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Intervention Symposium—"Plantation Methodologies: Questioning Scale, Space, and Subjecthood"

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Plantation Biology: Laboratory Methods for Knowing Plants

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Technoscience shapes plantation landscapes: hybridized and genetically modified crop plants, fertilizers, pesticides, herbicides, irrigation systems, mechanized farm equipment, transportation vehicles, even worker personal protective equipment. Each of these on-site technologies corresponds to processes of conceptualization, design, and production elsewhere, beyond the soil. Once crop plants are harvested and leave the fields, they are assessed and manipulated through a regime of technologies that, in turn, affect the ways that crops are grown in fields in the first place; in other words, the crops must match the machinery that they will meet (Singerman 2017). They must also thrive in changing climatological conditions that render fields different from when agronomists developed many plant stocks decades ago: soil is more flooded or more arid, growing seasons are longer or shorter, and invasive pest outbreaks are more frequent (Clapp et al. 2018). Capitalist-borne and -sanctioned "expert" knowledge and technology from European and North American scientific traditions structure, mark, test, verify, assert, and implement the plantation.

Image 1: A biologist in Brazil sets off, machete in hand, to cut sugarcane for research in the laboratory's experimental growing field (photo by author)

As in other postcolonial contexts, plantations have for centuries shaped the ecological and economic landscapes in Brazil (Dean 1997; Schwartz 1986). But as critical scholars in this collection and elsewhere have argued for more than a decade, plantations shape more than just landscapes; they are foundational to the formations of capitalist production, exchange, and ideologies of control and mastery of life that inform all aspects of Western modernity (Chao 2022; McKittrick 2013; Paredes 2023). Plantations generate infrastructures and logics that extend beyond fields (see McKinson in this collection). Of central concern in this essay are the logics created through exchanges between ground-level plant and soil conditions, the technologies that enable their formal establishment and processual continuation, and the methods through which such logics might be investigated.

Historians of science and environment have examined the material co-creation of spaces of plant cultivation and scientific knowledge production (Höhler 2020; Kohler 2002; Raby 2019; Saraiva 2010). Extending this lab and field co-creation to the ideological realm, plantations are material-conceptual hybrids of ecologically complex growing fields and technoscientific laboratories and factories, ones that hinge on the plants anchoring plantations. In this brief paper, I examine this formation, which I call plantation biology, and consider some disruptions to it. The practices and spaces of plantation biology extend dialectically: lab-based biological interventions on crop plants result in technoscientifically modulated plantations, and a necropolitical regime of productivism and control orders biological beings and the agronomic scientific practices that attend them. Focusing on plantation biology enables methodological attention to plant flourishing and dying amidst the protocols and designs of lab-based scientists. These methods can reveal more-than-human counterhegemonic resistance to attempts to increase homogeneity, efficiency, and control.

Image 2: Experimental transgenic sugarcane plants growing in vitro (photo by author)

Ethnographically studying the material, ideological, and social forms at work in these spaces of plantation production requires learning how biologists know about their plants. In the Brazilian agronomic molecular biology laboratory where I conducted research, scientists were working to make the world's first transgenic, or genetically modified, sugarcane plant. They experimented with genetic modification techniques and protocols so that they might make this already-lucrative crop that has been central to the Brazilian economy since the 16th century into a vehicle for a uniquely Brazilian form of sustainable development. Their genetic modification projects included increased drought resistance, increased pest tolerance, and reduced lignin (that is, fiber, to make the cane easier to press), each with the goal of creating a plant that could produce more ethanol—for use in fueling automobiles—on less plantation acreage.

Image 3: A biologist tends to his experimental sugarcane plants in the transgenics greenhouse (photo by author)

What regimes of practice guide molecular biologists who create transgenic plants in laboratory environments? How do scientists know their plants such that they can affect these intimate and permanent transformations? How do these scientists imagine the future fields they hope their plants will occupy? To answer these questions, I participated alongside biologists in the practices and engagements required to genetically modify sugarcane. But as I wielded a shovel or machete in the lab's experimental growing fields, gripped a scalpel through gloved hands to prepare plant specimens for tissue culturing, or assessed the outcomes of modification attempts by examining striated PCR analysis results on a computer screen, I found myself continually looking beyond prescribed protocols, taking interest in what the plants were up to amidst humans' interventions and manipulations. An additional question emerged: what role did sugarcane itself—a colonial crop that requires exceedingly labor-intensive processing in fields and mills—play in undergirding, advancing, and thwarting plantation biology in practice? To answer this, I looked to the biologists' reactions to the doings of sugarcane plants.

John Hartigan's (2017) method of "interviewing a plant" requires regarding plants as ethnographic subjects. In attempting this, Hartigan turns to scholars in the "vegetal turn" to construct an understanding of plants as possessing subjectivity—acting in the world with rich sensual and social lives—citing scientists who have identified plants' capacities for growing with kin and cooperating through chemical signals (2017: 256). In semi-resignation, Hartigan cautions that in the modernist experience, most access to understanding plants' lives comes from trained scientists who, over the course of their studies and careers, have developed a "feeling for the organism" they work with (Keller 1984: 198). Leaning into my human interlocutors' hard-earned knowledge (cf. Paxson and Helmreich 2014), I decided to observe the dynamics that sugarcane plants created in these more-than-human procedures and to document how they affected both the experimental outcomes and scientists' feelings about the plants and the work they were attempting to accomplish (Hustak and Myers 2012). In this way, my method of including plant agency in my lab-based fieldwork enabled me to study the intra-active dimensions of plantation biology, both as a set of more-than-human scientific practices and as a hegemonic yet patchy power formation (Barad 2007; Tsing et al. 2019).

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Image 4: A biologist prepares pieces of sugarcane tissue for transfer to new nutrient-rich plant growth medium (photo by author)

While most work in the lab contributed to results which scientists expected, sugarcane afforded ample opportunities to observe plant-caused setbacks in transgenic experimentation. Sugarcane is a monocot, a plant with one embryonic leaf, which is more difficult to modify genetically than plants with two embryonic leaves. Monocots respond poorly to genetic transformation because their regeneration systems are not resilient enough to grow back after an attempted gene insertion, which requires damaging the genome (Sood et al. 2011). Sugarcane also has a very large genome, making experimental design challenging. It took about three months to prepare cultured sugarcane tissue for transformation, and longer to see the results in the plants that grew subsequently. Half a year's work could easily lead to plants that were not viable in one way or another because they did not respond as scientists had hoped.

These "failures" reveal that plants exert an ever-present force that shapes the power wielded by scientists as they attempt to create new crops for future plantation fields. An example may serve to illustrate. One day, a few lab members gathered in the greenhouse to transfer young transgenic cane shoots from the white plastic cups they were bursting from into large 40-liter pots filled with nutritionally bespoke potting soil so their roots would have room to extend, and they could grow to near full size. This would enable the scientists to discover whether their genetic transformation experiments had been successful. Marco, a postdoc who had grown up on a family farm, was selecting which of the dozens of small plants he would transfer. I asked him, "What makes a good plant?" He thought for a while. Looking at the plant in his hand, he replied, "It should be strong, and growing straight up and down. It should also be bright green." As we worked together, Marco began to elaborate on other features of good plants, including height and leaves free of brown spots. "Also, its leaves should grow symmetrically. See here?" He led me past a few rows of 1.5-meter-high cane plants to a cluster of potted plants growing along the edge of the greenhouse. Indicating a few leaves growing next to each other on the same side of the stalk, he said, "This plant has a leaf here, and then a second leaf above, and then a third leaf above that … That's not ideal. The plant should grow uniformly and symmetrically." Something had gone wrong in this plant's ability to follow its original genetic instructions to grow with leaves sprouting symmetrically, as it would were it unmodified. And because its offspring would exhibit the same asymmetrical leaf pattern, this plant experiment was a failure. Rather than simply discard the plants, however, Marco viewed these nonconforming plants as testaments to the complexities of a reified "nature", one that admirably foiled their plans (cf. Chao 2018). Marco wistfully told me, "No matter what we try, Nature has its own way."

Image 5: A potted transgenic sugarcane plant growing leaves symmetrically on its stalk (photo by author)

These plants offered opportunities for scientists to improve upon their research designs and their culturing techniques, as they learned new theories, methods, and practices for GM cane creation. In addition to learning from plants, scientists also used nonconforming organisms to create new collaborations and bonds between themselves, as students, postdocs, and faculty often came together to discuss what might be improved in the next round of experimentation. These malformed, misshapen plants ultimately had two effects on scientists and their research. First, they inspired new research orientations and protocols, which in turn stood to yield so-called "successful" transgenic experiments, ultimately—someday—for large-scale sugarcane production. Secondly, though, faltering genetically transformed plants showed researchers that plants are not as manipulable, controllable, and designable as they would have them. Their apparent individual weaknesses reveal a species-wide heartiness that pushes back against attempts to modify their structure.

Despite the protocols and procedures they followed, each plan was always thwartable in the same way: the sugarcane itself might have different designs for how it would respond under experimentation. In laboratories, as well as in growing fields, the more-than-human plays a central role in disrupting plantation regimes of monoculture and necropolitical ordering (see Kumpf in this collection). The tenets of plantation biology require uniform plants modified by human technoscientific procedures in the lab in order to produce crops for hyperefficient future monocrop fields; yet the plants themselves often disrupt these attempts at standardization. As biological practice seeks to replicate these plantation conditions of control, sugarcane provides resistance and undermines such attempts through its exuberant flourishing. Scholars of plantation formations can seek out these ever-present exceptions to the rules of domination to foreground the heterogeneity that quietly thrives in and disrupts the thickets of plantation hegemony.

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