



2012 NUTRIENT MANAGEMENT ANNUAL REPORT



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The 2012 Nutrient Management Annual Report highlights the efforts of programs within the University of Maryland's College of Agriculture and Natural Resources (AGNR), which include nutrient management in field and vegetable crops, animal production, nursery and greenhouse industries and home landscapes and park lands.

The guiding principle behind nutrient management planning and implementation, as outlined in the Maryland Water Quality Improvement Act of 1998, is that nutrients applied in any form should balance with plants' nutrient needs. In agricultural production systems, managing nutrients to meet, not exceed, crop needs may increase profitability and is crucial to the health of the Chesapeake Bay and its tributaries.

Regardless of land use, improperly or excessively applied nutrients can leach into the groundwater or exit the field via runoff from precipitation, and then migrate into Maryland's waterways. Once in the water, excess nutrients upset the Bay's ecological balance by causing algal blooms and contributing to eutrophication and degradation of wildlife habitat.

For more information on the College of AGNR, visit www.agnr.umd.edu

Agricultural Nutrient Management

The University of Maryland Extension's (UME) Agricultural Nutrient Management Program (ANMP), which is funded by the Maryland Department of Agriculture (MDA), provides (1) nutrient management planning services to Maryland farmers through a network of nutrient management advisors located in all county Extension offices and (2) continuing education and technical support to certified nutrient management consultants and certified farm operators via nutrient management specialists.



Continuing Education

- MDA and the College of AGNR co-sponsored continuing education programs to assist certified nutrient management consultants in meeting their continuing education requirements.
 - Thirty-four (34) face-to-face workshops had 892 attendees.
 - Workshop topics included: "On-farm Nitrogen Management," "How to Write a Nutrient Management Plan," "Phosphorus Site Index (PSI)," "Small Scale Anaerobic Digesters," and "Cover Crops for Early Spring Vegetable Production."
 - Three online sessions had 116 attendees.
 - Sessions on "Web Soil Survey and Soil Data Mart," "Fate and Transport of Nutrients in Ditch-drained Agroecosystems," "Uncertainty in Manure Management," and "Enhanced Efficiency Fertilizers" were offered via the College of AGNR's web conference system during 2012.
 - In addition, UME coordinated with other organizations sponsoring online continuing education such as eXtension's Livestock and Poultry Environmental Learning Center (LPELC) and Pennsylvania State University's Agriculture and Environment Center's *Manure du Jour* series to provide continuing education opportunities for Maryland certified clients.

For more information on the ANMP, visit www.anmp.umd.edu



2012 Priorities

Nutrient management planning priorities for the ANMP are stated in a formal agreement between MDA and the University of Maryland. The priorities for Fiscal Year 2012 were as follows:

1. farmers who have filed a notice of intent (NOI) as a Concentrated Animal Feeding Operation (CAFO) or who have been designated a CAFO by MDE or EPA
 - a. and whose Comprehensive Nutrient Management Plan (CNMP) is currently being prepared by their Soil Conservation District, or
 - b. who need an updated nutrient management plan to remain in interim compliance while they await the development of the CNMP by their Soil Conservation District, or
 - c. who have a previously developed CNMP whose nutrient management component required updating.
2. farmers who have filed a NOI as a Maryland Animal Feeding Operations (MAFO) or who have been designated a MAFO by the Maryland Department of the Environment (MDE) who require a current nutrient management plan to complete permit requirements.
3. farmers with pollution problems or referred as non-compliant by MDA through an enforcement procedure;
4. farmers participating in the Manure Transport Project and those with a Maryland Agricultural Cost-Share (MACS) application pending for animal waste storage and poultry mortality composters;
5. updating nutrient management plans for the existing clientele with animal operations and expired plans developed by the Nutrient Management Advisors; and
6. first come, first serve for any other farmer who must comply with the Water Quality Improvement Act.

ANMP Web Site

The ANMP web site (www.anmp.umd.edu) is maintained on AGNR's server. This web site provides users with access to general information about the program, training materials, publications and resources for nutrient management plan development. The ANMP also maintains a web page of training opportunities and current events on the social media site, Twitter (www.twitter.com/UMANMP).



(Photo courtesy of Anastasia Vvedenskaya, ANMP Communications Specialist)

Progress and Achievements

- Plans for two Manure Transport Project clients were written, which allowed for the transport of manure to over 149 acres.
- Plans for 107 CAFO or MAFO clients were written to partially fulfill permit requirements.
- The Phosphorus Site Index was performed for 316 clients on 1,838 fields.
- Nutrient management advisors performed 23 yield checks and calibrated 19 manure spreaders.
- The Pre-Sidedress Nitrate Test was performed for 83 producers totaling over 9,590 acres. This resulted in an estimated reduction of over 172,000 pounds (or approximately 18 pounds per acre) of nitrogen.
- Three hundred twelve (312) new nutrient management plans were written for 129 Maryland producers for more than 11,500 acres. Five thousand, three hundred eight (5,308) plans were updated for 1,400 clients for approximately 276,700 acres (see Figure 1 below).

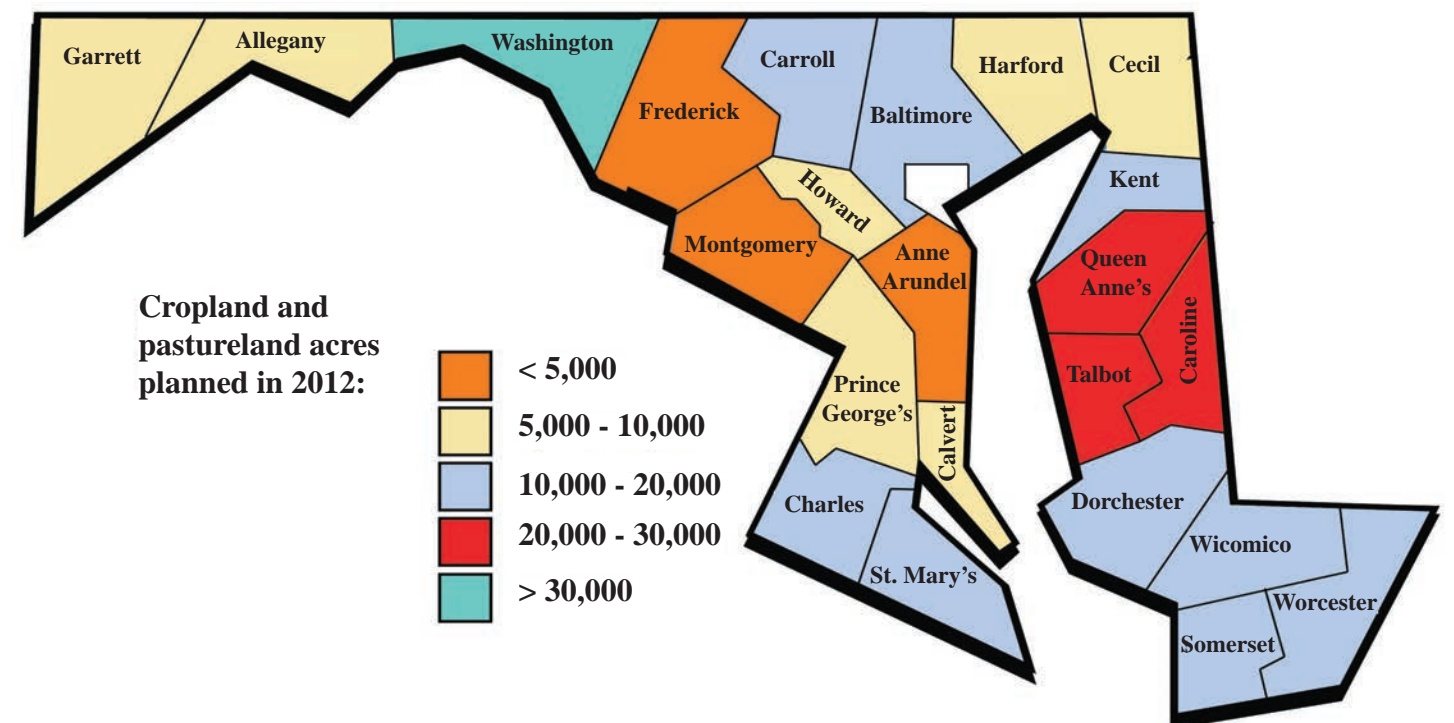


Figure 1. Farmland acres planned per county in Fiscal Year 2012 by University of Maryland Extension nutrient management advisors.

Pre-certification Exam Training

- Twenty-four (24) individuals attended "Fundamentals of Nutrient Management"—a course designed to help participants prepare for the MDA nutrient management certification exam.
- Fourteen (14) individuals enrolled in the Moodle exam review course which helped to prepare them for the exam.

Farmer Training and Certification

- Thirty-nine (39) farmers were certified through the Farmer Training and Certification (FTC) initiative to write their own nutrient management plans. To date, 449 farmers have become certified through this training initiative.
- After initial certification, farmers receive assistance with plan updates and software use from University of Maryland Nutrient Management Specialists.
- Nutrient management plan writing support was offered to certified farmers at five locations. These sessions provide an opportunity for farmers to get help with plan updates and software use.

Nutrient Applicator Training

- Thirty (30) face-to-face Nutrient Applicator Training sessions were held and 712 operators either received or renewed their nutrient applicator vouchers.
- One online session was held and four operators either received or renewed their nutrient applicator vouchers.



The University of Maryland, University of Delaware, Pennsylvania State University and Virginia Tech collaborated to organize the August 2012 Mid-Atlantic Precision Agriculture Equipment Day. Scientists and agricultural engineers from Oklahoma State University, Auburn University, and the University of Tennessee provided practical information on sprayer and planter section control, variable rate seeding, economics and practical implementation of satellite navigation technology and GPS, soil mapping, and using technology for on-farm research and developing variable rate prescriptions. Eighty-seven (87) participants received continuing education credit for this event.

(Photos courtesy of Anastasia Vvedenskaya, ANMP Communications Specialist)

Poultry Farm Management Workshop

The University of Maryland Extension, in cooperation with several other agencies (i.e., Soil Conservation Districts, USDA Natural Resources Conservation Service, Delmarva Poultry Industry, Maryland Department of the Environment and MDA) offered a Poultry Farm Management Workshop and Certification course designed to help new and existing poultry growers receive their National Pollutant Discharge Elimination System (NPDES) CAFO permit.

Topics discussed during the workshop included: basic farm management; site management and maintenance of poultry houses, pump rooms, manure sheds, composters, etc.; manure and mortality handling; vegetative environmental buffers; nutrient management and financial record-keeping; the CAFO permitting process; comprehensive nutrient management planning; and the Environmental Protection Agency inspection process. Four (4) continuing education credits were awarded to Maryland certified farmers, certified consultants and applicator voucher holders for attending this workshop.

This workshop's material was condensed and translated for Korean and Vietnamese poultry growers in Maryland.

In 2012, poultry farm management workshops were held on Maryland's Eastern Shore with over 35 participants in attendance.

Nutrient Management Revised Publications

The following publication was revised by the University of Maryland Extension specialists:

- *Nutrient Management Recommendations for Commercial Cut Flower Production*

Home and Garden Information Center (HGIC) specialists revised the following publications to align UME fertilizer recommendations with the 2011 Fertilizer Use Act:

- *HG #102: Lawn Establishment, Renovation, and Overseeding*
- *HG #63: IPM Series: Turf*
- *HG #100: Moss Control in Home Lawns*
- *Maryland Master Gardener Handbook: Chapter 13 - Turfgrass*

New HGIC publications:

- *HG #112: Turfgrass Maintenance Calendars for Maryland Lawns*

Nutrient Management Software

The latest version of Nutrient Management for Maryland Professional Edition (NuMan Pro) version 3.2.2 was released in February 2012. In addition to all of the features found in previous NuMan Pro releases, the latest version includes the following new features and capabilities:

- separate small grain recommendations are generated for fall and spring nutrient applications;
- crop codes that allow phosphorus removal rates for manure applied on small grain have been revised to meet fall and winter manure application restrictions; and
- import features have been updated for several soil testing labs.

Programming was initiated for the next revision which will include the revised Phosphorus Site Index.

(Photos courtesy of Anastasia Vvedenskaya, ANMP Communications Specialist)

Agronomic Crops

The following projects are ongoing:

- subsurface injection of poultry litter to minimize nutrient losses;
- development of a second-generation Phosphorus Site Index for predicting the relative risk of phosphorus transport from agricultural land;
- effectiveness of in-situ treatment of agricultural drainage ditch water to remove nutrients and other pollutants and reduce off-field nutrient transport;
- utilization of variable rate nitrogen application in the Mid-Atlantic region to increase nitrogen use efficiency in corn;
- use of rainfall simulation to determine relative nutrient loss efficiency factors from various best management practices to improve Bay-model estimates;
- estimation of an agronomic nutrient mass balance for nitrogen and phosphorus in Maryland;
- evaluation of soil and tissue tests as tools to determine appropriate sulfur fertilizer rates; and
- evaluation of floating treatment wetlands to reduce nitrogen and phosphorus losses from poultry CAFOs.

The following projects are completed:

• **Efficacy of Nitrogen Stabilizer Products**

Various nitrogen stabilizer products are designed and/or marketed as having the ability to provide protection to nitrogen from volatilization loss (Agrotain™), nitrification loss (Instinct™) or for Agrotain Plus™ and Nutrisphere-N™ to provide dual purpose protection from both those pathways. To test their efficacy, these 4 products were compared to UAN that was surface applied at sidedress time and to UAN injected at sidedress time at 10 sites between 2008 and 2011. The injection or incorporation of UAN is considered to be the best management practice for this source of nitrogen.

Measurements of ammonia volatilization during a three-week period following sidedress application were made to determine the performance of the volatilization inhibitors at reducing loss via that pathway. Soil samples were collected to measure total soil nitrogen periodically following application and after corn harvest to determine if any of the nitrification products or controls had provided nitrification protection. Finally, yield was measured to determine efficacy of the treatments for that most important variable. Based on the results of this research, the following conclusions are made:

1. Agrotain™ and Agrotain Plus™ provided ammonia volatilization protection for UAN for a 1-2 week period following sidedress application. This protection was comparable to the performance of UAN injected which had little to no loss during the period.
2. During this same 1-2 week period, Nutrisphere-N™ performed comparable to UAN surface applied which produced significant amounts of ammonia loss during the measurement period.
3. There were no consistent yield differences among the nitrogen stabilizer products and the UAN surface and injected treatments during the testing period.

This means that the use of a nitrogen stabilizer product with UAN fertilizer should not be done as a yield enhancing practice. Nitrogen stabilizer products are not designed to produce a yield advantage; instead, they are designed to temporarily protect nitrogen from loss via the loss pathways.

• **Long-term effects of cropping system choice (forage versus grain) on soil test phosphorus (P) decline.**

Major observations from this research after eleven years are:

1. A forage cropping system (corn silage, rye cover crop chopped for silage, multi-cut alfalfa) removes more total phosphorus from a field than a grain cropping system (corn, wheat, and soybean).
2. For high soil phosphorus fields, soil phosphorus concentration will decline at a slightly faster pace for a forage cropping system than it will for a grain cropping system.
3. Without any fertilizer P added, it will take three to four decades or more to reduce excessively high soil P sites to soil P levels that are considered optimum even under forage cropping systems.

Vegetable Crops

The following projects are ongoing:

- **The effect of plastic mulch color on soil temperature, potassium uptake, and tomato fruit ripening problems.**

Adding large amounts of potassium fertilizer to the soil helps to reduce this problem, but causes excessive amounts of potassium to be introduced into the environment. UME research has demonstrated that the reduction of potassium in the tomato plant is due primarily to the reduction in potassium uptake by the plant roots when soil temperatures reach at or over 93 degrees F. Soil temperatures usually reach over 93 degrees F when black plastic is used, as is the case in most commercial fresh market tomato fields. Over the last five years this heating trend of the soil has increased and so have the fruit ripening problems. Preliminary results have shown that using white plastic mulch can decrease soil temperatures enough to allow potassium levels stay at or just below adequate levels, reducing the incidence of fruit ripening problems in growers' tomato fields without adding any more potassium. Work will continue looking at the effect of white plastic mulch on various cultivars of tomato, adding just foliar potassium and the possibility of using mulches that are more reflective.

- **The effect of low rates of compost or manure as a “microbial starter” when cover crops of hairy vetch or hairy vetch and rye are used as a primary nitrogen source for many vegetable crops.**

Preliminary results indicate that a “microbe starter” more than doubles the soil microbial population and enhances the active decomposition and release of nitrogen from the cover crops.



To learn more about vegetable production practices and on-going vegetable research at the University of Maryland, visit <http://mdvegetables.umd.edu>

Animal Nutrient Management

Researchers in the University of Maryland's Department of Animal and Avian Sciences are studying how nutritional factors and feed management interact to effect phosphorus and nitrogen digestibility and retention in animals.

For more information,
visit <http://ansc.umd.edu>

Poultry

The following projects are ongoing:

- use of the dietary imprinting concept where changes in early nutrition could improve the broilers' ability to:
 - perform well when low phosphorus diets are fed in the finisher and withdrawal phases, and
 - deposit breast muscle such that breast yield does not change when low protein diets are fed in the finisher and withdrawal phases. This would allow producers to decrease the amount of phosphorus and nitrogen in 70% of the broiler feed without negatively impacting performance. The ultimate goals are to decrease phosphorus and nitrogen in litter;
- effectiveness of currently used and new forms of phytase in decreasing phosphorus in diets fed to broilers;
- determination of the impact of high copper concentrations used in poultry diets as growth promoters or antibacterials on phytase efficacy and on intestinal microbial populations. This is being done in broilers inoculated with *A. acervilina* and *maxima*. There is also an exploration of the impact of proteases and phytases in broilers grown on floor pens with used litter and with limited antibiotic and coccidial treatment.;
- investigation into proteases that might help improve protein availability from diets, thus allowing formulation of diets with lower protein. This would in turn result in lower excreted nitrogen and lower nitrogen volatilization;

- examination of amino acid digestibility in ingredients, their variability and how proteases can increase their utilization by poultry;
- defining requirements for calcium and phosphorus as affected by age and breed;
- development of methodologies that will allow us to determine ingredient nutrient (calcium, phosphorus, energy, amino acids) digestibility in one assay in the presence or absence of one or several enzymes. This will help to define differences within an ingredient and between ingredients that will result in diet formulation closer to requirements, decreased excretion of nutrients and lower production costs; and
- exploration of how management tools such as lighting programs and diet particle size can be used as tools to improve diet nutrient utilization by broilers. This complements the goal of maintaining or improving productivity while decreasing the excretion of nutrients.

Equine Rotational Grazing Demonstration Site

The Equine Rotational Grazing Demonstration Site, which has been in operation since spring 2009, educates horse farm operators to adopt environmentally-friendly best management practices (BMPs) for horse pastures to help reduce their farm's negative environmental impact. Since 2009, there have been 17 events with a total of 612 visits with individuals coming from 5 different states.

In 2012, UME hosted four evening educational events and one full-day seminar featuring a number of forage, horse, and conservation experts. Event topics included renovating overgrazed winter pastures, strategies for managing small horse farm pastures, non-chemical weed control, manure management, and soil erosion control. Specific skills taught were soil sampling, assessment of vegetative cover, toxic weed identification, estimating pasture height, and pasture renovation decision making.

There were a total of 144 participants for the year with 20 individuals coming to multiple events. Post-event surveys indicate that participants gained the most knowledge in:

- determining the proper plant species to integrate in horse pastures;
- establishing proper timing for seeding horse pastures; and
- designing a rotational grazing system.

The majority of participants indicated that their top three farm priorities after attending the educational events were to:

- maintain vegetative cover of 50% or higher in pastures;
- applying lime and fertilizer based on soil test results;
- renovate pastures to thicken the stand; and
- assess vegetative cover.



Under provisions of the Water Quality Improvement Act of 1998, Maryland's nursery and greenhouse operations must develop water and nutrient management plans to ensure that nitrogen and phosphorus are not lost to surface and groundwater from production sites in the state. The University of Maryland's Nutrient Management Program for the Nursery and Greenhouse Industry works with the industry to help develop these plans and promotes other sustainable practices that minimize environmental impacts through education and research.

Training

A number of nutrient management initiatives were offered for nursery and greenhouse operators and certified consultants during 2012:

- **Farmer Certification Training:** growers became certified to write their own nutrient management plans. One series was offered at the Wye Research and Education Center in April 2012. Eleven operators and consultants attended this one-day training; seven growers were certified at the follow-up session in May at MDA in Annapolis.
- **Advanced Applicator and Consultant Training:** A hands-on twilight workshop was held during March, 2012 at the University of Maryland Greenhouse complex to illustrate best management practices for substrate and irrigation of container-grown plants. Five growers and two consultants attended and were re-certified.



Research and Extension

- **Wireless Sensor Networks for Irrigation and Nutrient Management:** The third year of this five-year USDA-funded national specialty crops project was completed. A number of commercial nursery and greenhouse operations are actively involved in this research, including three operations (Raemelton, Waverley and Bauers greenhouse) in Maryland. A new low-power sensor node that can independently monitor and control irrigations based on sensor readings was tested during 2012. Irrigation water applications have been reduced on average by 2-6 times, with negligible effect on crop growth rates.

A full description of the project can be found online:
<http://www.smart-farms.net>

- **Integrated Management of Zoosporic Pathogens and Irrigation Water Quality for a Sustainable Green Industry:** This national specialty crops project involves a team from the University of Maryland and three nursery and greenhouse operations (Moon, Tidal Creek and Bauers) in Maryland. Containment ponds and irrigation systems are being actively monitored for water quality and pathogen status at each operation to understand the dynamics of nutrient loading on water quality and pathogen survival. The overall goal is to elucidate better disease management and water treatment strategies, since this is a key barrier to using recycled water for many growers.

A full description of the project objective can be found online:
<http://www.irrigation-pathogens.info>

(Photo courtesy of Dr. Jongyun Kim)

- **Nutrient Trading:** Nutrient trading options for nursery producers in Maryland, in collaboration with Bob Ensor (Howard County Soil Conservation Office), are being explored using the Maryland Nutrient Trading Tool at <http://nutrientnet.mdnutrienttrading.com>
- **Knowledge Center for Water, Nutrient and Plant Health Management:** There are currently over 1050 registered users in the Knowledge Center, which has over 25 learning modules on various aspects of substrate, irrigation, nutrient and pathogen management for nursery and greenhouse operations.

General information on the project can be found at <http://waternut.org> and learning modules can be accessed at <http://waternut.org/moodle>

Urban Nutrient Management

Master Gardener Program

In order to help alleviate concerns about the potential impact of fertilization of urban lands on water quality in Maryland, the UME relies upon its Master Gardener program to “educate Maryland residents about safe, effective, and sustainable horticultural practices that build healthy gardens, landscapes, and communities.”

- Currently there are active programs in 19 of 23 counties and Baltimore City.
- Master Gardener trainees receive basic and advanced training in soils, fertilizers, and composting. Online training (in basic soils) was provided for the first time this year.
- One thousand, six hundred thirty (1,630) active volunteers donated over 101,870 hours of volunteer service to the state of Maryland.
- Master Gardeners operated 25 compost demonstration sites to educate homeowners about recycling yard and food waste. Six hundred sixty three (663) compost bins were distributed around the state.

For more information about the Master Gardener program, visit www.mastergardener.umd.edu

The Home and Garden Information Center (HGIC) has eight video clips related to soil testing and soil quality, and composting: (1) “Types of Raised Beds”, (2) “How to Build Raised Beds”, (3) “Composting for Your Garden”, (4) “Composting: Varieties of Composting Bins”, (5) “Vermicomposting: Using Worms to Make Compost for Your Garden”, (6) “Vermicomposting: Varieties of Bins for Composting with Worms”, (7) “No-Till Gardening”, and (8) “How to Collect a Soil Sample.” These videos have received 30,986 downloads since 2010 and can be accessed at www.growit.umd.edu or www.youtube.com/user/UMDHGIC.

(Photos courtesy of Anastasia Vvedenskaya, ANMP Communications Specialist)



Photos from top to bottom: two varieties of containers for growing leafy greens, Jon Traunfeld demonstrating composting materials, and a demonstration of a rain barrel at a MDA's fertilizer public meeting.

Fertilizer Use Act

HGIC faculty and Master Gardeners educated residents around the state about the Fertilizer Use Act. This Fertilizer Use Act will become effective in October 2013 and institutes new guidelines for lawn fertilization, including:

- lawn fertilizer products sold in Maryland cannot contain phosphorus (with certain exceptions),
- new label requirements will ensure that no more than 0.9 pounds of total nitrogen is applied per 1,000 square feet and at least twenty percent of this nitrogen must be in a slow release form,
- all lawn care professionals must be certified to apply fertilizer, and
- fertilizer use will be prohibited between November 15 and March 1, within fifteen feet of a waterway, or when heavy rain is predicted.

An online session was conducted to train faculty and staff on the provisions of the new law. Extension fact sheets and the turf chapter of the Master Gardener handbook were updated to reflect the law's provisions. HGIC faculty also worked closely with Maryland Department of Agriculture (MDA) staff to update MDA publications and coordinate a public educational campaign.



Bay-Wise Landscape Management

Bay-Wise training in 2012 focused on: the history and condition of the Chesapeake Bay; hydrology; wells and septic systems; lawn fertilizers and the Bay; rain garden construction, living roofs and walls; critical areas and coastal zone management; soil compaction; stormwater management; integrated pest management; and ecologically sound landscape maintenance.

- Sixty-nine (69) new Master Gardener volunteers were trained in Bay-Wise Landscape Management techniques. To date, 1035 Master Gardeners from 20 counties and Baltimore City have been trained in Bay-Wise techniques.
- Forty-three (43) additional Bay-Wise Master Gardeners had their personal landscapes certified as Bay-Wise by the Urban Nutrient Management Program, bringing the total to 440.
- To date, 889 private properties (residential landscapes) have been certified as Bay-Wise by Master Gardeners in several Maryland counties. An additional 95 public landscapes have also been certified as Bay-Wise by Master Gardeners throughout the state.

Behavioral changes resulting from learning Bay-Wise best management practices were highlighted in chapter 8 of the book, "Encouraging Adoption of Integrated Pest Management in Non-Agricultural Settings," published by the American Chemical Society, ACS in December, 2011.

For more information about the Bay-Wise Landscape Management Program, visit: www.baywise.umd.edu



USDA NRCS soil scientist Jim Brewer leads a hands-on activity on soils at the Talbot Operations Center (Photo courtesy of Ms. Wanda MacLachlan, Extension Area Educator)

Turfgrass Nutrient Management

Extension turfgrass management specialists worked with HGIC faculty to develop a new set of nitrogen fertilizer recommendation for home lawns in response to the requirements of the Fertilizer Use Act.

MDA's Fertilizer Use Act Fact Sheet can be found online:
http://www.mda.state.md.us/pdf/FertilizerLaw_Facts_final.pdf

Sheridan Street Community Garden

Staff in AGNR are facilitating the Sheridan Street Community Garden, located at the Center for Educational Partnership in Riverdale, Maryland. As a part of the College of AGNR's outreach efforts to its neighbors, the community garden functions to build effective relationships among gardeners, encourage environmentally sound food production practices, and improve the nutrition of gardeners' families. Since its inception workshops have been organized to provide gardeners an opportunity to learn about such nutrient management topics as soil sampling and testing, the use of cover crops, and small-scale composting. The garden is also used for experiential training of Master Gardeners.



In Closing

In 2012 the College of Agriculture and Natural Resources' nutrient management programs continued to conduct research on nutrient utilization in agronomic and horticultural crop production and animal nutrition as well as educate the public on fertilizer management and sustainable horticultural practices. These research and education efforts allow the College's nutrient management initiatives to continue achieving their goal of improving and protecting the health of the Chesapeake Bay and Maryland's tidal and nontidal waterways while maximizing the state's economic potential.

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Photo Credits

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Rain Simulator (Dr. Robert Hill); Grass or Legume Study (Ms. Jennifer Reynolds); Horses (Mr. Edwin Remsberg); Greenhouse (Dr. Jongyun Kim); Cows (Ms. Heather Hutchinson); all other photos (Ms. Anastasia Vvedenskaya).

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