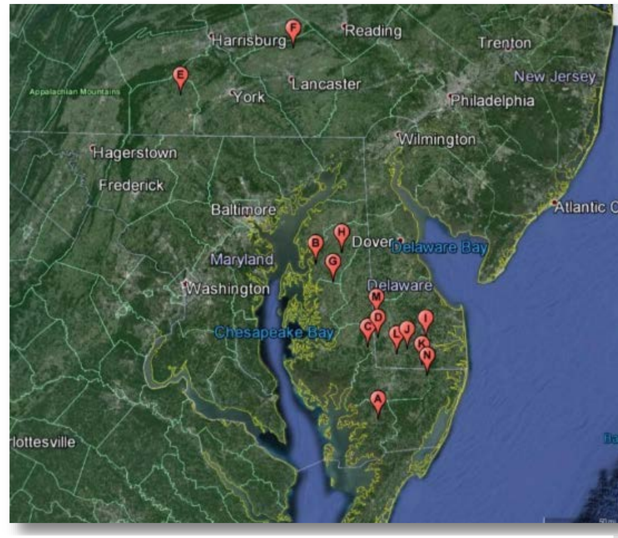


Figure 12. Map of the 14 different MD, DE and PA test farm locations.

Plant Survival: Fifteen of the 40 plants tested (38%) had survival percentages above 60% over a two year period (grasses) or a three year period (woody plants) (Table 3). Eight of the 40 plants tested (20%) had survival percentages below 60% which means they are intolerant of poultry farm emissions. Seventeen plants (43%) require further testing to determine emission tolerance.

Ventilation Fan Type: Twenty-one different plants tolerate single tunnel fan emissions, six different plants tolerate double fan emissions and five different plants tolerate sidewall fan emissions.

Distance between Fans and Plantings: Plants survive and grow only 20' from single bank, double bank and side wall ventilation fans (Figure 13) without compromising fan efficiencies. 20' is more than half

Figure 13. Bands of grasses, shrubs and trees can survive growing closer to ventilation fans (20'). Allowing producers additional land for cultivation and potentially more ammonia absorption.

of the previous set back distance which allows producers additional land for cultivation as well as increased ammonia absorption by certain plant species.

Additional information can be found [Plants Tolerant of Poultry Farm Emissions in the Chesapeake Bay Watershed]

Table 3. Plant Survival Results

Common Name*	Botanical Name	Variety(s)	Fan Dist. (ft.)	Fan Type**	Survival %
Coastal panicgrass	*Panicum amarum var. amarulum*	Atlantic	30	T	100
Switchgrass	*Panicum virgatum*	Timber	20	T, T²	100
Switchgrass	*Panicum virgatum*	Northwind	30	T, T²	100
Switchgrass	*Panicum virgatum*	Thundercloud	30	T, T²	91
Prairie Cordgrass	Spartina pectinata	Southampton	20	T	100
Red maple	*Acer rubrum*		25	T², T, SW	100
Chinkapin	*Castanea pumila*	Golden	30	T	100
Netleaf Hackberry	*Celtis laevigata var. laevigata*		24 - 35	T	100
Common Hackberry	*Celtis occidentalis*		25	T	100
Dwarf Hackberry	*Celtis tenuifolia var. pumila*		25	T²	100
Spreading Euonymus***	*Euonymus kiautschovicus*	Manhattan	30	T	100
Honeylocust	*Gleditisia triancanthos var. inermis*		30	T²	100
Eastern red cedar	*Juniperus virginiana*		45	T	75
Osage orange	*Maclura pomifera*	Whiteshield	25	T²	75
Dawn Redwood***	*Metasequoia glyptostroboides*		25	SW	100
American Sycamore	*Platanus occidentalis*		20	T	100
hybrid Poplar***	*Populus deltoides x nigra*	Spike	45	T	100
American sycamore	*Platanus occidentalis*		25	T, SW	100
Black Locust	*Robinia pseudoacacia*	Steiner	25	T²	72
Purpleosier willow	Salix purpurea	Streamco	34	T	78
Baldcypress	*Taxodium distichum*		25	T²	78
American Elm	*Ulmus americana*	Valley Forge, New Harmony	40	SW	75

*hyperlink to additional information **SW side wall fans, T tunnel fans, T² double fans *** Non native plant

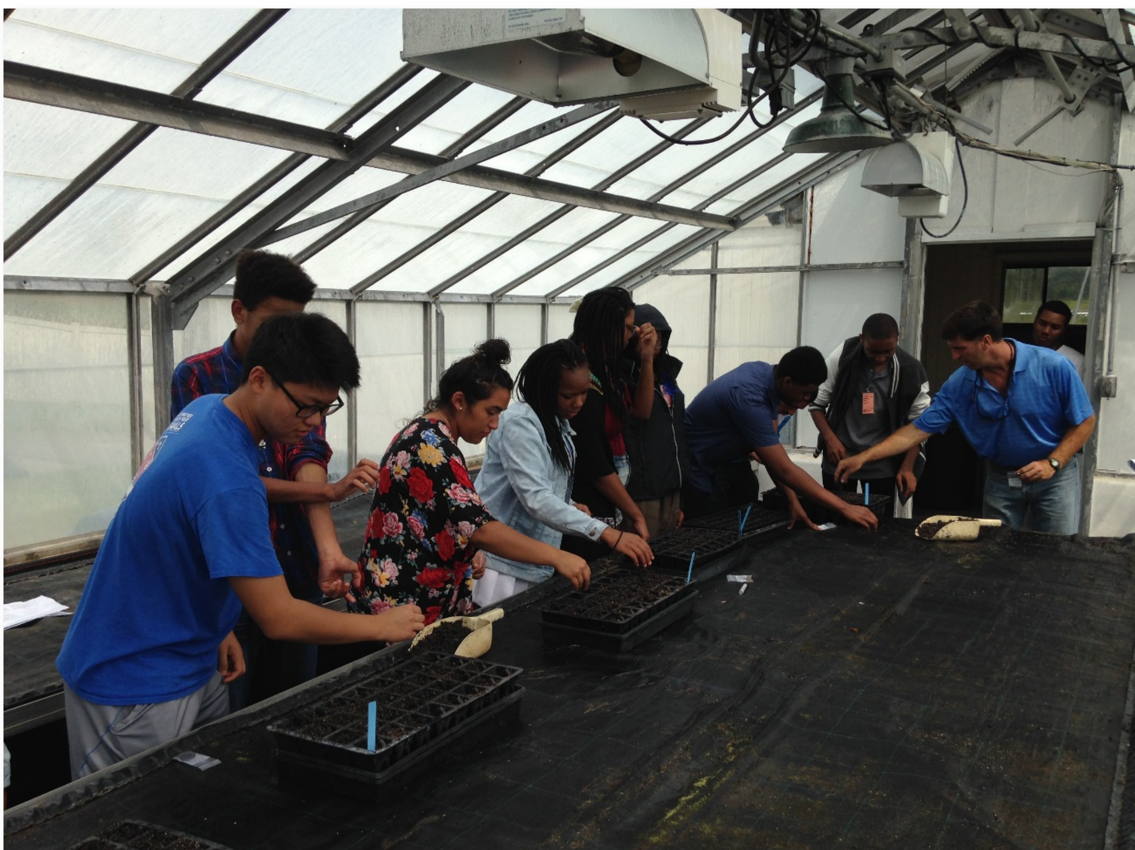
2015 Technology Transfer

Publications

- Belt, S. V. 2015. Plants Tolerant of Poultry Farm Emissions in the Chesapeake Bay Watershed. National Plant Materials Center, Beltsville, MD. September 2015.
- RJay Ugiansky 2015. National Soil Health Study Progress Report - Year 2. Norma A. Berg National Plant Materials Center, Beltsville, MD. 2015.

Presentations/Trainings

- Poultry Buffer Air and Water Quality Training and Field Day
- Vegetative and Riparian Buffers and Renewable Fuels on Poultry and Livestock Farms
- Plant Propagation Basics- Montgomery County Maryland Master Gardeners Program
- Beneficial Insects and Pollinator Plants- Smithsonian Institution
- USDA-OCIO STEM Student Tour
- Soil Health, Summer Cover Crop, and Weed Identification Training (x2)



Shawn Belt helping STEM students plant seeds at the MDPMC. These high school students were participating in USDA's "Open Data" Summer Camp which helps students become more familiar with the tools and techniques of data science.

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