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FILE: ▪ Weeds
▪ Climate Change

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RE: How Weeds Adapt to Climate Change and May Help Solve Global Warming

Christopher T. Can weeds help solve the climate crisis? *The New York Times Magazine*. June 29, 2008:42-47.

Weeds reduce farm profits (in the US by about 12%, an annual loss of $33 billion). Weeds are variously defined as plants "out of place," or, according to Ralph Waldo Emerson, plants "whose virtues have not yet been discovered." Humans have waged war against weeds, pulling, hoeing, burning, and using chemical herbicides on them (costing farmers worldwide over $10 billion annually). Some weeds were once important food plants such as rice (*Oryza sativa*) and wild oats (*Avena fatua*). In general, weeds have become "astonishingly plastic," flourishing despite, and even because of, human intervention. While genetic diversity has been deliberately bred out of food crops, weeds must maintain diversity to survive. Scientists are learning that weeds adapt to rising atmospheric carbon dioxide (CO^2) levels with the same enthusiasm with which they meet other challenges.

In growth chambers with atmospheres corresponding to those of past years (reconstructed with data from ancient ice cores) and in the environs of Baltimore, where city, suburb, and rural areas have varying CO^2 levels and temperatures, higher CO^2 and heat produced more weed growth and more pollen. Canada thistle (*Cirsium arvense*) and quack grass (*Elytrigia repens*) are more resistant to herbicides if grown in higher CO^2, perhaps because they mature sooner and are then less susceptible. Higher CO^2 alters plants' chemical make-up. Ragweed (*Ambrosia artemisiifolia*), at 600 p.p.m. CO^2 (the level predicted by the year 3000 in one climate change scenario) produced twice as much pollen as in 1998 conditions, with more of the protein that causes allergic reactions. Western poison ivy (*Toxicodendron rydbergii*) produced more virulent urushiol, its rash-inducing component, at high CO^2. US Department of Agriculture (USDA) plant physiologist James Bunce, studying effects of high CO^2 on dandelion (*Taraxacum officinale*), found that populations evolved in one growing season, changing physically to take advantage of this "resource enhancement."

Rising CO^2 may have already altered Western states' ecology. Cheatgrass (*Bromus tectorum*), accidentally introduced in the mid-1800s, has taken over 100 million acres of rangeland, crowding out nutritionally superior native grasses and reducing the land's value to cattle and wildlife. Cheatgrass prefers dry climates, is very prolific, and burns easily. Native rangeland burns every 60-100 years. Cheatgrass burns every three to five years, tolerating repeated destruction which native grasses cannot survive. Combustibility is inherent in its lifecycle. In 1990s CO^2 levels, compared to those of the 19^{th} century, cheatgrass produced 70% more biomass that was much more carbon-rich, making dry leaves less susceptible to decay, and richer as fuel. At projected 2020 CO^2 levels, it will produce an 18% biomass increase.

USDA ecologist Lewis Ziska has grown weed plots in Baltimore. The weed plot produced the results of higher heat, CO^2 speeded, and the succession of species altered. These results included succession of trees nearly complete in five years, compared to decades in previously observed successions. There was also a preference for invading weed trees, such as ailanthus (*Ailanthus altissima*), Norway maple (*Acer platanoides*) and mulberries (*Morus* spp.). After five years, the largest ailanthus in the rural plot was five feet tall. However, the hotter, CO^2-rich city plot had one tree topping 20 feet.

Invasive plants, long thought to cause environmental degradation, are being seen as opportunists in disturbed habitats. In an oak savannah on Vancouver Island, Canada, removing invading weeds did not revive native species; in some cases, they further declined. Biologist Andrew MacDougall (University of Guelph, Ont.), says invaders play a stabilizing role in the savannah, while the culprit in species decline was suppression of fires after European settlement. Similarly, he says, crested wheatgrass (*Agropyron cristatum*), an invader, has an advantage on Saskatchewan prairies due to global warming. It wakes from winter dormancy sooner than native species thus gets a head start in an early, warm spring.

Andrew McDonald, an agricultural scientist at Cornell University, says global warming will alter weeds' ranges as well. Kentucky, in one to three decades, will have a climate and flora resembling today's North Carolina. But, by the end of the century, it will be more like present-day Louisiana, while Florida's climate and floristic changes will be "unprecedented in this country."

With challenges come opportunities. Kudzu (*Pueraria montana* var. *lobata*), bane of the South, could be harvested as a prolific source of biofuel – or it could invade Michigan's Upper Peninsula by 2015. Wild ancestors of current foods will be tried as sources of new crops if current ones fail due to climate change. In an aside, Ziska says the real leaders in understanding effects of CO^2 on plants are illegal marijuana (*Cannabis sativa*) growers, "who don't publish in scientific journals." Such expertise, if legalized, could help protect our harvests and be a valuable intellectual export.

— *Mariann Garner-Wizard*

The American Botanical Council has chosen not to reprint the original article.