“No Nose, but a Heck of a Sniffer” Transcript

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IRA FLATOW: This is Science Friday. I am Ira Flatow. You know that spinach you have sitting in your refrigerator at home, waiting to be turned into a tasty salad, a side dish, or getting ready to be recycled, you know what I mean, the compost heap? Well, it's actually good for more than just eating. My next guest gave this super food super powers. And, that is, the ability to detect buried explosives-- spinach that can detect buried explosives.

And not only can it detect those bombs, it can send the signal to people about what it's found. It's plant to human communication, the first of its kind. Joining me to discuss it is Michael Strano, Professor of Chemical Engineering at MIT. Welcome to Science Friday.

MICHAEL STRANO: Ira. It's my pleasure to be here.

IRA FLATOW: So what you've actually, essentially created is a bomb-sniffing plant?

MICHAEL STRANO: That's right. It's a plant that can detect explosive molecules in the groundwater or in the air and send that information to your phone.

IRA FLATOW: So how does it do this? What did you do to the spinach?

MICHAEL STRANO: Well, we used two types of very small particles. We call them **nanoparticles**. They're small enough to get into pores within the plant. So the plant leaf has pores called **stomata**. And the plant uses them to **evaporate** water from the leaf. But you can use those pores to get two types of nanoparticles. And these are single-walled carbon nanotubes, or rolled cylinders of graphene. And they emit light in the near **infrared**. This is light that's so red that your eye can't see it. Your television remote control uses this kind of light.

IRA FLATOW: So how long does it take for the plant to do this?

MICHAEL STRANO: It takes about 10 minutes. It depends on the size of the plant, but also the evaporation rate, so how much sun is shining on the plant.

IRA FLATOW: And so what's the idea? How could you make practical use of this now?

MICHAEL STRANO: So this is part of an effort that we have at MIT to try to modify living plans to replace some of the devices that we make today and stamp out of plastic and circuit boards. So I call this area plant nanobionics. And the technology we developed could have applications to monitoring groundwater contamination around chemical plants, monitoring public spaces for terrorism. There may be defense applications.

But we're also taking these same sensors and we're turning them inward. And we're connecting them to the plant to help us study and understand plants. Plants have an extensive chemical signaling inside. They know when they're under attack from pests. They know when there's a drought coming. So this information is useful to humans. And so we're also interested in getting this information out of the plant and into a form that humans can use.

IRA FLATOW: So if you can do this in spinach, I imagine you could do it in other kinds of plants, too.

MICHAEL STRANO: That's right. We made a point in our paper to show that we could use these techniques on any plant, any mature plant that you find in the environment or in a nursery. We call them wild-type plants, so you don't have to genetically engineer or use a very special kind of plant or plant species.

IRA FLATOW: And how hard is it to modify? Do you just sprinkle on the nanoparticles and it just goes right into those little holes in the leaves?

MICHAEL STRANO: You essentially can just sprinkle on. We use a needleless syringe to apply a solution of the nanoparticles. We pressurize the solution on the surface of a leaf. And then this backfills spaces within the leaf where water is normally stored, waiting to be evaporated in the plant. However, we're working on ways that you could treat the water so that just the nanoparticles will infuse into the plant without that pressure. So there you could, in fact, just spray the leaves and you would have the particles be incorporated.

IRA FLATOW: Wow, that certainly would be a cheap way to create a detector, just using any plant that you can incorporate.

MICHAEL STRANO: So plants have some advantages for being used in this way. And I don't think engineers like myself have really seriously considered them as a platform. They provide their own power. They can move water from the ground to, in some cases, hundreds of feet in the air with no additional energy added. They use just water evaporation. And they self-repair. And they're naturally adapted to the outdoor environment. If you think about what it takes to have your cell phone sit outside for year after year in extreme cold and in the sun, it's an engineering challenge, but nature has essentially adapted to this task.

IRA FLATOW: So if you wanted to create a protective perimeter around something, you can just grow a lot of rhododendrons or something.

MICHAEL STRANO: Or just approach existing plants and modify them and set up a sensor network. That's right.

IRA FLATOW: That's great, interesting stuff. Thank you for taking time to be with us today. And good luck to you, Dr. Strano.

MICHAEL STRANO: Thanks a lot, Ira. Thank you.

IRA FLATOW: You're welcome. Michael Strano is Professor of Chemical Engineering at MIT.