Successful and Sustainable Gardening in a Changing Climate

- Outline -

- How Climate Change works
- Plants and Climate Change
- Successful Gardening, Master Gardeners, and mitigating Climate Change

Gardening in a Changing Climate

For our gardens

For our planet

Dr. Sara Via has provided all slides on scientific evidence for climate change. Slides provided by Master Gardeners or outside sources have source at bottom of slide.

Understanding Weather vs. Climate

Sayings to help explain the difference between weather and climate:

- Weather tells you what to wear each day; climate tells you what to have in your closet.
- Climate is what you expect; weather is what you get.
- Weather is the chocolate caramel truffle, climate is the whole box of chocolates.

Confusing Climate (trend) vs. Weather (variation)

https://www.youtube.com/watch?v=e0vj0imOLw

Global Warming, 1884 – 2011

This is EVIDENCE, not opinion

Source: NASA Goddard Space Flight Center Scientific Visualization Studio

2014 was the warmest year since 1884

Source: NASA

UNTIL....
2015! and 2016 is breaking all the records

WHY??

Where is global warming going?

- Ocean 93.4%
- Atmosphere 2.3%
- Continents 2.1%
- Glaciers & ice caps 0.9%
- Arctic sea ice 0.8%
- Greenland ice sheet 0.2%
- Antarctic ice sheet 0.2%

Warmer oceans, more moisture evaporates into the air (4% more/°F)

Severe Weather

“Global warming is contributing to an increased incidence of extreme weather because the environment in which all storms form has changed”

Dr. Kevin Trenberth, June 2011
National Center for Atmospheric Research

- Warmer air
- Warmer ocean
- More water vapor in air
- Higher sea level

This is the New Normal

Hurricane Harvey

- August 17, 2017
- September 3, 2017
- 130 mph (215 km/h)
- 91 fatalities
- Damage - $198.63 billion (Costliest natural disaster ever in US)

https://en.wikipedia.org/wiki/Hurricane_Harvey
We need gardens more than ever!
- Effects of climate change clear in gardens
- People protect what they know
- Many community benefits
- Stress reduction, health
- Local food sources increase food security

The NEW NORMAL for Gardens

1. More CO₂: Is this a benefit?
2. Rising temperatures
   - warmer winters, earlier springs
   - more extremely hot days, fewer cool nights
   - increased temperature variability
3. Heavier downpours, more severe weather
4. More possibility of drought
5. Possibility of salination (Eastern Shore)

Isn’t more CO₂ good for plants?

Yes: Plants use CO₂ in photosynthesis, so more should be good. but
No: As CO₂ rises in the atmosphere,
   - temperature rises, soil moisture decreases
   - summer droughts more likely
   - photosynthesis drops b/c stomates close to prevent water loss

Net effect of increased CO₂ is negative for plants

Plants can respond positively to rising CO₂,
but biggest boost may go to weeds

Poison Ivy growth up 149% at Duke CO₂ site, & oil is more allergenic.
And high CO₂ reduces herbicide efficacy

Effects of Climate Change: Temperature

- Minimum temperature rising faster than maximum
- Fewer cold nights for required plant chilling
  - perennials, bulbs, some fruit trees (apples)

Effects on winter: New Hardiness Zones

- planting, harvest dates
- length of season
- overwinter survival

1990 USDA

Average lowest temperature reached in the 15 previous years.

2006 Arbor Day Foundation

Warmer temperature, earlier blooming

Cherries bloom 7 days earlier than 30 yrs ago

Lilacs bloom 4 days earlier than in the 1950s

Grapes bloom 6 days earlier

“False Spring” in your garden

Warm February, freeze in March or April

cover up if possible

Flowering trees may lose the year’s blooms

Effects of warmer winters

Weeds benefit the most
- better overwinter survival
- earlier flowering time

Weeds can then outcompete crops or native plants
Adapting to Increasing weed pressure
- Weed early
- Weed often
- Mulch for weeds (sustainably)
- Stop tilling

Use of Cover Crops
- Decrease weeds
- Maintain moisture
- Preserve soil microenvironment
- De-compact soil
- Provide nitrogen, decrease fertilizer, pesticide use

Use of Cover Crops
- Add nitrogen – legumes like crimson and red clover, hairy vetch, alfalfa, winter peas
- Break up compacted soil: forage radish, winter wheat, alfalfa
- Must have way to cut down cover crop growth – string trimmer

Use of Cover Crops
Gardeners can use cover crops too!

Effects of warmer winters on animals
- Deer: more browse during winter
  - healthier populations
  - higher overwinter survival
  - increase in # offspring

- White-footed mouse also benefits, so more Lyme disease

Effects of warmer winters on animals
Pest insects & disease
- better overwinter survival
- earlier appearance
- more generations/yr
- range expansion
Warmer winters: range expansions

**Hemlock wooly adelgid**


Pests appear earlier, reproduce more quickly and may differ year to year.

- Be vigilant (learn signs of damage!)
- Consider row covers
- Decide on control strategy before pests arrive

Call in the experts at Home & Garden Info Center

Mismatched timing in species interactions

Biocontrol:
Host adds a generation, parasitoid doesn’t

Effects of Climate Change:
Temperature stress in plants

Expected # days > 86 degrees F

Heat stress reduces pollination, fruit set

**Tomato Pollination and Excessive Heat**
July 12, 2012 Jerry Brust, IPM Vegetable Specialist, University of Maryland, jbrust@umd.edu

High temperatures - poor fruit set in tomatoes

Peppers drop flowers and fruit when
Day temp > 90
Nite temp > 75

Source: TAMU

Heat stress: reduced pollination, leaf scald

**Sweet Corn Pollination Problems**
July 27, 2012 Unprecedented, Weekly Crop Update
Gordon Johnson, Extension Vegetable & Fruit Specialist, gjohn@udel.edu

- Leaf Scald in Sweet Corn Again in 2012

July 12, 2012 Gordon Johnson, Extension Vegetable & Fruit Specialist, gjohn@udel.edu

-Peppers drop flowers and fruit when
Day temp > 90
Nite temp > 75

Source: TAMU

- Potatoes
Some heat-tolerant vegetables are already available

Adapting to increased temperature
- Plant earlier in spring, later in fall
- Mulch (plant material, white or reflective)
- Try heat tolerant varieties
- Build shade
- Use existing shade

Is it really hot?? Shade helps!

Adapting to temperature variation
- Low tunnel to extend the growing season
- Plastic in winter - shade cloth in summer

Adapting to temperature variation
- Low tunnel to extend the growing season
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May delay planting, wash out or contaminate fields, stunt or kill plants, increase disease, cause soil compaction.

Water - too much?
- Improve drainage
- Monitor food safety

What's a gardener to do?
Too little water
- Drought tolerant plants
- Mulch around plants
- Drip irrigation

Climate Friendly Gardening
Gardeners are part of the solution!

Climate-Friendly (Sustainable) Gardening
Reduce emissions
- Use hand tools (or electric)
- Weed smart, weed early, mulch
- Cover crops, NO bare soil

Reduce emissions:
No-till planting plus mulch
- Leaves soil structure, worms,
- Keeps decomposable carbon underground
- Bonus: keeps weed seed underground
**Climate-Friendly Gardening**

**Build up the soil!**
- Organic material holds water, yet drains
- Add compost (compost your leaves this year!)
- Plant cover crops
  - add organic material
  - can add nitrogen
  - feed soil microbes
- Control erosion

**Reduce inputs**
- Reduce chemicals, artificial fertilizer
- Increase compost
- Reduce lawn
  (42 million acres of lawn in US)

**Control erosion**
- Garden design, raingardens
- Native plants (bayscaping)

**Reduce Lawn!!**
- 42 million acres of lawn in US
- Lawns often over-fertilized
  - N washes out into water, \( \text{N}_2\text{O} \) released

*If you really want lawn….*
- Plant grasses that need little N (fescue vs. bluegrass, white clover?)
- Mow less
- Mow high for root growth, mulch clippings

*Is lawn really the most beautiful landscape??*

**Cultural controls**

**“Insectary Plants” attract beneficials**
- Provide nectar, pollen, protection from predators

*Bachelor buttons in celery, beneficials reduce aphids*

**Reduce Lawn!!**
- Is lawn really the most beautiful landscape??

This?

**Reduce Lawn!!**
- Is lawn really the most beautiful landscape??

This?
Reduce Lawn!!
This can be a gradual process

Reduce Lawn!!

Climate Friendly Landscaping
- Don’t plant invasives!
- Use pervious surfaces

Climate Friendly Landscaping
To Reduce Energy Use
- Plant evergreens north or windy side (20%)
- Deciduous trees on south side
- Shade air conditioning unit (20-40%)
- Shrubs around foundation reduce heat loss

Support Conservation Landscaping
substitute native perennials for grass in commercial and public spaces

Montgomery County
Baltimore
Master Gardener Research Project: Adapting Gardens to Climate Change

• Collaboration between Digging Deeper and Derwood Demonstration Garden
• Advice from Steve Dubik and Sara Via
• Testing of new vegetable varieties adapted to grow in warmer climates in a backyard garden situation
• Help needed
  • Preparing beds, planting, and watering
  • Measurements – size, pests, water, heat response

Contact Janet Young
janet@goldray.com

Recap – Climate Change & Master Gardener Activities

• Participate in research project to test new vegetable varieties adapted to grow in warmer climates

• Digging Deeper - exploring the science of horticulture – janet@goldray.com

• Join Sara Via’s state-wide Climate Change and Gardening Extension Team to give this talk to garden clubs - svia@umd.edu

Thank you!

Email me anytime with questions:

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Soil bacteria help plants tolerate stress

Breeding heat-tolerant varieties with viable pollen at high temperatures

Soil fungus can
- increase salt-tolerance
- reduce root infections by Fusarium

Tomatoes

Walker F et al. PNAS 2005;102:13386-13391
Climate Friendly Gardening

Use bio-mulches, not plastic

Fungus colonizes roots
- acts as a mutualist

Warm temperature, earlier blooming

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Breeding heat-tolerant vegetables

U Delaware: Breeding heat-tolerant limas

International Maize & Wheat Improvement Center
Is breeding heat-tolerant maize for Asia

Cultural controls

Trap crops
- Radish lures flea beetles from other crop (beans?)
- Collards & mustard protect cabbage
- BUT, need to destroy trap crop before pests move to cash crop