“The Future Ain’t What It Used To Be” is the title of a very popular song from 1977, with very somber lyrics. It could also be the title for the climate change scenario that we are facing today. The changes that we expected to see are here. The last decade was the hottest on record, thanks to global warming, according to experts at the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA). At the University of the District of Columbia, a land-grant university, our primary focus is on addressing the very critical questions related to urban agriculture. If you set aside the jokes about it, one thing is for sure: “Mother nature always bats last.” Her batting average is very good these days. My first personal edification and interaction with the change in climate occurred in the 90s. While running a very small, certified organic farm in Jessup, Maryland, I noticed that the early spring rains were extremely excessive. Scientists agree that the earth is getting warmer, and every year is warmer than the previous year. Also, if you are a very “in-tune” farmer, you have probably noticed that the frost-free growing season is getting a little longer. Two of the most important tools in the urban and peri-urban farmer’s arsenal are “imagination” and “the art of being flexible.” Farmers must be prepared to change crop varieties, crop planting dates, and irrigation schedules, immersing themselves more in pest and disease management, and whatever other factors may affect urban agriculture as the planet warms. Here are some of the areas of concern that growers need to look at, and suggested solutions to these concerns, to implement adaptation for successful crop production in this era of climate instability.

ENTERING THE ERA OF BIGGER AND MORE PROLIFIC WEEDS

Of the four major greenhouse gases -- CO₂ (carbon dioxide), CH₄ (methane), N₂O (nitrous oxide) and water vapor (H₂O) -- CO₂ is the one that probably affects urban growers the most. The reason is that carbon dioxide is essential to plant growth. As atmospheric CO₂ increases, plant growth is also expected to increase. In some cases, that might mean higher crop yields, but it could also mean higher weed populations. Weed ecology and weed science are related, and are very interesting courses at the university level. When I was a student some years ago, I could not wait to enroll in a weed science course. To my dismay, the course did not offer any strategies for ecological weed management. When I asked my professor about that, he rolled his eyes and said, “sorry sir—you’re in the wrong class for that,” and continued to teach the conventional, toxic cocktail, weed prevention and management methods. At that point, I realized that I had to quickly learn both methods of weed management, chemical and non-toxic!
It is now documented that urban centers usually have higher temperatures and higher CO₂ levels in the summer than suburban areas do. Perhaps some growers do not have weed problems in their plots, but I am sure many do. If you ever have an opportunity to take a short vacation from your garden plot, you will experience what happens when you are not there to perform weed management in a timely manner. How much damage can a weed cause? In some cases, you can have 100% crop loss. That is especially true for crops where the plant canopy architecture does not shade the soil from light, which causes constant germination of small weed seeds on the surface of the soil. CO₂ is plant food for your crops AND weeds! Weeds are “opportunists,” and are widely adaptable to a range of environmental conditions. And as weather becomes more irrational and extreme, as seasonal fluctuations become more evident, as temperatures rise and rain changes, weeds, with their high genetic variation and plasticity, are likely to be the ecological “winners.” Weeds are like super athletes; they are highly competitive and have an excellent work ethic, which you cannot match! Some scientists proclaim that weeds will be at a disadvantage as CO₂ reduces crop/weed competition, due to some very specific plant physiologic traits. Another frustrating factor, especially early in the season when weed control is important, is that you cannot always distinguish between the crop and the weed, because they look alike. This is especially true when you direct seed crops into the soil. Sometimes they can look the same as they emerge from the soil. Later in the growing season, after the weed has had a chance to compete for light, nutrients, or water, growers may realize that they have been nurturing an impostor in the garden. It is sometimes too late to save the crop without a huge amount of weeding. Thus, one of the best management strategies you can employ as an urban grower, is the use of summer and fall cover crops. Here are the six best and easiest ones to use in our region to help address this issue.

**COVER CROPS**

Mother nature does not like her soil to be naked, and neither should urban farmers. One of the practices I see least often in urban food plots, is the use of cover crops. That should not be the case. Cover crops can be used to mitigate and adapt to climate change. More studies are coming out on the benefits of using cover crops to address climate change. The ancient practice of cover cropping is extremely critical in the restoration of nitrogen and other nutrients back into the soil. Returning these cover crops back into the soil also puts CO₂ carbon back into the soil. That process is called “carbon sequestration,” and addresses global climate change. The use of cover crops, or “green manures,” as they were once called, is like in-the-ground composting. Those crops shade out weeds, loosen heavy soils, prevent soil compaction by heavy rain or snow, and prevent soil erosion. Cover cropping is perhaps one of the easiest and most beneficial things you can do for your soil. There are many crops to choose from, depending on your location. There are nitrogen fixing and non-nitrogen fixing cover crops. The nitrogen fixing cover crops (legumes) have the unique ability to extract nitrogen from the atmosphere and transfer it to their roots, which allows it to be used later by other plants and microbes. There are cool-season and warm-season cover crops. Cool-season cover crops are the ones you plant in the fall and don’t touch again until the following spring. Oats, cereal rye, crimson clover, and field peas are the best ones for the mid-Atlantic region. Warm-season cover crops include buckwheat, cowpeas, sorghum-sudangrass hybrids, and yellow sweet blossom clover.
Here are some growing tips which can help urban growers better address problems associated with climate change:

- Match the cover crop to the season and climate.
- Grow legumes to increase soil nitrogen levels.
- Inoculate your legume seeds (your legume seeds will need to be inoculated with beneficial bacteria, which will allow the legumes to fix nitrogen from the air). Some suppliers sell their seeds pre-inoculated, or a powdered inoculant. If you plan to inoculate them yourself, just “mist” the seeds with water, and sprinkle the powder on the seeds before you plant them.
- Cut down the cover crops into very small pieces. Two of the most valuable tools that I use to manage my cover crops are a flat-edged garden spade and a battery-operated hedge trimmer. The resultant small pieces will break down faster when incorporated back into the soil with the spade.

**INSECT ECOLOGY, PLANT DISEASES, AND CLIMATE CHANGE**

Insects are cold-blooded; thus, their behavior is related to temperature. So how will the warmer climate and more extreme temperatures affect the urban agriculturalist and crop production? Definitive answers are elusive, but there is some research that might give general guidelines for what we might expect as the urban environment warms. One of the first signs of a rapidly warming climate is the number of insect generations in season. The warmer it gets, the faster insects develop and breed.\(^3\) As winter cold can keep insects in check, warming winters may be beneficial to insect survival. Warming winters, for example, are a key factor in the survival and destructive impact of pine bark beetles throughout North America.\(^4\) Also, insects will shift their habitat northward, and there are some indications that plant characteristics can change. The effect of rising CO\(_2\) on reducing plant protein concentration can result in greater feeding rates by insects to obtain necessary protein.\(^4\)

CO\(_2\) changes could cause changes in leaf thickness, and reduce infestation of leaf-sucking insects, although not in every case. Also, CO\(_2\) could reduce the ability of the plant to produce defensive compounds that keep insects at bay. Insect and plant interactions are very complex; you would need a crystal ball to make specific predictions for specific crops. It would be equally foolish to ignore the consequences of those interactions in the era of high CO\(_2\) and the very erratic climate that we now have. Also, plant diseases will be on the rise, due to an unpredictable climate. Hot and wet conditions, which are expected in some areas, are the perfect combination for disease development in many crops. For example, mild winters and warm weather are associated with increases in potato blight and powdery mildew, leaf spot disease, leaf rust, and many soil-borne, root diseases. Is there any good news? Plants might build resistance by defensively closing their plant pores to disease-causing fungal spores. This rise in CO\(_2\) might improve plant water loss by closing some of the plant pores, which could moderate leaf moisture evaporation. I have always relied mainly on three resources for insect and disease management:

1. Rodale’s Color Handbook of Garden Insects.
3. Imagination! (This requires knowing your pest and plant diseases, intuitively.)
CLIMATE SMART CROPS

For our 2019-2020, Farmer to Farmer, National Institute of Food and Agriculture (NIFA) grant, in collaboration with Tuskegee University, we chose to look at specific varietal selections of heat-tolerant crops. We looked at leafy green and fruiting crops that were sure to produce under consistent, high summer temperatures. The specific crops that were chosen included tomatoes, sweet and hot peppers, cucumber, eggplant, green beans, lettuce, squash, mustard greens, Malabar spinach, and purslane. Some varieties of these crops have a very high heat tolerance. These are just a few—there are others on the market that can be identified by a quick, online search.

**Tomatoes:** Some tomatoes don’t set fruit after the temperature reaches the 90-degree mark, so look for “heat set” tomato varieties.

**Varieties:** Super Sweet 100, Solar Set, Surefire, Oregon Spring, and Oregon Star

**Peppers:** Many sweet bell peppers don’t have a “heat set” gene; hot peppers, on the other hand, are still genetically close to their wild pepper heritage of the tropics.

**Varieties:** Cubanelle, Gypsy, Gator, Vidi, and Sweet Banana

**Corn:** Corn is thought of as a traditional, tasty, summer treat that is perfect to grow in the mid-summer heat, but some varieties of corn do not pollinate well when temperatures surpass the mid-90’s, especially in hot, dry areas. The pollen dries out, and you end up with poorly filled ears of corn. A lot of watering will help, but it will not solve the problem.

**Varieties:** Lancelot and Breeders Choice

**Cucumbers and Melons:** What happens to cucumbers and melons during a very hot and humid summer? The plant produces some fruit, but the heat and long days cause the plants to form too many male flowers, which do not produce fruit. Look for heat-tolerant and disease-resistant varieties.

**Varieties:** Marketmore 86 cucumber, Salad Bush cucumber, Planters Jumbo melon, and Ambrosia melon

**Leafy Greens:** There are a few nutritious, leafy greens that can be grown in the high-heat days of summer, but many varieties of lettuce do not thrive under high temperatures and long, sunny days. “Bolting” occurs when lettuce flowers prematurely. That condition is caused mainly by the long, sunlit days of summer, rather than high temperatures. A little shading of the lettuce helps to remedy that bitter situation. There are a few slow-bolt lettuce varieties on the market. Swiss Chard will grow well in hot or cool weather. Many Asian mustard greens also do very well under high temperatures. New Zealand Spinach, which is not related to traditional spinach, is an excellent summer green to grow. It is an acquired taste, which many gardeners have grown accustomed to. I recommend it, due to its high amount of omega-3 fatty acids. Amaranth is the mighty plant that grows like a weed (it is a relative of pigweed, and not to be confused with the Amaranth grain). This plant’s leaves are consumed throughout the tropics. In Jamaica, Amaranth is used to make a dish called “Callaloo.” The hotter the temperature, the more this plant grows!
Other “climate smart” crops include:

- **Green Beans** (Varieties: Romano and McCaslan)
- **Lima Beans** (Varieties: Sieva, Florida Butter)
- **Okra** (Almost any variety)
- **Melons** (Planters Jumbo Melon, Edisto 47)
- **Eggplant** (Thai Long Green)
- **Sweet Potato** (Beauregard, Vardaman)

**REFERENCES**


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