



Soil Basics: Erosion

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Linda Blum
Associate Professor (emeriti)
Environmental Sciences
University of Virginia



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1


Mission of Extension Piedmont Master Gardeners

We are volunteer educators who engage the Charlottesville/Albemarle communities through a broad range of programs and information resources that provide research-based horticulture best practices and encourage environmental sustainability, in furtherance of the values and goals of the Virginia Cooperative Extension



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2

Charlottesville-Albemarle Master Gardeners

For the Year 2023:

178 Master Gardeners
22 Master Gardener Interns
27 Emeritus Master Gardeners



Contributed at total of:

21,016 volunteer hours and made
13,985 direct educational contacts

Valued:

\$ 684,911.00*

*Based on a value of \$29.14/hour from Independent Sector 2021 Value of Volunteer Hours by State



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3

"There can be no life without soil and no soil without life; they have evolved together."

(Charles Kellogg, 1868-1949, Naturalist)

Objectives of this talk are to:

1. Describe

- Soil – what it is and how it functions
- Importance of soil texture to soil quality

2. Soil erosion

- What is it and why it matters – the environmental impacts
- Approaches to minimize erosion to promote plant growth and improve water quality
 - mulch
 - cover crops
 - add organic matter
 - plant lots of plants
 - no-till
 - invasive Asian jumping worms

4

The Soil is Natural Body- It ain't Dirt!

The Soil: is the interface between rocks, water, air, and organisms, all interacting with one another over tens of thousands of year or more to form soil

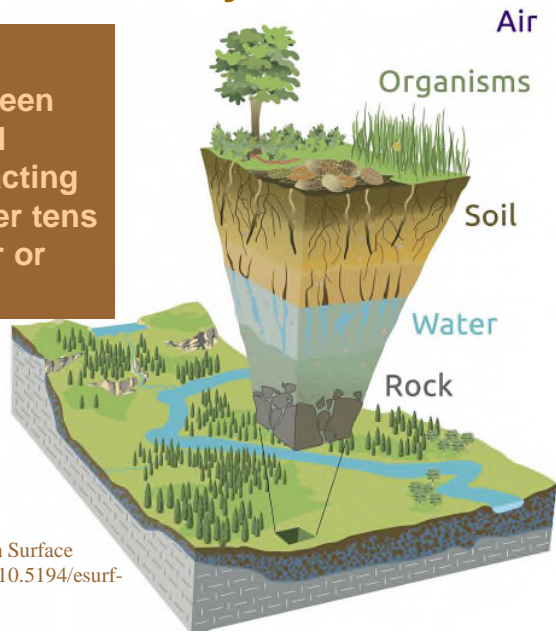
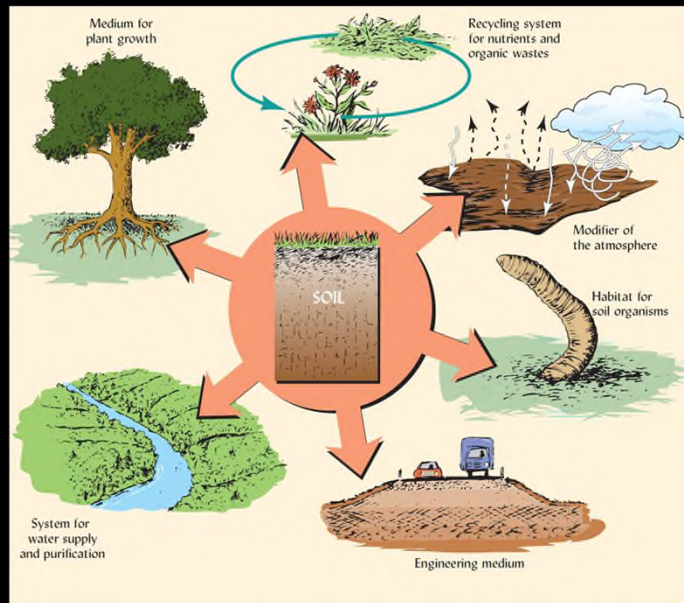


Figure from Brantley et al. 2017 Earth Surface Dynamics 5:841-860. <https://doi.org/10.5194/esurf-5-841-2017>

5

Soils are crucial to life on Earth. Soils function to:



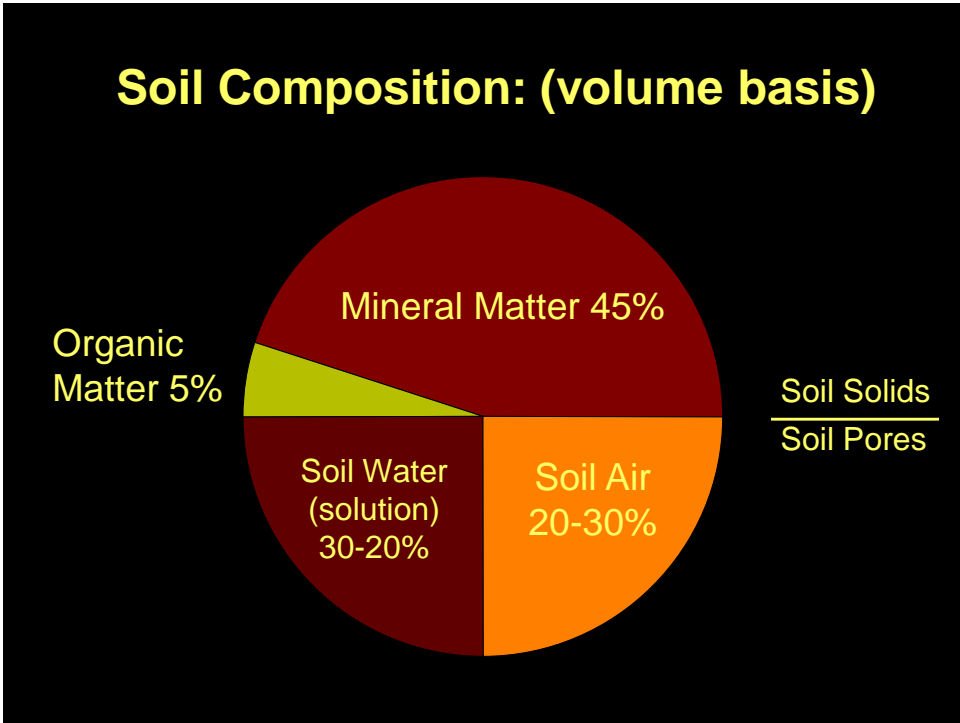
6

Soil provides plants with

- Physical support
- Water
- Nutrients (N, P, K, etc.)
- Temperature moderation
- Protection from toxins



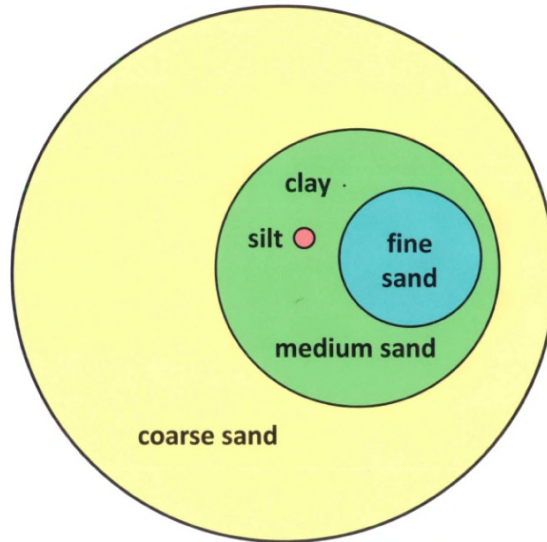
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8

Soil Mineral Particles – wide range of sizes

Comparative size of sand, silt, and clay-sized particles.



Clay < silt < fine sand < med sand < sand

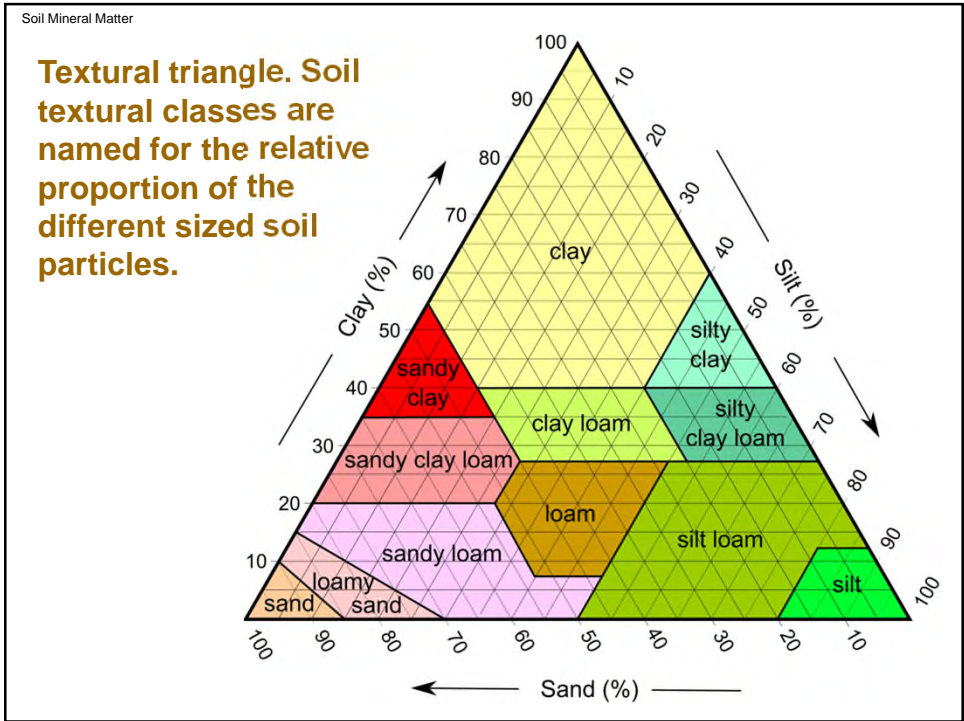
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Soils are a mixture of sand-, silt-, and clay-sized particles. Soil texture depends on the proportion of these particles.



10



11

Soil Texture Influences:

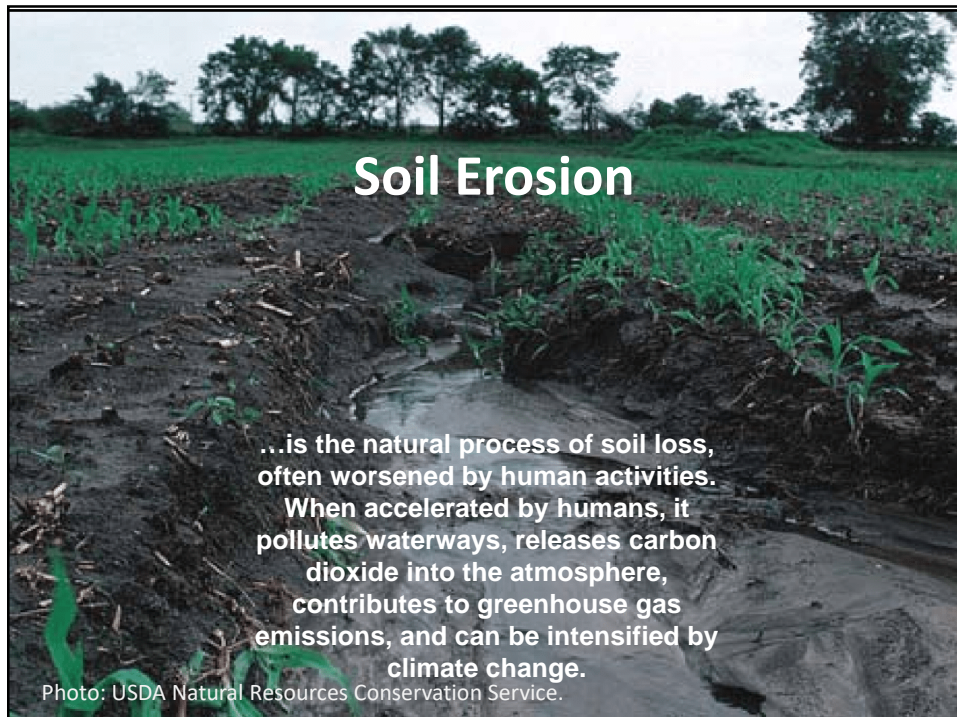
Soil Property	Sand	Silt	Clay
Water holding capacity	Low	Moderate	High
Ability to store plant nutrients	Low	Moderate	High
Resistance to pH change	Low	Moderate	High
Aeration	High	Moderate	Low
Soil organic matter content	Low	Medium	High
Warming in spring	Rapid	Moderate	Slow
Compaction	Low	Medium	High
Susceptibility to erosion	Low	High	Low

12

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13



14

What is erosion?

- ❖ **Process by which soil particles are:**
 - detached
 - transported
 - deposited
- ❖ **Particles can be deposited**
 - near point of origin
 - or very far away



<https://www.dcr.virginia.gov/laws-and-regulations/document/presentation-on-t-and-rusle-2.pdf>



www.ssentinel.com/index.php/news/article/vims_to_study_how_sediment_plume_from_irene_and_lee_might_affect_bay/

From presentation by Chris Lawrence (VA Cropland Agronomist, USDA-NRCS)

15

Agents of Erosion in Virginia

- **Water (+gravity)**
 - Dominant erosive agent statewide
 - Raindrop impact key to detachment
 - Water running downhill key to transport
- **Wind**
 - Occasionally issue in eastern VA
 - Only occurs when soil is dry



<https://www.nrdc.org/stories/soil-erosion-101#what-is>



<https://www.dcr.virginia.gov/laws-and-regulations/document/presentation-on-t-and-rusle-2.pdf>

16

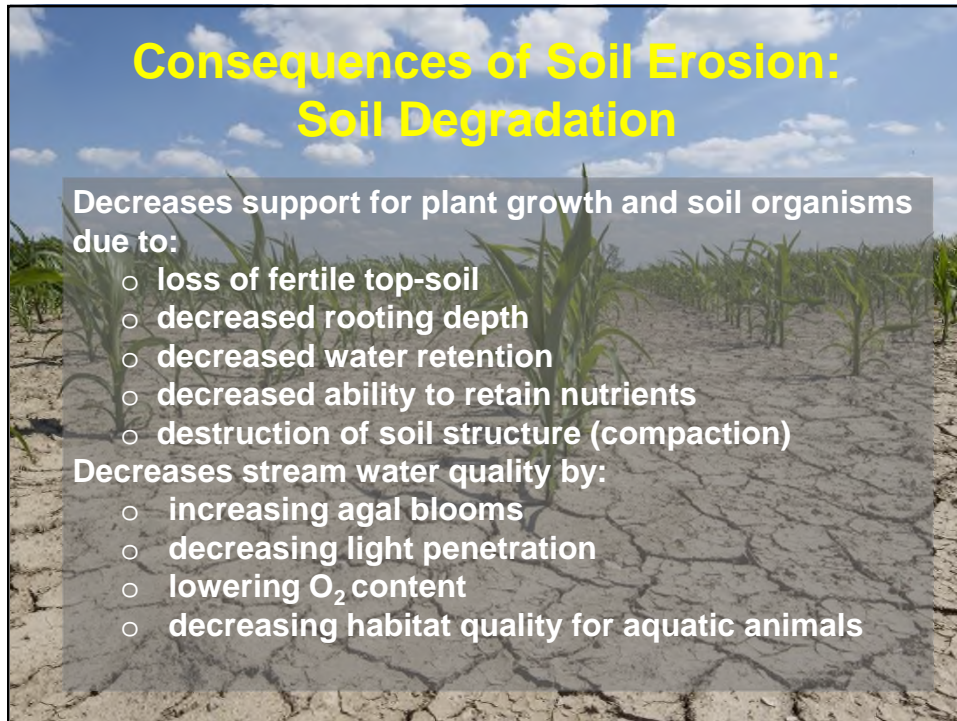
Consequences of Soil Erosion: Soil Degradation

Decreases support for plant growth and soil organisms due to:

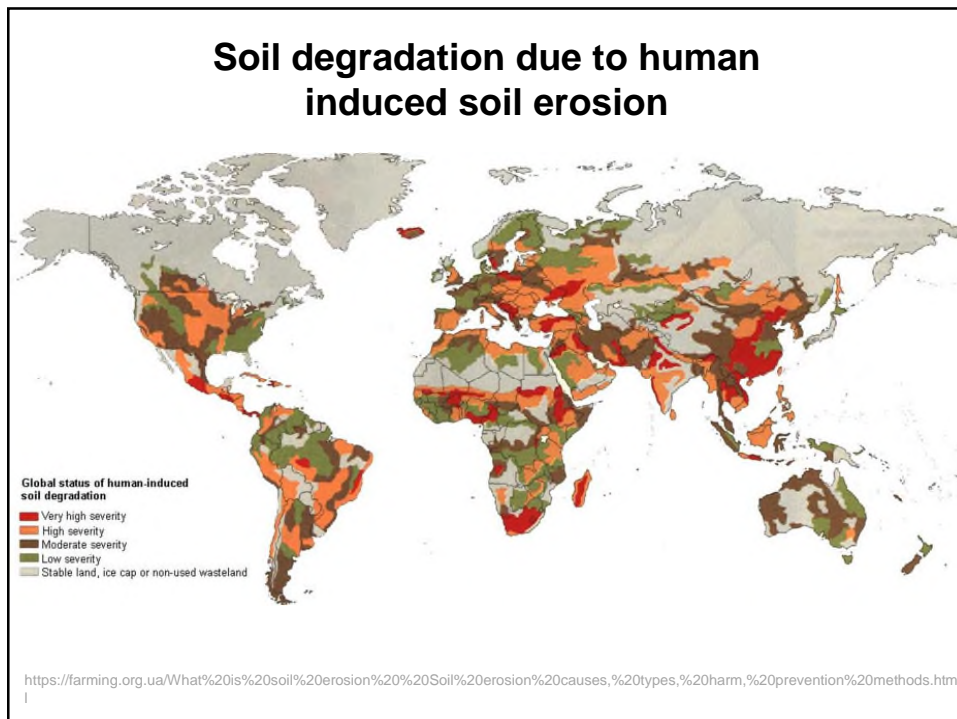
- loss of fertile top-soil
- decreased rooting depth
- decreased water retention
- decreased ability to retain nutrients
- destruction of soil structure (compaction)

Decreases stream water quality by:

- increasing algal blooms
- decreasing light penetration
- lowering O₂ content
- decreasing habitat quality for aquatic animals



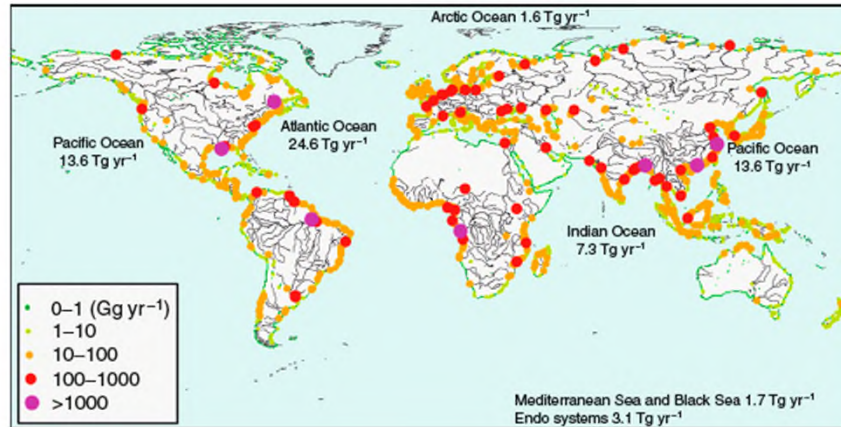
17



18

Soil Degradation Leads to Increased N and P in Coastal Zones

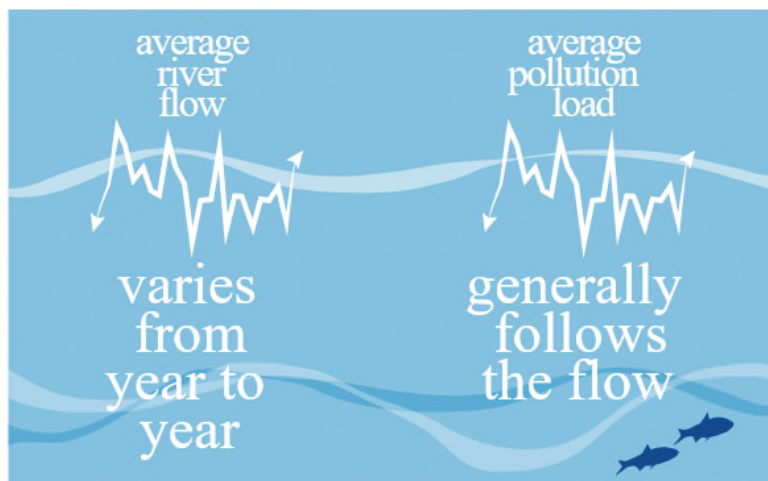
Total N export from world's rivers



Seitzinger et al. 2008

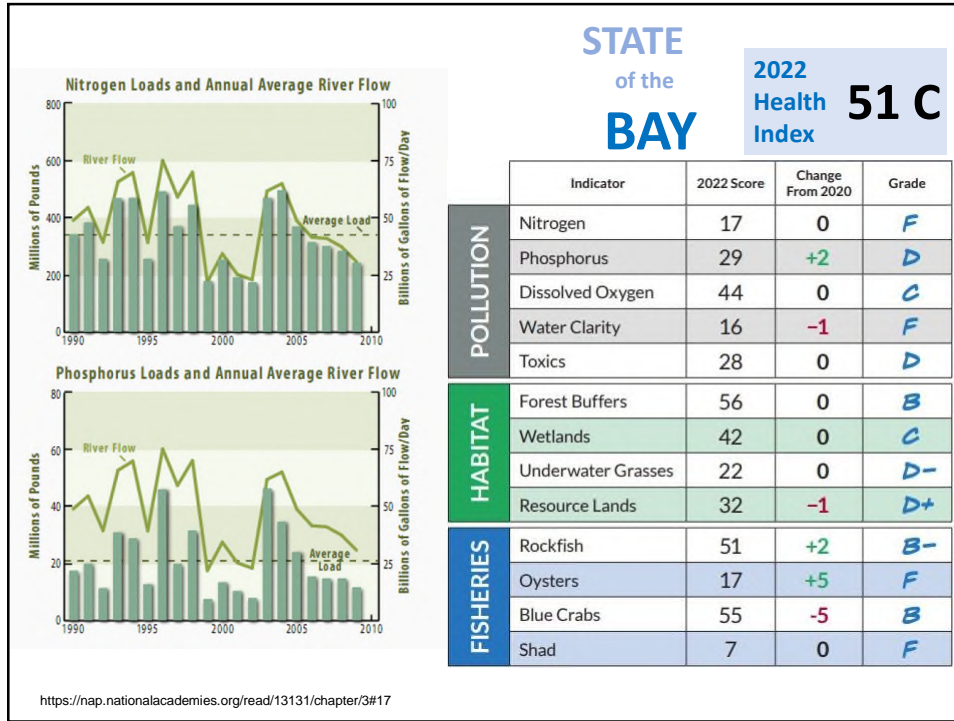
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river flow X pollutant concentration = amount of N + P flowing into coastal waters

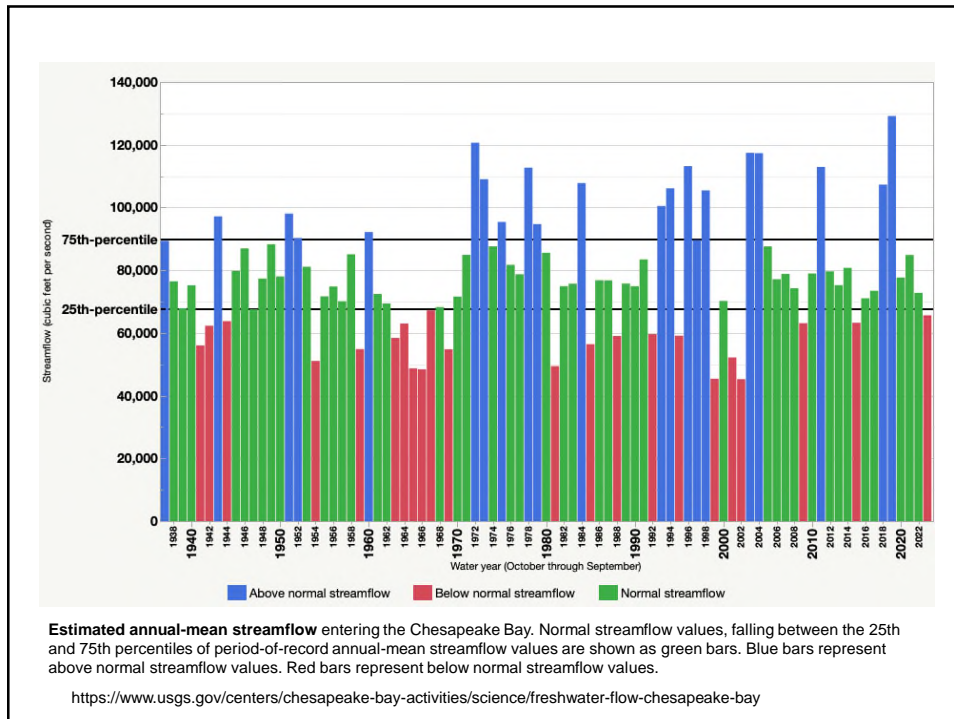


<https://chesapeakebaystory.umces.edu/health/bay-health-index/>

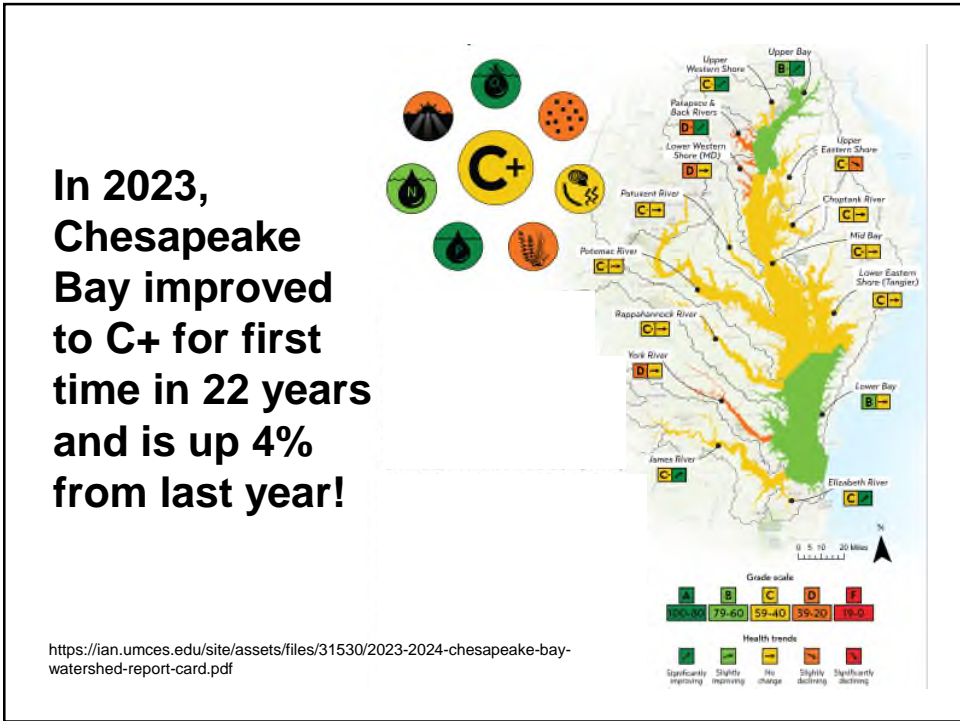
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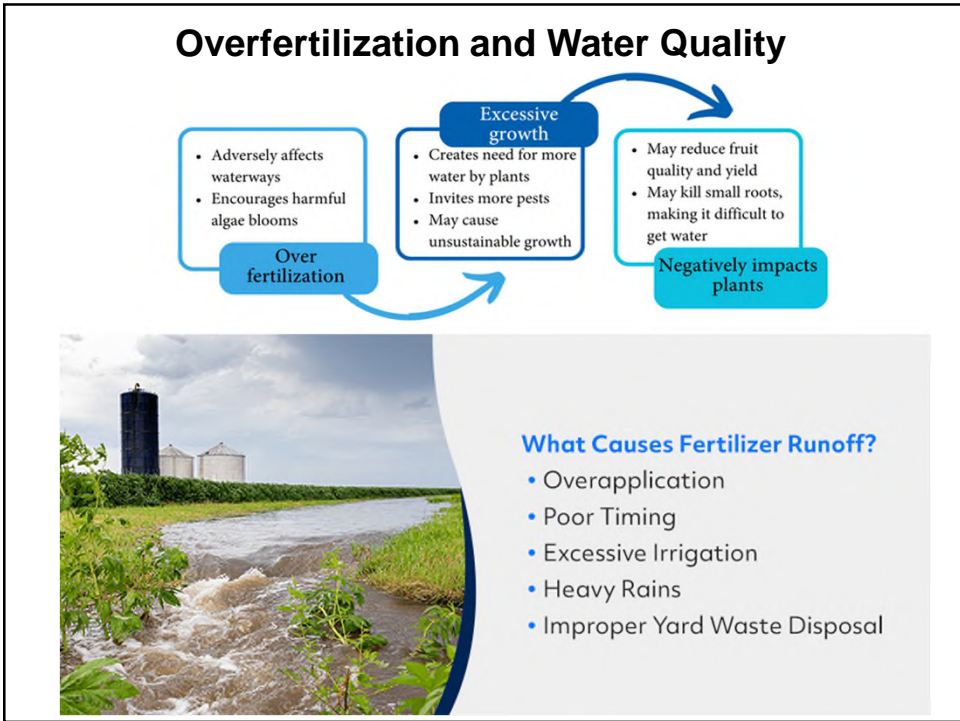
21



22



23



24

Determine Nutrients in Soils

**Don't Guess
Soil Test**



- Maximizes plant growth/production
- Saves money
- Protects environment
- Simple to do

25

Example of soil test report:

https://www.soiltest.vt.edu/content/dam/soiltest_vt_edu/PDF/soil-test-note-01.pdf

SAMPLE HISTORY										
Sample ID	Field ID	LAST CROP		LAST LIME APPLICATION		SOIL INFORMATION				
		Name	Yield	Months Pres.	Tons/Acre	SMU-1 %	SMU-2 %	SMU-3 %	Yield Estimate	Productivity Group
620LB										
LAB TEST RESULTS (see Note 1)										
Analysis	P (lb/A)	K (lb/A)	Ca (lb/A)	Mg (lb/A)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	B (ppm)	S.Salts (ppm)
Result	241	290	3388	287	5.7	11.4	1.1	9.4	0.9	
Rating	VH	H+	VH	VH	SUFF	SUFF	SUFF	SUFF	SUFF	
Analysis	Soil pH	Buffer Index	Est.-CEC (meq/100g)	Acidity (%)	Base Sat. (%)	Ca Sat. (%)	Mg Sat. (%)	K Sat. (%)	Organic Matter (%)	
Result	6.1	6.01	12.3	18.8	81.2	68.6	9.6	3.0		

FERTILIZER AND LIMESTONE RECOMMENDATIONS

- Has adequate nutrients to support plant growth
- pH is adequate for plant growth, slightly higher better – need to add lime
- pH will change quickly as nutrients are used (Buffer Index)
- Exchange sites are occupied mostly by nutrients (%Base Sat.)
- Moderate ability to retain nutrients (CEC)
- OM% is 15.5% (not shown) - excellent

26

Soil Test Results

Fertilizer and Limestone Recommendations

Crop: VEGETABLE GARDEN (210)

610. **LIME RECOMMENDATIONS:** Apply 13 pounds of agricultural limestone (ground or pulverized) per 100 square feet. If lime is not going to be mixed into soil, make several small applications of up to 5 lbs each, at intervals of 1 to 6 months, until the full amount is applied.

991. “Explanation of Soil Tests, Note 1” and other referenced notes are viewable at www.soiltest.vt.edu under Report Notes.

225. **FERTILIZER RECOMMENDATIONS:** Apply a nitrogen-only fertilizer, such as one of the following amounts per 100 sq. ft. --- 1.25 lbs (2 cups) of nitrate of soda (16-0-0) or 1.33 lbs (2 2/3 cups) of calcium nitrate (15-0-0) or 1.0 lb (2 1/2 cups) of ammonium sulfate (21-0-0) or 0.4 lbs (1 cup) of urea (46-0-0). Do not over fertilize! These products will burn plants at high rates! If you are unable to find one of these fertilizers, apply a turf-type (lawn maintenance) fertilizer that is high in nitrogen with little or phosphorus and potassium at a rate close to 0.2 lb of nitrogen per 100 sq. ft., such as applying two-thirds of a pound of either 26-0-2 or 32-0-4. For additional information on fertilization, see Note 19.

27

For more information

- <http://www.soiltest.vt.edu>
- Piedmontmastergardeners.org/garden-shed Article on Soil testing, April, 2015



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28

Factors Contributing to Erosion

- Rainfall intensity
- Soil erodibility/aggregation
- Slope gradient and length
- Cropping and vegetation
- Tillage practices



29

Minimizing Erosion and Maintaining Soil Productivity

- Avoid compacting the soil
- Cover the soil
 - Mulch
 - Cover crops
 - No till
- Add organic matter annually
- Plant lots of plants



Stunted crop growth due to compaction
(Fulton and Shearer, OSU)

30

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31

BENEFITS OF USING MULCH

2" to 3" of Mulch

<p>Nourishes Soil</p> <p>As ORGANIC mulch decomposes, it nourishes your soil and feeds your plants. This happens over time.</p>	<p>Suppresses Weeds</p> <p>Mulch cuts weed seeds off from sunlight. This prevents them from growing enough to break through the surface.</p>	<p>Conserves Water</p> <p>Mulch helps soil retain moisture. This lowers the amount of watering needed in your plant bed.</p>	<p>Regulates Temperature</p> <p>Mulch insulates your plants' root systems against the sun and extreme temperature variations.</p>	<p>Prevents Erosion</p> <p>Mulch acts as the first defense against nature's elements that threaten to wear away your soil.</p>
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<https://1sttoplanscapefl.com/the-benefits-of-mulch/>

32

Mulching **Dos** and **Don'ts**

- **Do** apply spring mulch at planting time
- **Do** apply winter mulch before frost
- **Do** remove weeds prior to mulching
- **Do** use 3" +/- of depth
- **Do** spread to drip line of young trees
- **Do** keep 2-3" away from tree trunks
- **Do** keep 1-2" away from stems of annuals
- **Don't** pile against tree trunks or plant stems
- **Don't** pile too thick or too thin
- **Don't** use green materials
- **Don't** mulch over weeds
- **Don't** use plastic mulch under trees or shrubs

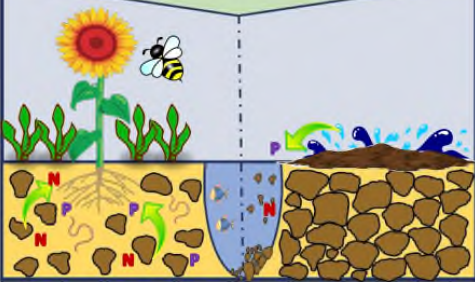
33

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<https://fyi.extension.wisc.edu/foxdemofarms/conservation-agriculture/permanent-soil-cover-cover-crops/>

Why Cover Crops?



Benefits of Cover Crops	Cons of Conventional Crop Rotation
<ul style="list-style-type: none"> ▪ Improved nutrient cycling ▪ Increased organic matter ▪ Reduced soil erosion ▪ Increased weed suppression ▪ Increased water absorption ▪ Improved wildlife habitat 	<ul style="list-style-type: none"> ▪ Increased soil compaction ▪ Increased surface runoff ▪ Increased nutrient and sediment loss ▪ Organic matter degradation ▪ Increased risk of heavy rain ▪ Increased risk of severe drought

34

Cover Crops



- Sow in fall before frost
- Cut in spring before seed set
- Till-in greens (3-4 wks before planting), or mulch or compost

Cover Crop	Examples	%N
Legumes	Hairy vetch Clover Pea	4% at flowering 3% as seeds mature
Non-legume grasses	Rye Oat	3% at flowering 2% as seeds mature
Non-legume broadleaves	Buckwheat Tillage radish Canola	Similar or a little less than grasses

- Winter kill cover crops
 - Annual rye
 - Oats
 - Cow peas
- Winter hardy cover crops
 - Crimson clover
 - Winter rye
 - Hairy vetch

35



Mixed cover crop



Compost



Leaf mold (right)

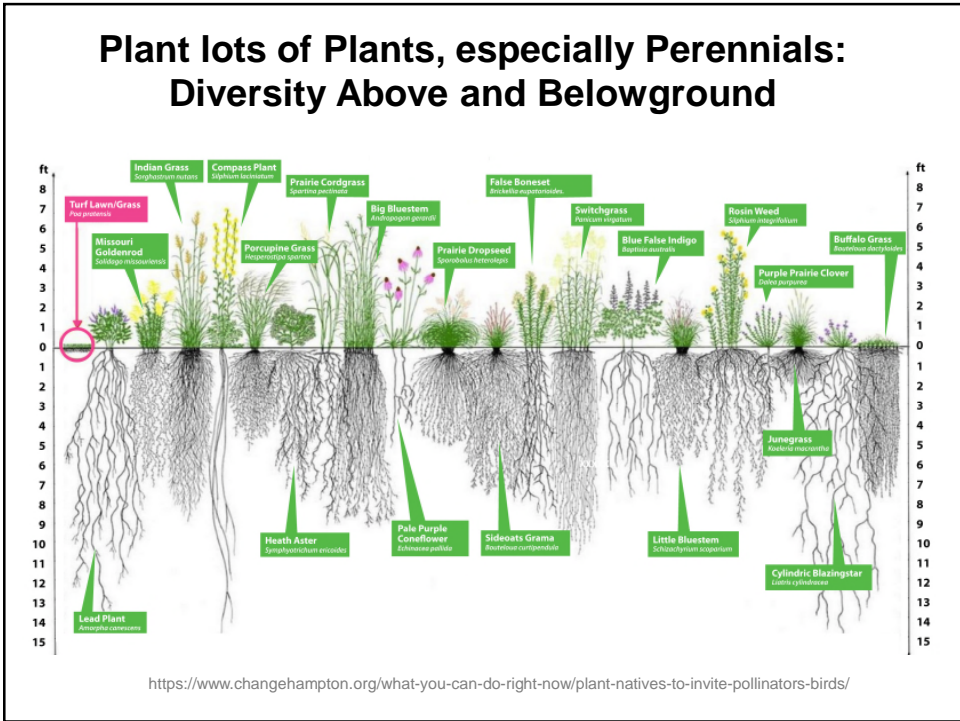


Composted manure (left)
Manure (right)

Adding OM to soil – a continual process to maintain benefits

- Cover crops
- Compost
- Leaf mold
- Composted manure

36



37

Minimizing Erosion Maintaining Productivity in the Garden Soil: No-Till Gardening

A method of growing crops without disturbing the soil through plowing or tilling. Crop residue remains on the soil surface to decompose naturally.

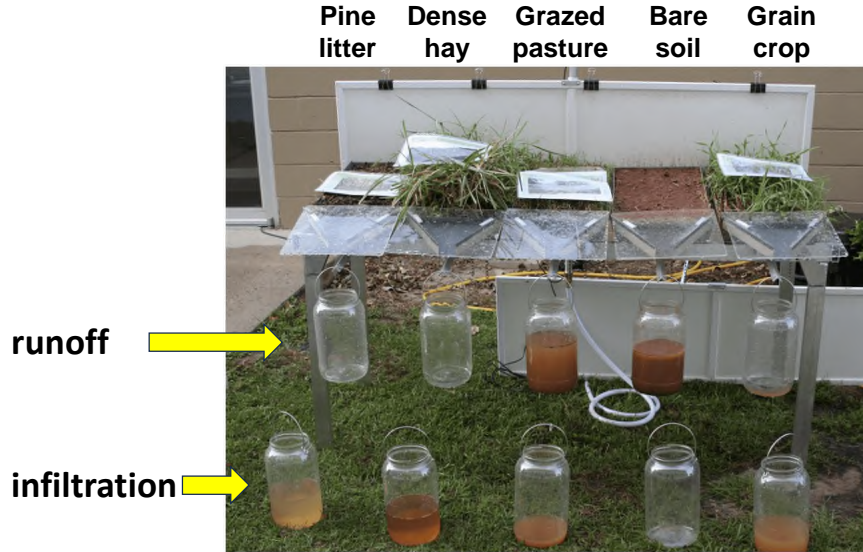
BENEFITS

- Reduced soil erosion caused by plowing and tilling
- Increased soil organic matter
- Improved soil structure and aeration
- Increased beneficial soil microbes
- Retained soil moisture and water conservation
- Reduced fuel use from not plowing

38

Soil Cover and Erosion Control

Photo: Jennifer T. Miller, courtesy UGA Extension Jeff Davis County



39

Maintaining Soil Cover: A recent soil invader: Asian jumping worms (*Amyntas agrestis*)

Comparison: jumping worm vs. European nightcrawler



Jumping worm	European nightcrawler
Brown/gray	Pink/reddish
Bodies are sleek, dry, smooth and firm	Bodies are thick, slimy, floppy
Thrash violently when disturbed; snake-like movement	Wiggle and stretch when disturbed.
Mature worm 4-5 inches long	Mature worm 6-8 inches long
Light colored, smooth clitellum* that is flush with body, relatively close to head. Completely encircles body.	Reddish or pink clitellum* slightly raised from rest of body. Partially encircles body (like a saddle).

Great article: <https://piedmontmastergardeners.org/article/invasive-jumping-worms/>

40

Forest floor with evidence of jumping worms.

- Introduced to NA in 18th and 19th centuries.
- Consume litter faster than any other worms, destroying litter layer and OM
- Many native plants require litter layer for seeds to germinate.
- Native plants slowly disappear; invasive plants take their place.
- As the forest floor structure changes, ground nesting birds, amphibians, and invertebrates disappear disrupting food chains.

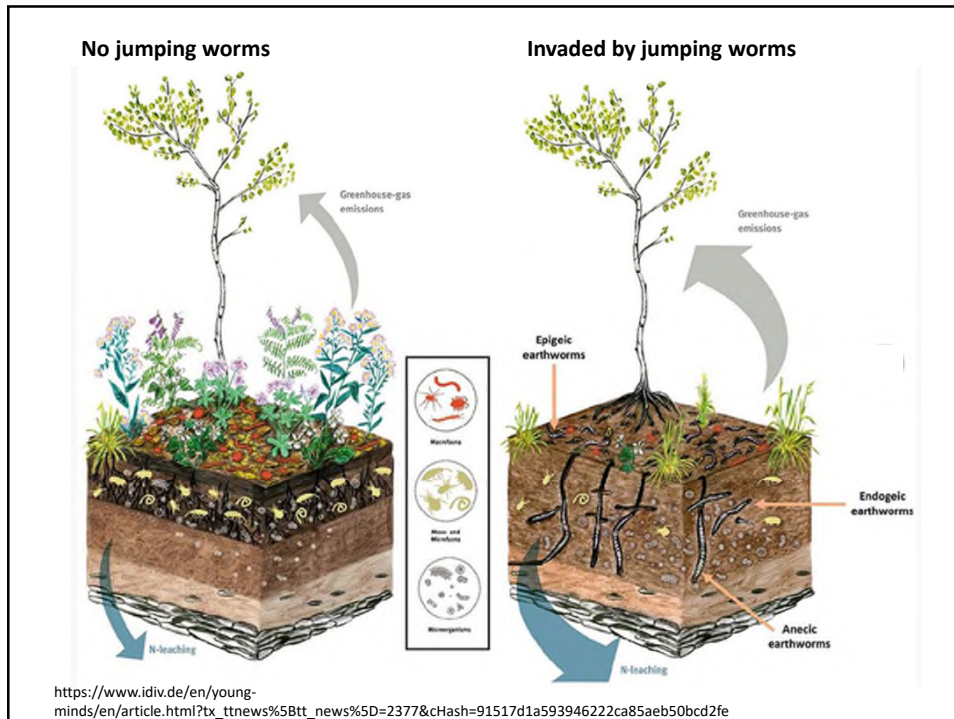


Photo from University of Vermont



Photo from John Hopkins University

41



42

How do I know if I have jumping worms on my property?

- Look for telltale granular looking soil resembling coffee grounds
- Check your property by using a mustard pour (it won't harm your plants!). Mix a gallon of water with 1/3 cup of ground yellow mustard seed and pour slowly into the soil. This will drive any worms to the surface where you can easily remove them.



Cornell Extension Fact Sheet: <https://warren.cce.cornell.edu/gardening-landscape/warren-county-master-gardener-articles/invasive-asian-jumping-earthworms>

43

What to do to if you find jumping worms on your property

Dispose of them by:

- Place them in a plastic bag; leaving in the direct sun > 10 minutes; dispose of bag in the trash
- Place them in container of soapy water deep enough they cannot climb out . Make certain all worms are dead before dumping the water and worms out.

Kill cocoons in soil by:

- Clear plastic solarization; in late spring or summer, cover moistened soil with a sheet of transparent polyethylene for two/three weeks or until the soil temperature exceeds 104°F for at least three days.



Cornell Extension Fact Sheet: <https://warren.cce.cornell.edu/gardening-landscape/warren-county-master-gardener-articles/invasive-asian-jumping-earthworms>
 Virginia Extension Fact Sheet: https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/ENTO/ENTO-427/ENTO-559.pdf

44

Prevent the spread of jumping worms

- If you have jumping worms on your property, **DO NOT** share plants.
- Share only bare rooted plants.
- Do not buy jumping worms for fish bait or vermicomposting.
- Do not dispose of unused fish bait or vermicomposting worms in the environment.
- Buy bare-root plants.
- Examine purchased potted plants carefully; look closely at the soil and under the pot for worm castings. Turn potted plant into bare-root by washing soil off roots and disposing of wash debris carefully.
- Shop with local businesses that take steps to prevent the spread of jumping worms.

<https://piedmontmastergardeners.org/article/invasive-jumping-worms/>

45

Prevent the spread of jumping worms, con't.

- Make your own compost from materials on your property.
- Buy mulch or compost from suppliers who certify their materials attain 104-130°F for a minimum of 3 days.
- Or solarize purchased mulch after delivery.
<https://ipm.ucanr.edu/PMG/PESTNOTES/pn74145.html>
- Buy mulch in bags; it's been solarized.
- Clean soil from shoes, tools, vehicles, etc. that are being moved from one area to another, especially if the area of origin has jumping worms present.

<https://piedmontmastergardeners.org/article/invasive-jumping-worms/>

46

Summary

Take these actions....

1. Add organic matter
2. Grow a diversity of plants
3. Use cover crops
4. Keep it covered; disturb less
5. Soil test every 3-4 yrs
6. Follow soil test recommendations
7. Prevent soil erosion

....to maintain and improve soil condition

1. Conserve soil nutrients
2. Increase soil organic mater
3. Increase water absorption
4. Moderate soil temperatures
5. Increase weed suppression
6. Increase plant health and productivity
7. Improve wildlife habitat
8. Improve stream water quality

47

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- Go to : www.piedmontmastergardeners.org
- Click on Community Newsletter in header to go to the current issue
- On the lower right of the page, enter your email and hit "Sign Up"
- You will receive notification each month via email with a link to the new edition
- It includes articles on science-based ornamental and vegetable gardening, seasonal garden management advice, recipes, and garden-related activities in our area
- Ability to search for previous issues for articles by topic
- It's good information and it's free!



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48

Better Yet: Become a Piedmont Master Gardener!

- Apply in the fall
- Classes one day per week from February through May
- Minimum commitment of 50 hours the first year and 20 hours per year after that, plus 8 hours of continuing education
- Variety of community education projects to meet volunteer hour commitment
- Great way to do something you enjoy while increasing knowledge and contributing positively to the community
- Meet really wonderful, dedicated people with so much to knowledge to share
- Investigate further at PiedmontMasterGardener.org
- GET INVOLVED



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49

Helpful Resources

- Virginia Coop Extension Publications: <http://ext.vt.edu>
- Land Grant University Extension Web Sites: <http://www.extension.org/search>
- Call, e-mail, or visit our Horticulture Help Desk
 - email: albemarlevcehelpdesk@gmail.com
 - telephone: (434) 872-4583
 - 460 Stagecoach Road, Charlottesville
- www.piedmontmastergardeners.org
 - Subscribe to *The Garden Shed*, our free, monthly online newsletter
 - Check for upcoming events and classes
 - Become a Master Gardener
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50