

Note to readers: This interview script was used when interviewing CRISPR scientists and experts in gene editing policy, IP, and communications. Part II about democratization did not vary among samples, and I adapted the other Parts to the specific work projects and expertises of informants.

Introduction

CRISPR-Cas9 is one of a handful of so-called new biotechnologies that stand to radically change prospects for human intervention in agriculture. Said to have unprecedented precision, speed, and cost-efficiency, CRISPR has become ubiquitous in biotech labs worldwide, won numerous “breakthrough” prizes, and is amassing roughly 5,000 new research papers each year.

Although human therapeutic applications of CRISPR have garnered more limelight, CRISPR’s uptake in agriculture has been no less significant. Gene-edited versions of mushroom and waxy corn have already been greenlighted by the USDA, and the R&D pipeline is rapidly filling with CRISPR’d tomatoes, potatoes, wheat, rice, cassava, cacao, cattle, chickens, and pigs. Burgeoning start-up finance, research initiatives, patent applications, and new regulations and trade policies attest to this technology’s power and potential.

Yet with CRISPR, as with any “disruptive innovation,” comes a spectrum of possibilities, the trajectories of which my project is designed to trace. Will CRISPR tend to reinforce the lock-ins characteristic of industrial systems? Could it, by contrast, foster transitions to sustainable food systems by decentralizing science, diversifying crop development, and re-distributing centers of ownership and control? Who owns this technology, who has access to it, and who is making decisions about its development and use?

Combining participant observation, semi-structured interviews, literature review, and intellectual property studies, my project asks questions about CRISPR in three key areas:

(1) Democratizing biotechnology - Who participates in developing, accessing, and making decisions about gene editing and its applications? How is "democracy" understood and applied in different aspects of CRISPR research, agriculture development, and governance?

(2) Diversifying crop development for sustainability - Can gene editing support breeding of locally adapted varieties and reduce crop genetic erosion? What is being diversified and for whose benefits?

(3) De-concentrating ownership and control - What are the prospects for smaller companies in the CRISPR biotech space to interrupt seed market concentration? How affected by intellectual property rights?

In our interview today, the focus will be principally on part 1 (democratizing) as well as on specifics about the research or other CRISPR-related work you undertake.

Who is involved

I am seeking the perspectives of CRISPR scientists and experts in CRISPR-related fields of policy/regulation, communications, ethics, and intellectual property issues. In parallel, I am gathering contrasting perspectives from academic sustainable food systems scientists and researchers in civil society organizations with a record of critical engagement with genetic technologies.

Questions

The purpose of this document is to provide you with a preview of the questions I will ask during our interview. Per the consent form provided, you are always able to decline any questions and/or stop the interview at any time. With your approval, I may also ask clarifying follow-up questions.

I. Background and establishing CRISPR

1. Can you tell me a bit about your research background? How did you come to be working on the gene editing project you are now?
2. How has the advent of CRISPR-Cas technology, in particular, affected your research? Can you describe for me how CRISPR has changed what you see as achievable, tractable, doable in your own research? In your field more generally?
3. Has CRISPR shifted your long term thinking about agriculture and food security? How and in what ways?

II. “Democratizing” biotechnology

Several scientists and media observers suggest gene editing could decentralize and democratize biotechnology. Because CRISPR-Cas9 is cheaper and easier to develop and use, it could enable many more scientists, smaller companies, and even DIY tinkers to become involved in making, accessing, and using the biotechnology for many purposes including crop development. 4) What does “democratization” of a technology mean for you?

- 4) Do you think CRISPR is helping “democratize” biotechnology science? If so, how is this happening?

Follow-ups:

- A. Cheap, fast: why is this democratizing?
 - B. How are tools, data, and products of research being openly/freely shared?
 - C. Do you see a trend toward more, different scientists being able to use CRISPR to develop crops for specific geographic and agricultural contexts?
- 5) How does this situation compare to older agricultural biotech/plant biology research?

6) Do you feel that CRISPR is different than older biotechnologies in enabling grad students and postdocs to do significant research in a fairly short time span? Or do you think this has always been the case?

7) What resources has it taken to make your project succeed? (thinking of lab, equipment, testing costs, transformation facilities, greenhouse costs)

8) In terms of democratization, many people suggest that CRISPR is widely accessible and can technically be used by people in their backyards or garages. I have heard others suggest that you actually need an army of people, facilities, and resources to realize a useful/important change in a plant-able crop. What do you think about this?

9) Do you think that CRISPR is helping “level the playing field” for agricultural and biotechnology scientists all over the world? If yes, how so?

10) Intellectual property: As you likely know, leading academic institutions, including the Broad Institute and MIT as well as UC Berkeley, have agreed to offer free use of the technologies they control for academic research purposes through the nonprofit clearinghouse Addgene. Major agreements between Broad and DuPont have similarly signalled a “democratic” approach to licensing that allows non-profit organizations and universities to access foundational CRISPR-Cas9 IP for research.

- A. What in your opinion has been the impact of this approach to IP on the uptake of CRISPR by the scientific community?
- B. How do you feel that this situation compares with the state of commercial licensing rights? Are the IP trends in proprietary seed/trait development similar to those of conventional GM crops, or do you detect qualitative departures?

11) Would you be in favor of expanding the range of people and expertises involved in making CRISPR crops? Why or why not?

12) Do you see potential for more and more-diverse scientists, breeders, and/or farmers to become involved in using and shaping the development of biotechnology like CRISPR? Is this happening already? If not, what would it take from your perspective?

13) Another way that people often talk about democratization and CRISPR is in the potential to expanding biotechnology to crops and traits that are important for farmers in developing countries. That is, instead of primarily focusing on herbicide-tolerant and Bt crops of benefit to large corporations, several scientists express optimism that CRISPR could potentially be used to develop crops that could reduce chemical use, benefit smallholder farmers, and breed subsistence varieties that have not been profitable for companies to invest in. Does this perspective resonate with you?

Can you talk a little bit more about what “democratization” of CRISPR means to you, especially in terms of plant breeding?

14) On the flipside of democratization, some experts suggest is the problem of socializing risk. Are there risks to having less specialized (even untrained) gene editors accessing the technology?

15) Do you think there are still important barriers to the ability of CRISPR to bring greater democracy to biotechnology science? What are these obstacles and how might we overcome them?

III. Project details (getting to know an extended ‘case’)

Would you be able to walk me through one of your current projects so that I can get a sense of your research and development process? If possible, I would especially like to learn a few different things:

16. How did you decide to pursue the project in the first place? What motivated you to take it on, and what do you hope the outcome will be?

17. What does the decision-making process look like in designing a crop gene editing project?

- A. How do you learn about the problem that your research aims to address, and about the interventions that are needed?
- B. Who is involved in setting priorities? At which institutional level does this occur?
- C. Who are some of your partners in the research and what roles do they play?
- D. How do you get a sense of local need or support for a particular crop improvement project? At which stage does this occur and who is involved?

18. What benefits are you anticipating for [farmers, rural populations, consumers, companies?]

19. What are the intellectual property rights on the CRISPR products of your research? How is this affecting the extent to which the crop/seed will achieve intended benefits?

20. What challenges, either technical or social (eg, regulatory), are you facing in your CRISPR project and what do you see as a potential solution(s)?

Thank you!