



Bugs for Breakfast

by Lee Allen

To a bug, your garden is a smorgasbord. So, why not even up the score by chowing down on the very critters trying to eat your veggies? Sure, the concept has a “yuck” factor to Westerners, but Dr. Goggy Davidowitz says we’ll have to get over it, as the benefits of eating bugs outweighs the downsides.



Google the word “Goggy” and you’ll get redirected to the word “geek.” However, Dr. Goggy Davidowitz doesn’t mind, as “geek” can be defined as a technically oriented person (albeit with an implied nerdy personality) who likes to tinker with scientific projects. So, with a name like his, it was almost inevitable that Davidowitz would end up in a career like the one in which he now excels. He is a professor in the entomology/ecology/evolutionary biology department at the University of Arizona. His companions are frequently insects because, as he notes in his biography, “I’m an unconventional kind of guy, from my departmental affiliations to my first name. But to paraphrase a line from

Hamlet, there is purpose in this (apparent) madness.”

When speaking to an audience of those interested in the subject of larval meanderings, he noted: “Plant growers have an on-going battle with their number one enemy: insect herbivores. And left to their own devices, these always-hungry insects have the ability to make short work of field crops.” Davidowitz uses multiple, diverse, and interdisciplinary tools to study the predatory and often symbiotic relationships between plants and insects. “For me, herbivores and other insects constitute case studies in evolutionary physiology focusing on their environment, the effects of plant cultivation for crop production, and how the latter can affect insect survival.”

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In that same lecture, after discussing the life cycle and mating habits of garden critters like the tomato caterpillar (referred to scientifically as *Manduca sexta* or colloquially as the tobacco hornworm), he suggested we humans turn the tide on the insects. Instead of the bug world eating plant food designed ultimately for human consumption, why don't people even up the score by eating the bugs that try to eat their veggies?

"Might as well get used to the idea, as eating insects will become a part of our future," Davidowitz predicts.

"The yuck factor is an issue in the Western world—Europe and the US—but regardless of public opinion, it won't make a big difference how we feel about it in 20-30 years; we won't have a choice," he told a Covering Environments seminar at the University of Arizona's College of Agriculture and Life Sciences. "If you think about it, a couple of decades ago, the mere idea of eating raw fish was disgusting to consumers in the US, but look at the number of sushi restaurants there are today."

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"As the 10 PBQ problem looms large—that existential issue of having to feed a burgeoning population of 10 billion people—it requires that we produce twice as much food as we currently do, an impossible task under current methods. Improving plant growing conditions for higher yields will help, as will finding novel crop plants that are better able to withstand environmentally changing conditions and hybridizing crop plants to resist weather and pest damage. But whatever we do, it won't be enough," Davidowitz says. Hence why he suggests turning the table on herbivorous insects eating our lunch and converting the destructive insects themselves into people food.

An estimated two billion people habitually consume insects as part of their diet. In the Congo, caterpillars can be purchased in Kinshasa marketplaces. In Asia, you'll find lots of insect items prepared in a variety of ways. Beetles and caterpillars remain popular food items, along with crickets, locusts, cicadas, and flies.

"Inhabitants in more than 175 countries are already consuming some of the 1,600 species of insects, 95 per cent of which are currently harvested from the wild," he says. "In sub-Saharan Africa, worms rank at the top of the edibles list, while Europeans are already evolving into insect epicureans. In Switzerland, you can chow down on bug burgers."

Industry growth is already taking shape. "As of July 31, 2017, there were 298 start-up businesses around the world that are already growing insects as food," Davidowitz says. "That's about an \$8 million-a-year industry in the US alone. Worldwide, it's a heck of a lot more, and it's growing exponentially."

Three species predominate that market at the moment: black soldier flies (used as feed), crickets, and meal worms.

"The reason crickets and meal worms appear OK is they're low-hanging fruit. The pet industry has been growing them for ages to feed birds and lizards, so the protocol to make this work is well-known."

Davidowitz is taking a different approach—five different approaches, in fact. Five different approaches, different habitats, involving 12 different insect species, not one of which is currently being studied. "All our insects are found locally in southern Arizona, like fig beetles, ox beetles, rhinoceros beetles, and the aforementioned *Manduca sexta*."



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The tomato hornworm plays into the Goggy Master Plan as one of his five approaches to food production. An estimated 40 per cent of all food produced worldwide, especially in the US, goes into the dump. Salvaging it for another purpose—i.e., countering that inefficiency—results in better food utilization results.

Two collaborations are with the University of Arizona's Controlled Environment Agriculture Center (CEAC). One involves research on those protein powerhouses, mushrooms, frequently grown in compost mixtures involving straw and landscape clippings and food waste. In this case, they are also being grown in wood chips, a new methodology for a new reason.

"We're growing beetle grubs and they eat compost and decomposing wood as part of their diet. So, we involve two waste streams. The mushroom growers produce one edible product, then I take their after-harvest growth medium waste, mix it with some garden compost, and feed it to beetle grubs, producing a second source of protein. What's left over from the frass, or beetle food, we send back into a new compost pile."





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It appears to be working well. “We started in July with a handful of beetles and four months later, we have something on the order of 12,000 of them.”

A second collaboration involves hydroponics; specifically, the pruned leaves off tomatoes grown hydroponically in CEAC greenhouses. The leaf waste stream is turned into a larva lunch for the *Manduca sexta*, which means “glutton” in Latin.

And what pigs they are. “It’s amazing how much they eat. I can grow tobacco hornworms in my lab by the bazillions and they can completely defoliate a hot house full of tomato plant leaves in a matter of hours. In a pilot study last year, we estimated we’d be able to rear about 22,000 caterpillars from the pruned tomato leaf waste stream from one greenhouse alone. Imagine what kind of an insect farm production line we could have with a whole bunch of greenhouses.”

Other experiments under his purview involve one of the most popular food insects of sub-Saharan peoples: caterpillars of the emperor moth that live in a mopane tree. Harvested wild in Africa where the trees need to be climbed and caterpillars captured by hand to have their innards expurgated, his researchers don’t chase them, but wait for their insects to purge naturally, then wander down the tree into a “cat trap,” a new invention for which the patent has already been applied.

At one spot in his PowerPoint presentation, Davidowitz reinforced the efficacy of growing critters rather than cattle for human consumption. He noted that if one cow and bull produced one calf, there would be a total of about 1,100 kilograms of meat, or enough to feed 15 people for a year, after 22 weeks. If you let two grasshoppers mate, they will produce 3 trillion hoppers in 22 weeks. That’s a total of 890 million kilograms of “meat,” or enough to feed the whole country of Belgium for a whole year. Not a bad return on investment.


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“Another cool thing about insect growing is it doesn't require a lot of space. People could grow insects for food in their backyards or garages. They can do it in an urban setting as opposed to growing cows, where a rural setting is needed.”

Because the University of Arizona rearing facility to grow insects as an alternate source of protein is still in its experimental phase, the sky is the limit in learning how to produce more protein, faster, and cheaper. “I have no problem with the risk versus reward equation,” Davidowitz says. “My grant funding was provided to try things nobody's tried before and if they don't work, they don't work. And if they don't work, I can always feed the results to the chickens.”

And speaking of feeding, Davidowitz was asked if he had personally tasted his *Manduca* offspring. “I've not yet eaten that insect, but we only recently began our lab experiments, so the caterpillars are still growing. But people in my lab are already planning a stir fry for harvest time.” 

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