Article

When Myxobacteria Travel: Localizing a Laboratory Biocontrol Technology in Xinjiang Pear Orchards

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Abstract: Laboratory-validated agricultural technologies often perform unpredictably once introduced into local farming environments, yet the reasons for this gap remain insufficiently understood. Drawing on field research in Korla pear orchards in southern Xinjiang, China, this article examines how a laboratory-developed myxobacterial biocontrol agent encounters diverse ecological, social, and institutional conditions during its implementation against fire blight. Rather than asking whether the technology is effective, the article asks how its effectiveness is continually reconfigured through interactions among pathogens, pear trees, farmers, technicians, agricultural markets, and regional governance systems. Building on Bruno Latour's Actor-Network Theory and Margaret Lock's concept of Local Biologies, this article develops Local Agricultural Biologies as an analytical framework to explain how agricultural diseases and biocontrol technologies are co-produced through localized ecological, biological, socio-economic, and governance processes. It argues that the limited field performance of myxobacterial biocontrol is not simply a technological failure, but the outcome of multiple translation failures across heterogeneous actor-networks. By conceptualizing agricultural disease as a situated and relational process rather than a universal biological condition, the article extends Local Biologies beyond human health and offers a new perspective for understanding the localization of agricultural technologies and the adaptive governance of sustainable crop protection.

Keywords: Korla Fragrant Pear; Fire Blight; Valsa Canker; Microbial Biocontro; Technology Translation

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1. Introduction

A diseased pear tree rarely tells a single story. During fieldwork in Korla, southern Xinjiang, I found that the same symptoms of branch dieback could generate remarkably different explanations. Orchard technicians traced fire blight to Erwinia amylovora, a bacterial pathogen capable of spreading through infected pollen, insects, wind, and contaminated pruning tools [1,2]. Experienced growers, however, often attributed the disease to poor pruning practices, dense canopies, insect damage, or declining tree vigour. Some agrochemical retailers described branch dieback as a viral disease, while others insisted that no pesticide could fundamentally cure infected trees. Meanwhile, researchers introducing Mei Ao Qing, a laboratory-developed myxobacterial biocontrol agent, understood the problem primarily as one of microbial inhibition: if the antagonist bacterium could suppress E. amylovora under controlled conditions, it should also reduce disease incidence in orchards.

Yet the technology travelled differently from expectations. In the laboratory, Mei Ao Qing consistently inhibited the growth of E. amylovora under sterile and standardized conditions. In Korla's orchards, however, identical formulations produced highly uneven outcomes. Some orchards reported visible improvement, while others experienced little effect despite following recommended protocols. The discrepancy could not be explained solely by microbial efficacy. Rather, it emerged through interactions among grafted pear varieties with declining resistance, commercial pollen transported across regions, sandy soils with high permeability, orchard microclimates created by dense planting, ageing farming populations, fragmented disease management, and local agrochemical markets. As the biocontrol product moved from laboratory benches into orchards, it entered an entirely different world of biological, ecological, social, and institutional relations.

For plant pathology, such inconsistencies are often understood as problems of field efficacy. Laboratory experiments isolate pathogens, evaluate antimicrobial performance, and optimize formulations under controlled conditions before recommending field application. From this perspective, differences between laboratory and orchard are primarily treated as variables requiring further technical refinement. Such an approach has undoubtedly advanced biological control technologies, yet it often assumes that pathogens, host plants, and microbial agents remain essentially identical as they move across experimental and agricultural settings. The challenge is therefore framed as one of technological optimization rather than ontological transformation.

Science and Technology Studies suggests a rather different starting point. Rather than treating technologies as stable objects transferred from one setting to another, scholars have shown that technologies are continuously assembled, translated, and reconfigured through heterogeneous networks of humans and nonhumans [3-5]. Laboratory facts do not simply travel intact into the world. They acquire meaning and efficacy only through new alliances with instruments, environments, institutions, infrastructures, and everyday practices. From this perspective, the uneven performance of Mei Ao Qing is a process of translation instead of a technical problem. The laboratory biocontrol agent encounters pear trees, pathogens, growers, technicians, markets, regulations, and ecological conditions that collectively reshape what the technology becomes and what it is capable of doing.

However, technology is only one side of the puzzle. During the fieldwork, it also became increasingly difficult to regard fire blight itself as a singular biological object. Disease was enacted differently across orchards through distinct histories of grafting, pruning practices, pollen circulation, pesticide use, local ecological conditions, and farmers' experiential knowledge. The pathogen Erwinia amylovora remained biologically identifiable, yet the disease it produced was inseparable from the localized environments in which it emerged. Fire blight was transported into Korla. At the same time, it was continually made and remade through situated interactions among microbial life, cultivated landscapes, agricultural labour, market circulation, and regional governance.

This observation resonates with Margaret Lock's concept of Local Biologies, which argues that biological processes are never purely universal but emerge through dynamic interactions between organisms, environments, histories, and social worlds [6,7]. Originally developed to challenge universal assumptions in biomedicine, Local Biologies demonstrates that bodies and diseases are simultaneously biological and social. Yet the framework has largely remained centred on human health. Comparatively little attention has been paid to how agricultural diseases, crop ecologies, and biological control technologies may likewise become locally constituted through ecological histories, farming practices, infrastructures, and governance arrangements.

This article brings these two conversations together. While Actor-Network Theory explains how technologies are translated across heterogeneous networks, Local Biologies reminds us that biology itself is locally produced. Neither perspective alone, however, fully captures how agricultural diseases and biocontrol technologies are simultaneously shaped through interactions among microorganisms, crops, ecological environments, agricultural knowledge, market institutions, and regional governance. To address this gap, I develop the concept of Local Agricultural Biologies. Rather than understanding agricultural disease as a universal biological phenomenon occurring within local settings, Local Agricultural Biologies conceptualizes disease emergence, technological efficacy, and agricultural intervention as mutually constitutive processes produced through localized socio-ecological relations.

Accordingly, this article asks a single fundamental question: How does a laboratory biocontrol technology become transformed as it enters a local agricultural world, and what does this transformation reveal about the localized co-production of biology, technology, knowledge, and governance? Addressing this question requires moving beyond evaluating whether a technology succeeds or fails. Instead, it requires examining how pathogens, microbial agents, pear trees, farming practices, ecological conditions, scientific expertise, and institutional arrangements collectively produce what counts as effective disease control in particular places.

The article proceeds in four sections. Section 2 reviews the relevant literature and develops the Local Agricultural Biologies framework through empirical examples from Korla. Section 3 analyses four translation failures as Mei Ao Qing moves from laboratory to orchard. Section 4 outlines corresponding translation pathways. Section 5 discusses the theoretical contribution of Local Agricultural Biologies and concludes.

2. From Laboratory Biology to Local Agricultural Biologies

2.1. Literature Review and Laboratory Biology

Breaking the linear unidirectional logical framework of traditional technology diffusion theories, Bruno Latour's Actor-Network Theory proposes a core theoretical judgment that technology is not an isolated objective physical object, but a dynamic heterogeneous actor-network formed through continuous interactive relations between human subjects and non-human objects [3]. Translation has been further elaborated as a process of problematization, interessement, enrolment, and mobilization, through which actors define problems, recruit others, and render networks durable [4]. Heterogeneous engineering has likewise been emphasized as the alignment of materials, techniques, and institutions that produces stable effects [5]. The popularization process of new technology does not equal passive top-down diffusion, but a circular, iterative translation activity. Within closed laboratory environments, the myxobacteria preparation Mei Ao Qing forms a stable actor-network composed of myxobacterial strains, constant-temperature cultivation equipment, purified pathogenic bacteria and professional research personnel. Once the preparation is transferred out of laboratory facilities and put into Korla's pear cultivation field, the original closed network structure will completely collapse, while new actors including fragrant pear vegetation, indigenous pathogenic populations, individual smallholder growers, agrochemical retail stores and sandy highly permeable soil will simultaneously enter the production analysis field. If research practitioners cannot complete the coordination and stabilization of new actor alliances, the biocontrol technology will be labeled as ineffective from the perspective of on-site fruit growers.

Margaret Lock's Local Biologies theory holds the core viewpoint that human diseases are not unified, standardized biological events, but localized comprehensive outcomes jointly shaped by regional natural environments, social and cultural customs, medical treatment norms and individual life trajectories [6,7]. Pharmaceutical technologies have further been shown to shape bodily experiences and disease realities, while diseases are enacted differently across multiple practices [8,9]. All existing research applications of this theoretical framework are confined to human medical and public health research fields, without systematic expansion to crop endemic disease research directions.

The laboratory biology of Mei Ao Qing is well understood. Under constant-temperature and sterile conditions, the myxobacteria preparation achieves stable and efficient suppression of Erwinia amylovora. This efficacy depends on a specific actor-network that includes purified bacterial strains, optimal culture media, controlled humidity, the absence of ultraviolet radiation, and skilled technicians who follow standardized protocols. Each element within this network is stabilized through the laboratory environment. The question is whether these relations can be replicated in the field. Laboratory protocols assume standardized conditions that Korla's orchards do not provide. The transition from laboratory to field is not a simple relocation but a network rupture that redefines what the technology is and what it can do. This is where Actor-Network Theory and Local Biologies converge, because the biology of the biocontrol agent and the biology of the disease are both locally constituted through the interactions within their respective networks.

2.2. Disease Is Not Singular

Large-scale synchronous outbreaks of fire blight and Valsa canker do not belong to simple biological events triggered by single pathogenic microorganism invasion, but form a stable localized disease system generated through long-term interactive relations among multiple interwoven factor groups [10,11]. Three empirical examples from the fieldwork illustrate this localized production of disease.

The first example concerns pollen and pathogen circulation. Natural pollination relying on wild bees distributed within local orchards only carries limited cross-plot disease transmission risks under traditional small-scale planting modes. However, large-scale commercial production at the present stage widely adopts bulk pollen purchased from inland provinces, and such externally introduced pollen often carries viable fire blight pathogens to form high-speed cross-village transmission vectors for pathogenic microorganisms. Pathogens can spread through multiple overlapping transmission channels including pollen, flying arthropods, wind currents and shared pruning tools. Even fruit growers who implement strict orchard sanitation cleaning work cannot block continuous pathogen inflow from adjacent extensively managed orchards, so isolated single-plot prevention measures cannot achieve radical disease elimination. A retail operator observed: "You can spray every tree in your own orchard. If your neighbour doesn't spray, his pollen will carry the bacteria straight to your trees. It doesn't matter how careful you are. The disease doesn't respect boundaries." This demonstrates that disease is not a problem of individual trees but a cross-orchard network phenomenon. The pathogen travels through commercial circulation networks, and its effects depend on the coordination, or the lack thereof, across orchard boundaries.

The second example involves female pear regulators and market-driven physiology. Calyx abscission regulators, locally called female pear regulators by fruit growers, adopt a 10:1 mixing ratio of triazole active components and gibberellic acid. This preparation only functions to improve fruit morphological uniformity to match commodity evaluation standards required by the market, and it possesses zero disease suppression and yield increase effects. Pear fruits treated with this regulator contain 1.3% higher soluble sugar content and 155% lower stone cell density than untreated male pear fruits, so they can obtain higher market transaction prices. Yet the chemical agent will disrupt the endogenous hormone balance inside pear trees and inhibit the innate immune response system of vegetation, which significantly increases the overall infection risk of fruit trees. One village supervisor explained: "Female pears sell-they're smooth, symmetrical. The regulators make every pear look like a photograph. But the tree pays a price. Its natural immunity drops. So you get a perfect-looking pear on a diseased tree that won't survive another season." Here, consumer market demand for aesthetically perfect fruit links directly to tree physiology and disease susceptibility. Market aesthetics become biological realities that reshape disease outcomes.

The third example concerns imported planting models and local ecology. High-density planting protocols introduced from external agricultural regions conflict with the arid and high-light climate characteristics of Korla. Excessively narrow row spacing blocks cross-orchard air circulation and sunlight penetration, and it maintains long-term high relative humidity inside orchard spaces that satisfies the optimal reproduction conditions of pathogenic microorganisms. One orchard manager observed: "We planted according to standards brought in from the east-high density, high yield. But the trees don't breathe. The humidity stays high. It's a perfect environment for bacteria and fungi to multiply." An agricultural model that was valid elsewhere is reshaped by local soil, climate, and orchard microclimate. The standardized protocol becomes a different practice in a different ecology, producing disease patterns that could not be predicted from the model's region of origin.

These examples reveal that agricultural disease is not a universal biological condition, but is produced through interactions among organisms, markets, practices, and ecologies. Lock tells us that biology is local. The Korla case further shows that Local Agricultural Biologies refers to the situated production of agricultural biological realities through the interaction of organisms, environments, technologies, agricultural practices, markets, and governance. Fire blight prevalent in Korla possesses exclusive transmission channels, unique inducing factors and indigenous farmer cognitive frameworks that distinguish it from fire blight outbreaks occurring in other pear-producing regions. Universal plant protection schemes formulated for other areas cannot achieve targeted suppression effects against Korla's localized pear disease system. This framework brings together Actor-Network Theory's concern with translation and Local Biologies' concern with biological situatedness, arguing that in agricultural settings, technology, biology, ecology, economy, and governance are simultaneously localized through co-production processes.

3. Technology in Translation: Mei Ao Qing in Korla Orchards

Within laboratory environments, the myxobacteria preparation Mei Ao Qing constructs a closed and stable actor-network composed of myxobacterial strains, standardized cultivation equipment, constant-temperature culture conditions and purified pathogenic bacteria. Once the preparation enters the complex commercial orchard production field of Korla, the original closed network structure will completely disintegrate, while new actors including fruit growers, pathogenic microorganisms, sandy soil, agrochemical vendors and administrative departments will simultaneously participate in the on-site interaction process. Synchronized rupture phenomena occur across four core actor-networks, and these ruptures directly trigger the practical field failure of laboratory-derived biocontrol technology.

3.1. Knowledge Translation

Local fruit growers collectively name all branch withering symptoms as branch blight out of psychological avoidance psychology, and they cannot effectively distinguish bacterial fire blight, fungal Valsa canker and miscellaneous dry rot diseases caused by different microorganisms. One grower stated: "I don't know which disease is which. The branches turn black. They die. I call it branch blight. Sometimes a product works. Usually not." Agrochemical retail operators possess uneven professional knowledge reserves, and many merchants misclassify branch blight as viral diseases and claim that conventional fungicides have zero inhibitory effects, which misleads fruit growers to abandon validated biocontrol preparations and purchase ineffective alternative products. An agrochemical retailer admitted: "We tell growers branch blight is a virus-that's what the distributors taught us. They say no chemical kills viruses. I don't know if it's actually a virus. I just sell what I'm given." Scientific research teams attribute the long-term prevalence of endemic diseases to cross-regional pathogen circulation and degraded orchard ecological structures. Frontline field technicians take pruning wounds, wind and insect transmission as core disease inducing factors. Ordinary smallholder growers regard disordered tree shapes, weed insect pests and unbalanced water and fertilizer input as primary disease sources. Such fundamental cognitive inconsistencies form persistent information communication barriers and block the transmission of pathogen-centered biocontrol logics from scientific research institutions to frontline production personnel. Persistent communication gaps also exist between Han nationality agricultural technicians and Uyghur field laborers, and the transmission process of information including disease symptom description, pesticide mixing ratio, application cycle and pruning specifications will generate distortion phenomena, which drastically reduces the practical implementation efficiency of formal technical training activities. The same disease is not a single object across these actors. Without shared classification, biocontrol technology cannot be properly prescribed or used.

3.2. Ecological Translation

Local climate and soil conditions reduce the activity of biocontrol preparations. Conventional biocontrol substances such as zhongshengmycin lack ultraviolet radiation resistance, and Korla's year-round intense solar radiation drastically shortens the effective duration of pesticides within field environments. A technical engineer observed: "We applied exactly according to protocol. Within two days of sun exposure, bacterial populations dropped by 90%. The lab conditions-controlled temperature, filtered light-don't exist here." Local sandy highly permeable soil and long-term humid orchard microclimates change the survival and reproduction parameters of myxobacterial strains, and constant-temperature sterile laboratory soil conditions cannot be replicated within open-air orchard spaces to form a persistent efficacy gap between laboratory test data and on-site actual performance. This is where Actor-Network Theory and Local Biologies truly meet. The laboratory organism had entered a different ecology. Mei Ao Qing did not simply move from laboratory to field, but its survival, activity, and efficacy were redefined by local ecology, including ultraviolet intensity, sandy soil permeability, and orchard microclimate. The biological entity that worked in the laboratory was not the same entity in the field, because its very biological performance was localized through ecological relations. The technology was not just used differently; it became different.

3.3. Practical and Economic Translation

Novel myxobacteria biocontrol preparations possess stable pathogen suppression effects yet require large application dosages and carry high unit procurement prices that most smallholder growers cannot afford for long-term use. A planting enterprise manager calculated: "A single full-orchard application costs about 500 yuan per mu. Growers need four to six applications per season-close to a third of their annual income. They simply cannot afford it." The single management area of individual orchards is generally extensive, and full-orchard lesion scraping, wound sealing and uniform pesticide spraying work consume massive labor hours, which superimposes the regional youth labor drain phenomenon to make refined standardized operation protocols verified under laboratory conditions lack practical operability within on-site production environments. One elderly grower explained: "I have thirty mu. My sons are in the city. The laboratory procedures assume perfect conditions, perfect labour, perfect time. I have none of these." Decades of exposure to falsely advertised ineffective counterfeit pesticides generate universal trust crisis among local fruit growers for all biopesticide products. A grower stated: "Every year, new products. Every year, promises. We spend money. We spray. The trees die anyway. Why should I believe this new product is different?" The laboratory protocol itself is an actor-network that presupposes a specific configuration of labour, money, time, and equipment. In Korla, this configuration does not exist. The practical and economic network within which the technology must operate is incompatible with the laboratory network from which it emerged.

3.4. Governance Translation

The stable operation prerequisite of the joint disease prevention actor-network lies in synchronous implementation of all intervention operations by all growers within contiguous orchard zones, while local production activities adopt uncoordinated independent smallholder management modes without unified joint governance mechanisms. A village supervisor explained: "Each grower does their own thing. Some spray Monday. Some Friday. Some don't spray at all. No coordination. You can't tell farmers what to do with their own trees." Even if individual growers carry out meticulous orchard sanitation management, wind, insects, imported pollen and shared farm tools will continuously bring external pathogenic bacteria to offset the biocontrol efficacy formed within single plots. A grower expressed frustration: "I do everything right. But my neighbour's orchard is a mess. The wind carries his pathogens to my trees. What can I do?" No targeted fiscal subsidy items and special agricultural disease insurance products are set for cash fruit cultivation industries, which forces individual fruit growers to independently bear all costs of biocontrol preparation procurement and orchard ecological renovation. A research scientist observed: "We developed the technology. We demonstrated efficacy. But there is no policy infrastructure to support adoption. No subsidies. No insurance. The market is not structured to deliver biological control products to smallholders." Restrictions on the circulation of on-site endemic disease data hinder the backflow of pesticide application efficacy records to scientific research teams, which delays the iterative optimization of myxobacteria preparations targeting Korla's light intensity, soil texture and cultivation habits. A technical engineer noted: "We collect data on efficacy, soil conditions, grower practices. But we have no formal channel to send this back to research institutes. Researchers are working with outdated information." Disease crosses orchard boundaries, but governance remains organized around individual orchards. The pathogen network extends across orchards, but governance remains fragmented at the farm level. Coordinated prevention is impossible without coordinated governance. Even if individual growers adopt Mei Ao Qing, cross-orchard pathogen sources will undermine its effects.

4. Reassembling the Network: Translation Pathways

Combining the endemic disease formation logic derived from the Local Agricultural Biologies framework and four hierarchical technology translation failure modes identified through Actor-Network Theory analysis, this paper reconstructs heterogeneous actor-networks from four coordinated dimensions that correspond to each identified failure. These are not conventional policy recommendations but translation strategies that address specific network ruptures.

The first translation pathway is knowledge co-production. Rather than implementing top-down training, researchers, technicians, and growers should jointly identify fire blight, Valsa canker, and branch dieback using local photographs, bilingual materials, and demonstration orchards. Joint working groups composed of scientific research institutions and grassroots agricultural stations should compile Han-Uyghur dual-language on-site operation handbooks that clearly distinguish symptom characteristics of different diseases. Single classroom lecture training modes should be abandoned in favour of contiguous demonstration orchard zones where on-site hands-on operation teaching activities occur. Experienced local senior fruit growers should be hired as grassroots technical instructors to eliminate cross-ethnic language communication barriers. The goal is not transferring expert knowledge but producing locally usable classifications that all actors share.

The second translation pathway is local co-design. Laboratory scientists, technicians, growers, and orchard ecologies must collectively modify formulation, dosage, timing, ultraviolet protection, and application protocols. This is not laboratory development followed by farmer application, but joint adaptation that occurs within the orchard. Ultraviolet-protectant adjuvants should be added into preparation components to extend the effective duration of microbial agents under Korla's intense solar radiation environment. Broad-spectrum composite preparations capable of simultaneously inhibiting bacterial Erwinia amylovora and fungal Valsa pathogens should be developed to resolve the core practical pain point of mismatched intervention schemes. Small-sized automatic spraying equipment and rapid wound sealing tools should be matched to reduce manual labor consumption. Indigenous ecological prevention methods using wormwood and lavender for insect and bacteria repellent should be integrated into combined intervention schemes. The technology must be redesigned in and for the local ecology.

The third translation pathway is network rebuilding. Costs, labour shortages, equipment availability, and trust must be addressed through rental mechanisms, simplified equipment, bulk procurement, and transparent demonstration trials. Special financial subsidy policies targeting young new-generation fruit growers should be issued to attract young practitioners to return to orchard cultivation. Small portable pruning and automatic pesticide spraying machinery should be comprehensively promoted to lower the intensive labor threshold. Local administrative departments should take the lead in establishing centralized bulk procurement channels for certified biocontrol preparations, organize unified large-scale on-site demonstration activities and fully disclose complete efficacy test data. Free small-area trial plots should be set aside to allow fruit growers to directly observe the actual control effect of myxobacteria preparations on their own orchards. The technology adoption network requires practical reconfiguration to align with local resources and constraints.

The fourth translation pathway is adaptive governance. Because disease crosses boundaries, coordinated disease monitoring, pollen and seedling circulation management, neighbouring orchard coordination, and research-field feedback mechanisms are essential. Unified joint disease prevention zones should be delimited based on village and production cluster boundaries, with unified time schedules for orchard pruning, sanitation cleaning and full-orchard pesticide spraying. Mandatory pre-transport pathogen testing systems should be formulated for all commercially purchased pollen and externally introduced seedlings. Permanent on-site endemic disease monitoring stations should be established to regularly collect long-term disease development and pesticide application efficacy data and feed such data back to scientific research teams. Complete transmission channels covering laboratory research, field verification, administrative approval, market commercialization and long-term regional governance should be established. Governance must match the scale of the pathogen network, and this requires institutional support for collective action rather than just individual farm-level interventions.

5. Discussion and Conclusion

What does Local Agricultural Biologies contribute beyond existing frameworks? Actor-Network Theory shows that technology is translated through heterogeneous networks. Local Biologies shows that biology is localized through interactions between organisms and their environments. Local Agricultural Biologies shows that in agricultural worlds, technology and biology become localized together through ecological, economic, practical, and governmental relations. When Mei Ao Qing entered Korla, the technology changed in terms of its efficacy, its meaning, and its use, and simultaneously the biological conditions of efficacy changed as well. The microbial agent's survival and activity were reshaped by local ecology. The disease it targeted was itself a localized product of pollen networks, market pressures, and soil conditions. Technology translation and biological localization were not separate processes, but they constituted a single process of socio-ecological co-production.

This is what Local Agricultural Biologies adds to the two theoretical traditions. Actor-Network Theory and Local Biologies have largely developed in parallel, with Actor-Network Theory tracking the movement and transformation of technologies and Local Biologies examining the situated production of biological phenomena. In agricultural worlds, these are not parallel processes. The technology does not travel into a pre-existing local biology, but the technology and the biology remake each other through their encounter. The myxobacteria preparation is not simply applied to a stable disease, but both the preparation and the disease become something different through their interaction with local orchards, markets, and governance. The framework contributes to agricultural STS by offering a language for analysing how laboratory technologies enter local worlds, not as intact objects but as entities reconfigured through encounters with diverse actors.

Returning to the fundamental question, laboratory evidence proves that Mei Ao Qing can inhibit Erwinia amylovora under controlled conditions. But laboratory evidence cannot independently determine whether Mei Ao Qing "works" in Korla, because effectiveness is not an intrinsic property of the preparation. Instead, effectiveness is produced at the intersection of microbes, trees, soil, climate, growers, markets, and governance. The laboratory can predict inhibition, but it cannot predict translation. The journey from laboratory to orchard is therefore not the transfer of a finished technology, but the making of a new local agricultural biology.

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