Peru's Pest Problem: Organic Pest Control in High-Altitude Greenhouses

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Peruvian culture is an agrarian one. In March, 2018, I traveled to Peru as part of a Youth Development and Agricultural Education service-learning trip. There for ten days, we spent much of that time interviewing people living in and around rural villages. These were people of many backgrounds, but nearly all of them, regardless of career, had some hand in agriculture. For some, a home garden provides food for their family in the summertime. Others have jobs in tourism that only run in the dry season and use farming as an income during the fertile rainy season. But Peru's unique environmental conditions, namely its extreme altitudes and dichotomous climate, make growing many crops difficult or impossible without structural assistance.

Greenhouses and high tunnels (henceforth referred to ubiquitously as "greenhouses" for brevity and clarity) offer farmers in the Andes a chance to grow produce nearly year round. The atmosphere atop Peru's mountains is much thinner than that in the lowlands, where many plants grow without cover. The thin layer of ozone at 4,000 meters above sea level does little against UV radiation, which can damage chlorophyll in plants. But having a greenhouse comes with its own set of difficulties; construction and purchase of materials can be expensive, irrigation may be impossible with available resources, and pests can build into overwhelming scourges.

The first two issues are often taken up by locally-based NGOs and community groups. For example, Andean Alliance is a foundation that builds greenhouses for schools and families. Their actions in the country have greatly reduced malnutrition among children. Families with

their own greenhouses are able to produce food outside of the rainy season, and they are not confined to native plants that have adapted to the altitude, e.g., onions, potatoes, and maize.

Heifer International, meanwhile, was instrumental in bringing irrigation to many farms in the mountains. Some farms still utilize Incan waterways to bring glacial runoff to the fields, but the glaciers in many parts of Peru—and the world—are disappearing, making these ancient pipelines obsolete. As a result, some of the rural communities left without irrigation have neither the resources nor the knowledge to set up new systems. In scenarios such as these, education and assistance from external organizations is crucial.

It was often the case that people we interviewed lived a full day's travel from the nearest, large produce market, so being able to gather enough quality produce to justify that trip weighed heavily on them. However, we were told that greenhouses offered increased output when managed correctly, thereby creating an additional advantage.

As far as pests are concerned, greenhouses often provide perfect, regulated environments for insect explosions. Pests are welcomed mainly by two greenhouse staples: the warm air, exempt from the freezing mornings of the Peruvian highlands, and the high humidity, lasting well past Peru's rainy season.

In the United States, pests are often controlled with synthetic pesticide treatments, but that may not be an option in this case. Peruvians do not value products in the same way as some other countries, the United States notwithstanding. As we were told repeatedly by many interviewees from all over the Cusco region, Peruvians will usually only price goods to reflect the actual money they put into producing them. Therefore, farmers will likely not feel the need to raise their prices dependent on seasonal crop losses, time spent working, or desirability of a

produce item. They are more likely to charge only for the seeds they sowed and the cost of growth agents, like fertilizer, with a slight upcharge to turn a meager profit.

This money-unfocused view of the market is a deep-seated cultural practice, and any suggestions we made during our visits to the farms that would increase profit were met with scorn. This ideal also means that non-organic produce is, unlike in North America, generally more expensive, to reflect the cost of the pesticides used. Therefore, when given the choice, Peruvian consumers are much more apt to purchase cheaper, more "natural," organic produce than the pricier, chemical-laden alternative.

High-altitude farmers, then, are left with a difficult task; they must produce high-quality, varied produce in artificially bolstered conditions (i.e., a greenhouse), without relying on any synthetic pest control agents, or be outcompeted by their neighbors. For this reason, it is imperative that these farmers have effective methods of managing greenhouse pests *sans* neonicotinoids or pyrethrins. But some methods are more successful than others.

The first greenhouse I inspected was in Mollepata, a few hours outside of Cusco by van. I first toured an open-air instructional garden consisting of native plants, after which I was shamefully shown the greenhouse our hosts used for tomatoes. The house smelled like mold, and there were thick clouds of whiteflies surrounding every wilting tomato sprout. Each plant had severe leaf curling, but the infestation was so severe that I could not tell whether the damage was from feeding or from a pathogen.

Our host, Alejandra, explained to me that they used no deterrents in this greenhouse. They did, however, have around forty soda bottles, painted orange and covered in resin, to trap the pests. Each was saturated with whiteflies. Alejandra told me the greenhouse was a lesson to them to find a better way of managing their crops, and they had plans to burn the most infected

plants in an effort to save the ones that still showed signs of life. After a brief investigation, I advised her to burn the entire stock, to which she agreed.

Alejandra's experience growing organically was no great success story, but my faith in the practice was renewed while visiting the even smaller village of Ccorca. There we met with Edgar, a community agricultural leader with a strawberry greenhouse. Like most greenhouses in Ccorca, Edgar's was built and paid for by his neighbors, in an effort to better the village overall. His neighbors' greenhouses were successful, but nowhere near to the level of Edgar's. I spent a while examining each row of strawberries growing in the plastic house, and, of the hundreds I saw, only one or two plants showed any signs of damage. I saw only a single beetle, and it was already dead.

Edgar claims that his success is in part from the quality of his greenhouse's materials. The plastic is UV-rated for more than two years, and his ventilation ports are covered with an extremely fine mesh. In addition, each row of plants is contained within UV-shielding plastic that also retains moisture. Edgar also makes his own compost, which he believes guarantees the integrity of the soil and cuts down on costs. He practices vermiculture, and uses a mixture of food scraps and droppings from his guinea pig farm to supply the compost. Finally, he treats this compost with homegrown tobacco and hot peppers, which is meant to deter insects. Unlike any of his neighbors to whom I spoke, Edgar sprays his plants with a 4:15 water to ethanol mixture regularly. All of these steps contribute to a healthy farm, and net Edgar enough money to help his neighbors develop their own gardens.

The video resulting from this observation was made with a couple of goals in mind. I am a strong believer in the importance of cross-cultural communication and education. Organic produce is currently in high demand in the United States, and seeing the effectiveness of Edgar's

practices could certainly help some intrepid gardeners find their start. At the very least, seeing a new perspective on an old issue is never a negative, and the insight my trip gave me into the ideals of Andean people is invaluable in any future communications I may have with that part of the world. Sociological understanding of an agrarian people is just as important as an agricultural understanding of a successful organic farm.

In addition, this project is important because of how ingrained farming is to many communities worldwide. As noted previously, there was not a single person we met during our trip who did not participate in agriculture in some capacity. Even the Peruvian students who accompanied us from Lima were all from farming backgrounds. And, since Peruvian consumers expect and demand organic produce, seeing the strategies of other farmers may be of utmost importance.

I would recommend my video to anyone struggling with pest problems in a greenhouse and would consider an organic solution. I think the project is also well-suited for people interested in global farming techniques, those who have an interest in organic gardening, ot those who would like to help a high-altitude community in the ways that Andean Alliance or Heifer International have. However, as stated, I think there is never a disadvantage to learning more about the amazing ways people adapt to difficult situations, and the inventive methods utilized to make any place a place for agricultural success.