

GenX and PFAS Uptake by Food Plants



Yuanbo Li, Yue Zhi, Stephen W. Broome, Detlef Knappe, and Owen W. Duckworth

Department of Crop and Soil Sciences
Department of Civil, Construction, and Environmental Engineering
North Carolina State University

PFAS — Emerging Persistent Contaminants

❖ Per-and polyfluoroalkyl substances (PFAS):

Family of more than 3000 chemicals.

Manufactured and used since 1940s.

❖ Fluorinated chemicals that repel both oil and water.

❖ **Good:** used to make many household and industrial products

❖ **Bad:** persistent, bioaccumulative, and toxic (maybe at ppt concentrations)



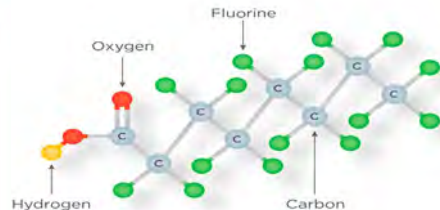
Nonstick
Cookware



Water-Repellant
Clothing

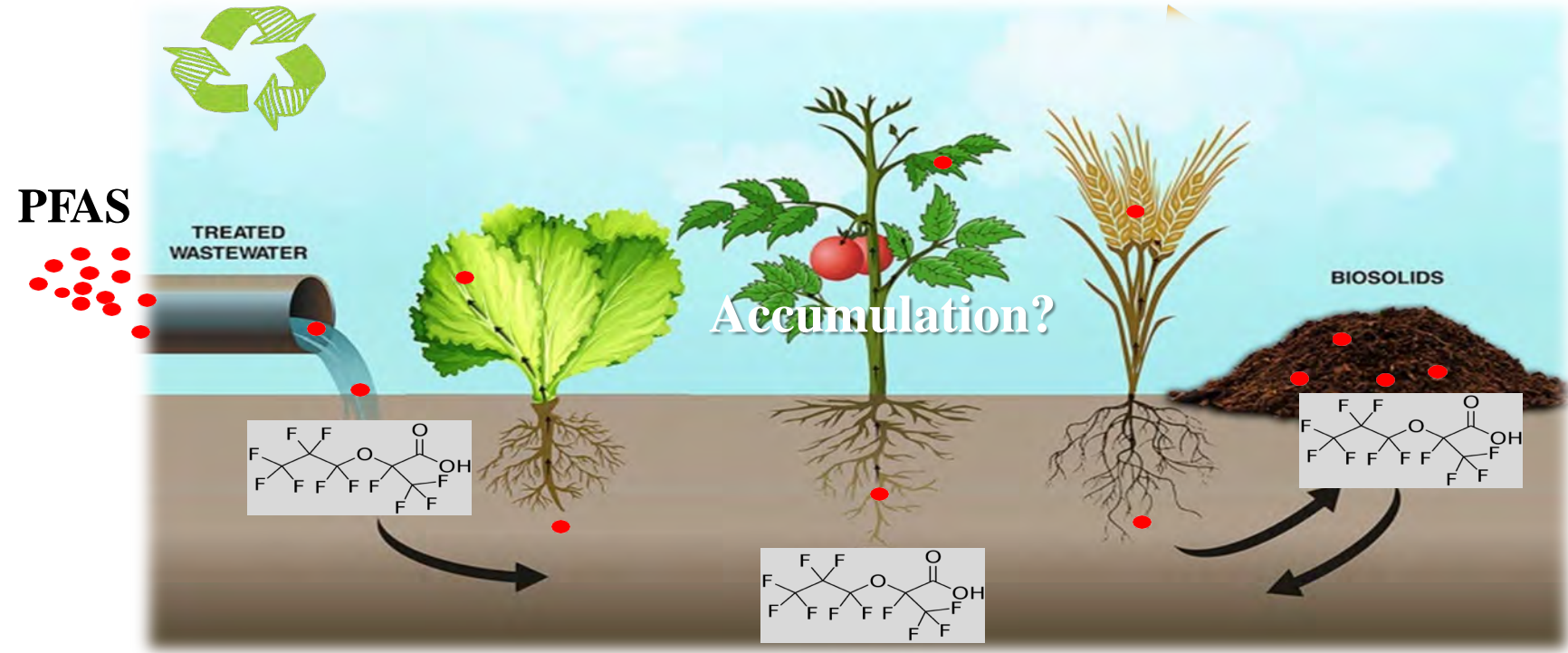


Firefighting
Foams



Perfluorooctanoic acid (PFOA)

Potential food crops uptake and human exposure

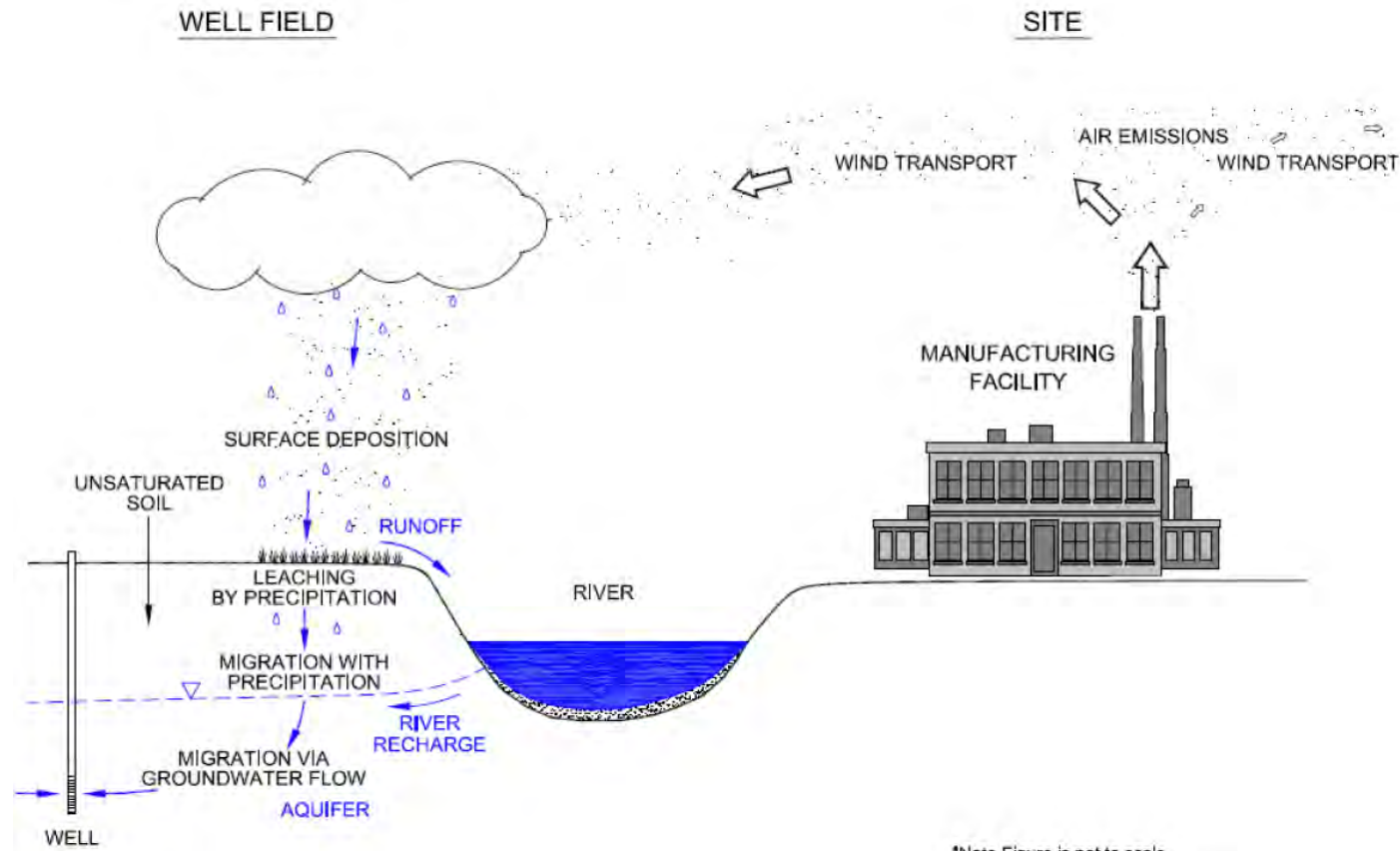


Plant uptake is an **important process** to transport PFAS to food chain.

Chemours and History of PFAS in NC

- Plant located in Fayetteville near the Cape Fear River (which supplies drinking water to over 1 million residents)
- History of discharging PFAS-contaminated waste into the river, as well as releasing air emissions from the plant
- Associated (most) with fluoroethers (a sub-class of PFAS, like GenX)
 - Phased-out production of PFOS and PFOA (C8 compounds) starting in mid-late 2000's

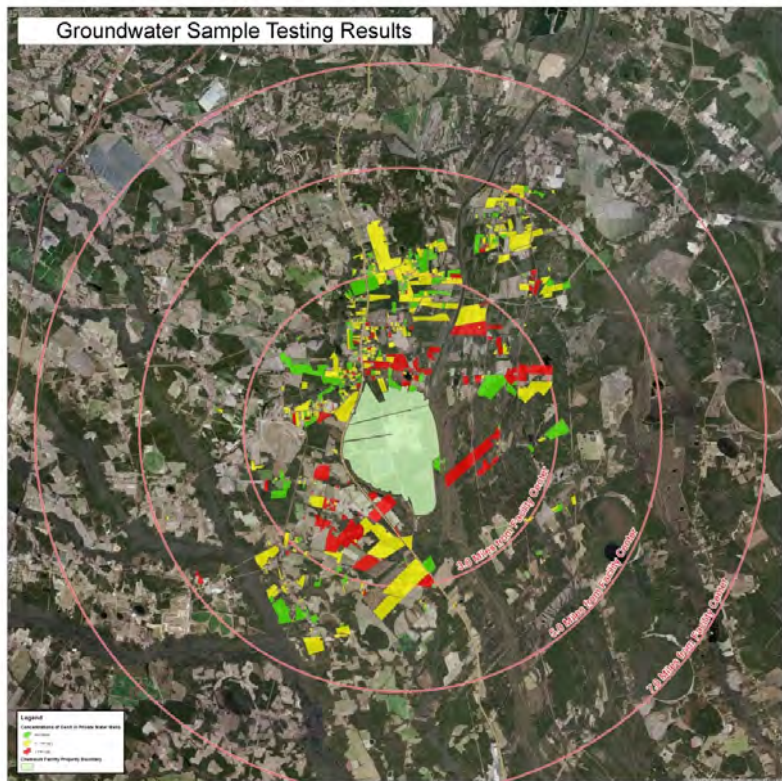




*Note Figure is not to scale

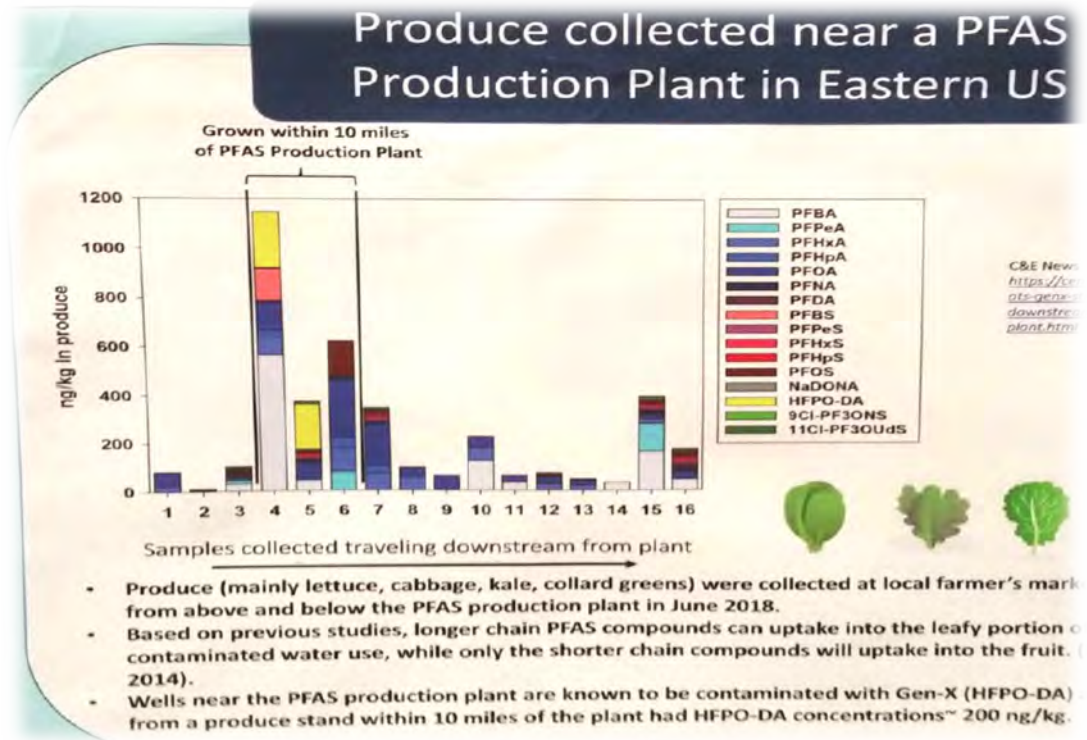
Crops uptake and accumulation of PFAS

Groundwater Sample Testing Results



Groundwater Map:
NC Dept. of Environmental Quality

Produce collected near a PFAS Production Plant in Eastern US



Genualdi, deJager, Begley, FDA (2019)

Greenhouse experiment

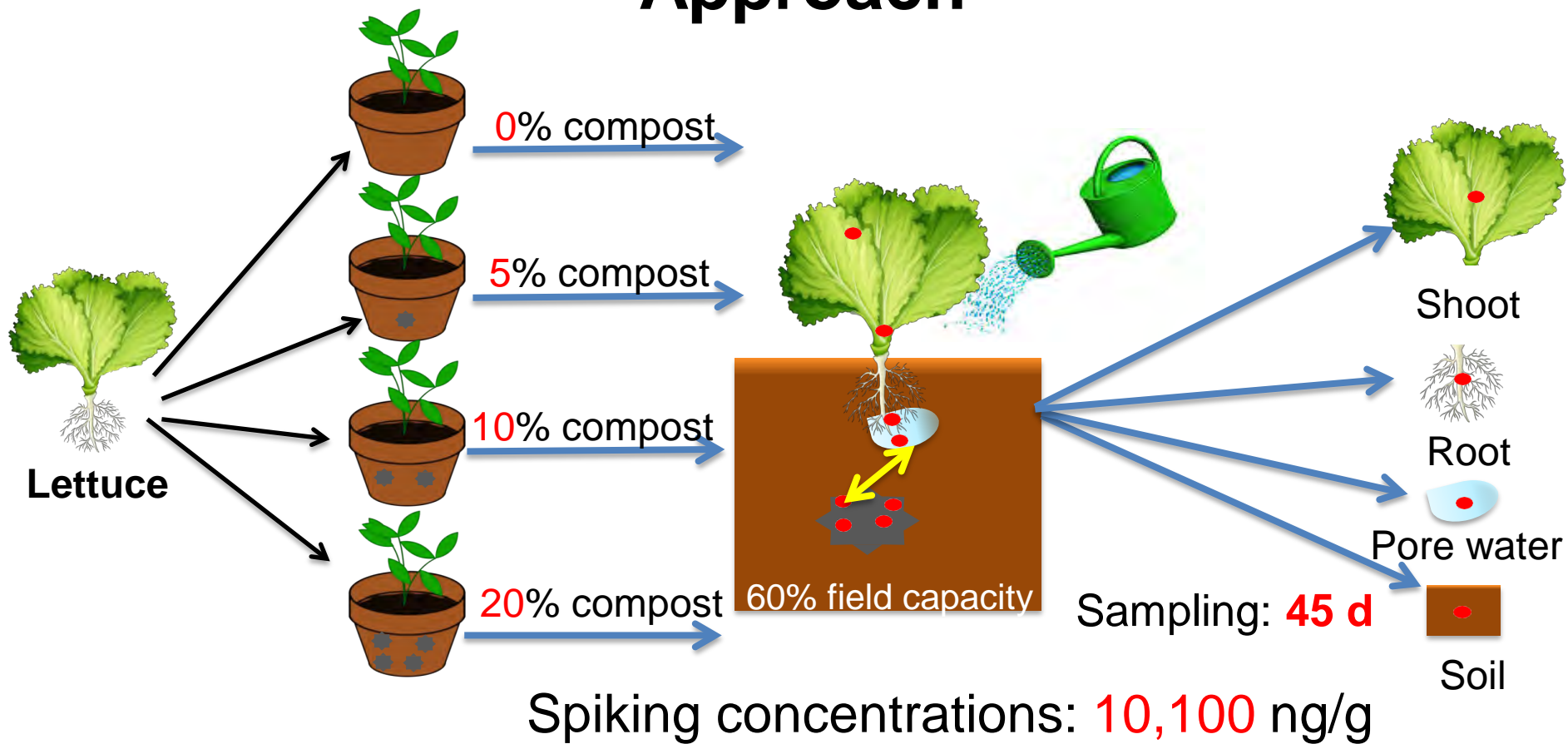
| Compound | CAS | supplier |
|--------------|-------------|----------|
| PFMOAA | 21837-98-9 | fluoryx |
| HFPO-DA/GenX | 13252-13-6 | Synquest |
| PFBS | 375-73-5 | Synquest |
| PFHxS | 355-46-4 | Synquest |
| PFOS | 1763-23-1 | Synquest |
| 6:2 FtS | 27619-97-2 | fluoryx |
| 4:2 FtS | 757124-72-4 | Synquest |
| 8:2 FtS | 39108-34-4 | Synquest |

Organic compost was made from wheat straw and cow manure

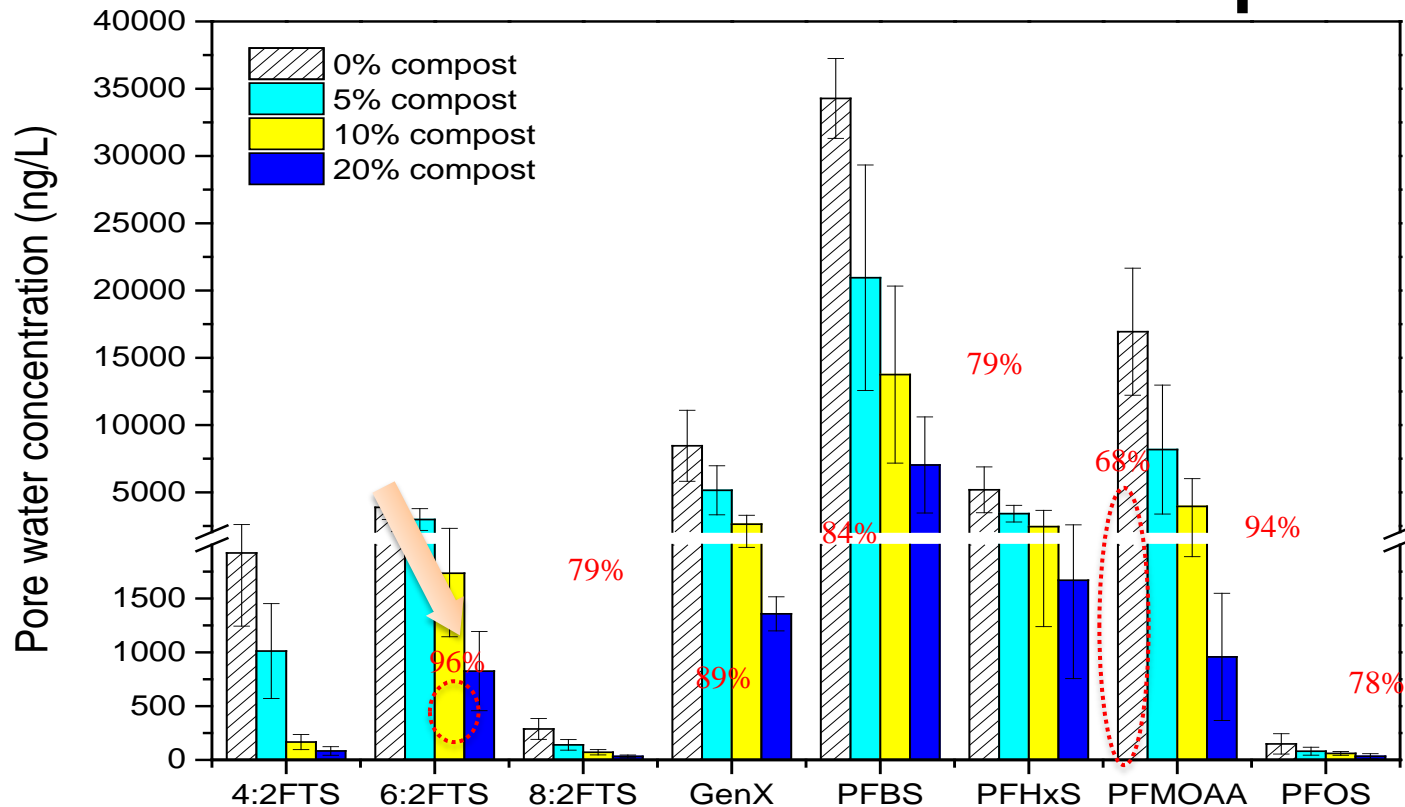


Lettuce

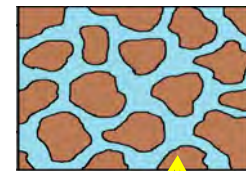
Approach



PFAS concentration in soil pore water

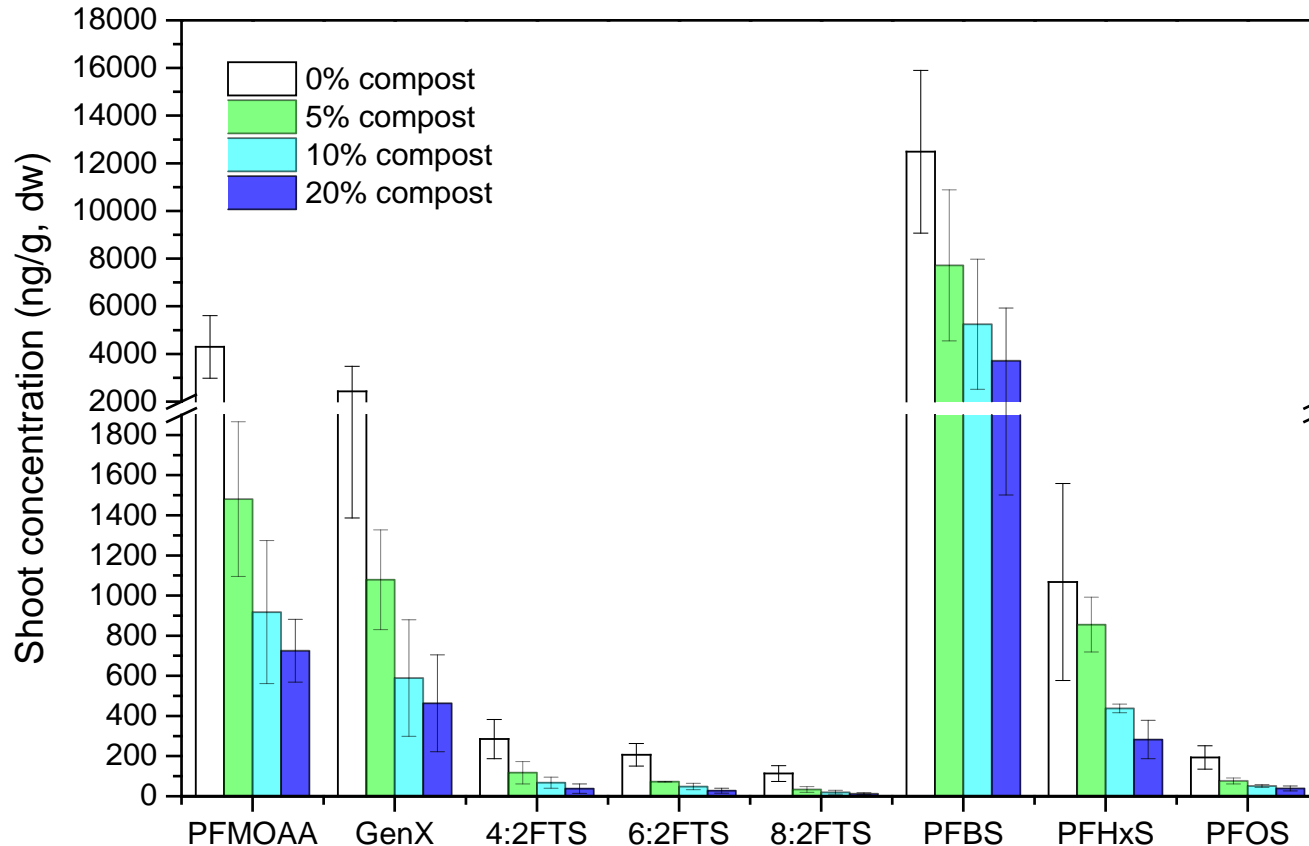


Soil pore water



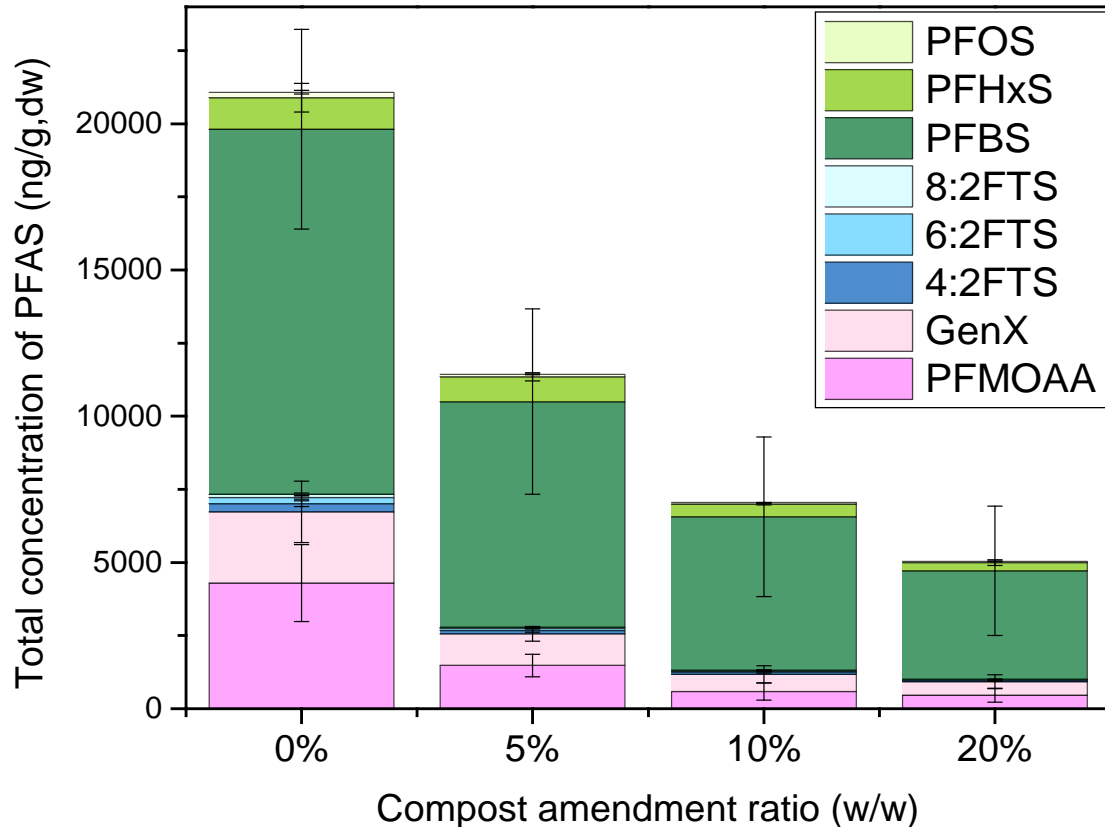
Increasing compost content decreases the soluble PFAS concentrations in soil by 68-96%.

PFAS concentration in lettuce shoots



**All PFAS studied
are found in
lettuce leaves;
compost lowers
the concentration
in lettuce leaves**

PFAS concentration in lettuce shoots



Short chain sulfonic and fluoroethers (like GenX) are transported into leaves more than legacy PFAS like PFOS and PFHxS

Conclusions

- All PFAS studied are found in lettuce leaves
- Compost lowers the concentration in porewater and leaves
- Fluoroethers (like GenX) are transported more efficiently than legacy PFAS
- More work is need to understand the behavior of other types of food plants and to assess the importance of food vs. water for PFAS exposure

Acknowledgements

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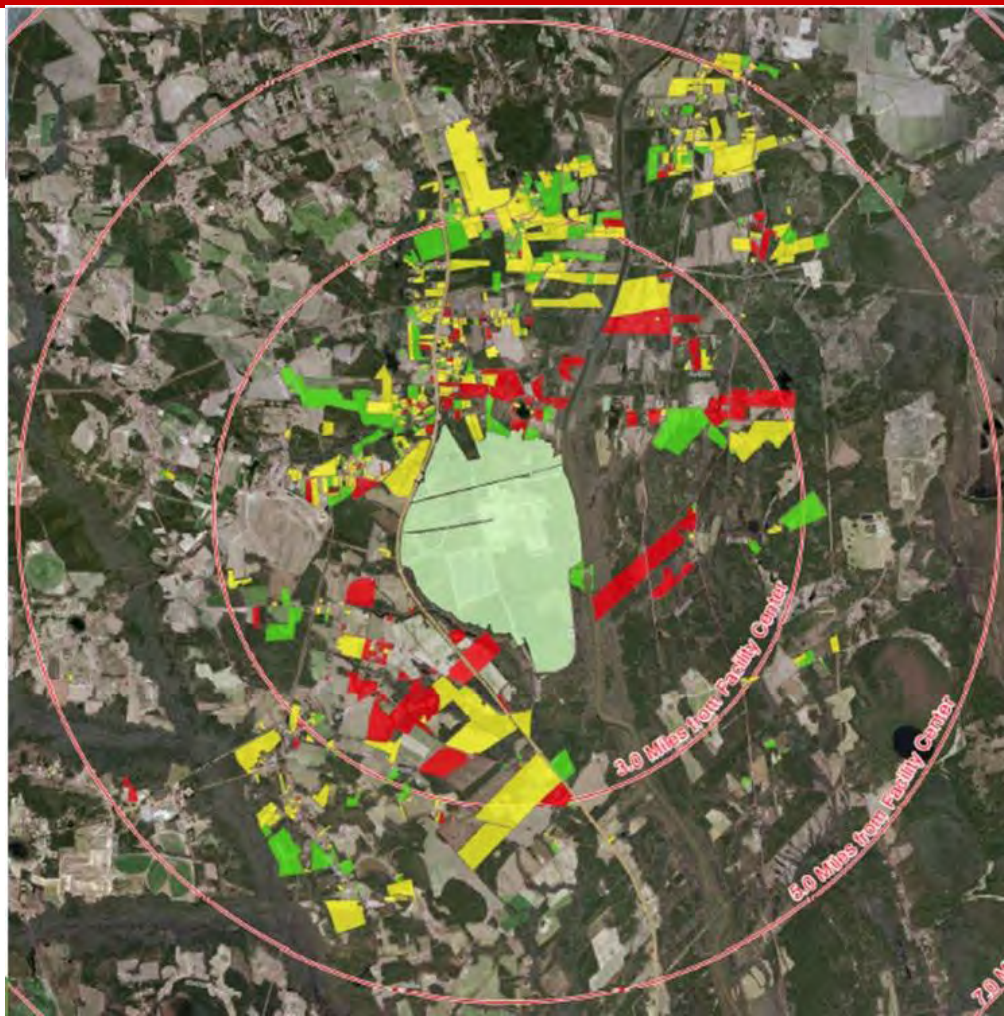
Next Steps: Digging Deeper

- Surveying real food products
- Understanding fundamental soil chemistry



Is it safe to eat the food I grow in my garden?

Currently, there is no recommendation against eating local produce. DEQ and DHHS are continuing to review the scientific literature related to plant uptake of GenX and other chemicals in the same family (per- and polyfluoroalkyl substances, or “PFAS”). Studies have shown that some other chemicals in the PFAS family can be found in variable amounts in plants and vegetables, but the amount depends on the particular chemical and the plant type. Direct testing of garden produce for GenX has not been conducted by NC DEQ, and to our knowledge results of such testing are not available from other sources at this time. A study conducted by the Minnesota Department of Health found that the amount of exposure to five other PFAS compounds from plants and vegetable sources was much lower than the amount of exposure through drinking water, and concluded that the benefits of growing and eating homegrown produce outweighed the potential risk from low levels of PFAS (<https://deq.nc.gov/news/key-issues/genx-investigation>)



Collection of produce from local residents

| | |
|-------------|----------------|
| Water | Apples |
| Soil | Blackberries |
| Blueberries | Pears |
| Corn | Peas |
| Okra | Turnips |
| Pecans | Sweet potatoes |
| Potatoes | Figs |
| Squash | Eggs |
| Peaches | Cucumbers |
| Tomatoes | Lettuce |
| Grapes | Radish |
| Field Beans | Celery |
| Green Beans | Pickles |

Sample extraction and analysis

Pore water:



Soil and lettuce plant:

