Barbara Kingsolver on Genetic Engineering

A Fist in the Eye of God

From her new book “Small Wonders”

http://www.organicconsumers.org/gefood/SmallWonders.cfm

Page 97: At the root of everything, Darwin said, is that wonder of wonders, genetic diversity. You're unlike your sister, a litter of pups is its own small Rainbow Coalition, and every grain of wheat in a field holds inside its germ a slightly separate destiny. You can't see the differences until you cast the seeds on the ground and grow them out, but sure enough, some will grow into taller plants and some shorter, some tougher, some sweeter. In a good year all or most of them will thrive and give you wheat. But in a bad year a spate of high winds may take down the tallest stalks and leave standing at harvest time only, say, the 10 percent of the crop that had a "shortness" gene. And if that wheat comprises your winter's supply of bread, plus the only seed you'll have for next year's crop, then you'll be almighty glad to have that small, short harvest. Genetic diversity, in domestic populations as well as wild ones, is nature's sole insurance policy. Environments change: Wet years are followed by droughts, lakes dry up, volcanoes rumble, ice ages dawn. It's a big, bad world out there for a little strand of DNA. But a population will persist over time if, deep within the scattered genetics of its ranks, it is literally prepared for anything. When the windy years persist for a decade, the wheat population will be overtaken by a preponderance of shortness, but if the crop maintains its diversity, there will always be recessive aspirations for height hiding in there somewhere, waiting to have their day.

How is the diversity maintained? That old black magic called sex. Every seed has two parents. Plants throw their sex to the wind, to a hummingbird's tongue, to the knees of a bee - in April you are inhaling sex, and sneezing - and in the process, each two parents put their scrambled genes into offspring that represent whole new genetic combinations never before seen on Earth. Every new outfit will be ready for something, and together - in a

large enough population - the whole crowd will be ready for anything. Individuals will die, not at random but because of some fatal misfit between what an organism has and what's required. But the population will live on, moving always in the direction of fitness (however "fitness" is at the moment defined), not because anyone has a master plan but simply because survival carries fitness forward, and death doesn't….

Page 99: Nikolai Vavilov was an astounding man of science, and probably the greatest plant explorer who has ever lived. He spoke seven languages and could recite books by Pushkin from memory. In his travels through sixty-four countries between 1916 and 1940, he saw more crop diversity than anyone had known existed, and founded the world's largest seed collection.

As he combed continents looking for primitive crop varieties, Vavilov noticed a pattern: Genetic variation was not evenly distributed. In a small region of Ethiopia he found hundreds of kinds of ancient wheat known only to that place. A single New World plateau is astonishingly rich in corn varieties, while another one is rolling in different kinds of potatoes. Vavilov mapped the distribution of what he found and theorized that the degree of diversity of a crop indicated how long it had been grown in a given region, as farmers saved their seeds through hundreds and thousands of seasons. They also saved more types of seed for different benefits thus popcorn, tortilla corn, roasting corn, and varieties of corn with particular colors and textures were all derived, over centuries, from one original strain. Within each crop type, the generations of selection would also yield a breadth of resistance to all types of pest and weather problems encountered through the years. By looking through his lens of genetics, Vavilov began to pinpoint the places in the world where human agriculture had originated. More modern genetic research has largely borne out his hypothesis that agriculture emerged independently in the places where the most diverse and ancient crop types, known as land races, are to be found: in the Near East, northern China, Mesoamerica, and Ethiopia.

The industrialized world depends entirely on crops and cultivation practices imported from what we now call the Third World (though evidently it was actually First). In an important departure from older traditions, the crops we now grow in the United States are extremely uniform genetically, due to the fact that our agriculture is controlled primarily by a few large agricultural corporations that sell relatively few varieties of seeds. Those who know the seed business are well aware that our shallow gene bank is highly vulnerable when a crop strain succumbs all at once to a new disease, all across the country (as happened with our corn in 1970), researchers must return to the more diverse original strains for help. So we still rely on the gigantic insurance policy provided by the genetic variability in the land races, which continue to be hand-sown and harvested, year in and year out, by farmers in those mostly poor places from which our crops arose.

Unbelievably, we are now engaged in a serious effort to cancel that insurance policy.

It happens like this. Let's say you are an Ethiopian farmer growing a land race of wheat - a wildly variable, husky mongrel crop that has been in your family for hundreds of years. You always lose some to wind and weather, but the rest still comes through every year. Lately, though, you've been hearing about a kind of Magic Wheat that grows six times bigger than your crop, is easier to harvest, and contains vitamins that aren't found in ordinary wheat. And amazingly enough, by special arrangement with the government, it's free.

Readers who have even the slightest acquaintance with fairy tales will already know there is trouble ahead in this story. The Magic Wheat grows well the first year, but its rapid, overly green growth attracts a startling number of pests. You see insects on this crop that never ate wheat before, in the whole of your family's history. You watch, you worry. You realize that you're going to have to spray a pesticide to get this crop through to harvest. You're not so surprised to learn that by special arrangement with the government, the same company that gave you the seed for free can sell

you the pesticide you need. It's a good pesticide, they use it all the time in America, but it costs money you don't have, so you'll have to borrow against next year's crop.

Page 101: The second year, you will be visited by a terrible drought, and your crop will not survive to harvest at all every stalk dies. Magic wheat from America doesn't know beans about Ethiopian drought. The end.

Actually, if the drought arrived in year two and the end came that quickly, in this real-life fairy tale you'd be very lucky, because chances are good you'd still have some of your family-line seed around. It would be much more disastrous if the drought waited until the eighth or ninth year to wipe you out, for then you'd have no wheat left at all, Magic or otherwise. Seed banks, even if they're eleven thousand years old, can't survive for more than a few years on the shelf. If they aren't grown out as crops year after year, they die - or else get ground into flour and baked and eaten - and then this product of a thousand hands and careful selection is just gone, once and for all.

This is no joke. The infamous potato famine or Southern Corn Leaf Blight catastrophe could happen again any day now, in any place where people are once again foolish enough, or poor enough to be coerced (as was the case in Ireland), to plant an entire country in a single genetic strain of a food crop.

While agricultural companies have purchased, stored, and patented certain genetic materials from old crops, they cannot engineer a crop, ever, that will have the resilience of land races under a wide variety of conditions of moisture, predation, and temperature. Genetic engineering is the antithesis of variability because it removes the wild card - that beautiful thing called sex - from the equation.

This is our new magic bullet: We can move single genes around in a genome to render a specific trait that nature can't put there, such as ultra rapid

growth or vitamin A in rice. Literally, we could put a wolf in sheep's clothing. But solving agricultural problems this way turns out to be far less broadly effective than the old-fashioned multigenic solutions derived through programs of selection and breeding. Crop predators evolve in quick and mysterious ways, while gene splicing tries one simple tack after another, approaching its goal the way Wile E. Coyote tries out each new gizmo from Acme only once, whereupon the roadrunner outwits it and Wile E. goes crestfallen back to the drawing board.

Wendell Berry, with his reliable wit, wrote that genetic manipulation in general and cloning in particular: "...besides being a new method of sheep-stealing, is only a pathetic attempt to make sheep predictable. But this is an affront to reality. As any shepherd would know, the scientist who thinks he has made sheep predictable has only made himself eligible to be outsmarted."….

To choose one example among many, genetic engineers have spliced a bacterium into a corn plant. It was arguably a good idea. The bacterium was Bacillus thuringensis, a germ that causes caterpillars' stomachs to explode. It doesn't harm humans, birds, or even ladybugs or bees, so it's one of the most useful pesticides we've ever discovered. Organic farmers have worked for years to expedite the path of the naturally occurring "Bt" spores from the soil, where the bacterium lives, onto their plants. You can buy this germ in a can at the nursery and shake it onto your tomato plants, where it makes caterpillars croak before sliding back into the soil it came from. Farmers have always used nature to their own ends, employing relatively slow methods circumscribed by the context of natural laws. But genetic engineering took a giant step and spliced part of the bacterium's DNA into a corn plant's DNA chain, so that as the corn grew, each of its cells would contain the bacterial function of caterpillar killing. When it produced pollen, each grain would have a secret weapon against the corn worms that like to crawl down the silks to ravage the crop. So far, so good.

But when the so-called Bt corn sheds its pollen and casts it to the wind, as corn has always done (it's pollinated by wind, not by bees), it dusts a fine layer of Bt pollen onto every tree and bush in the neighborhood of every farm that grows it - which is rapidly, for this popular crop, becoming the territory known as the United States. There it may explode the stomach of any butterfly larva in its path. The populations of monarch butterflies, those bold little pilgrims who migrate all the way to Mexico and back on wings the consistency of pastry crust, are plummeting fast. While there are many reasons for this (for example, their winter forests in Mexico are being burned), no reasonable person can argue that dusting them with a stomach explosive is going to help matters. So, too, go other butterflies more obscure, and more endangered. And if that doesn't happen to break your heart, just wait awhile, because something that pollinates your food and builds the soil underneath it may also be slated for extinction. And there's another practical problem: The massive exposure to Bt, now contained in every cell of this corn, is killing off all crop predators except those few that have mutated a resistance to this long useful pesticide. As a result, those super resistant mutants are taking over in exactly the same way that overexposure to antibiotics is facilitating the evolution of antibiotic-resistant diseases in humans.

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