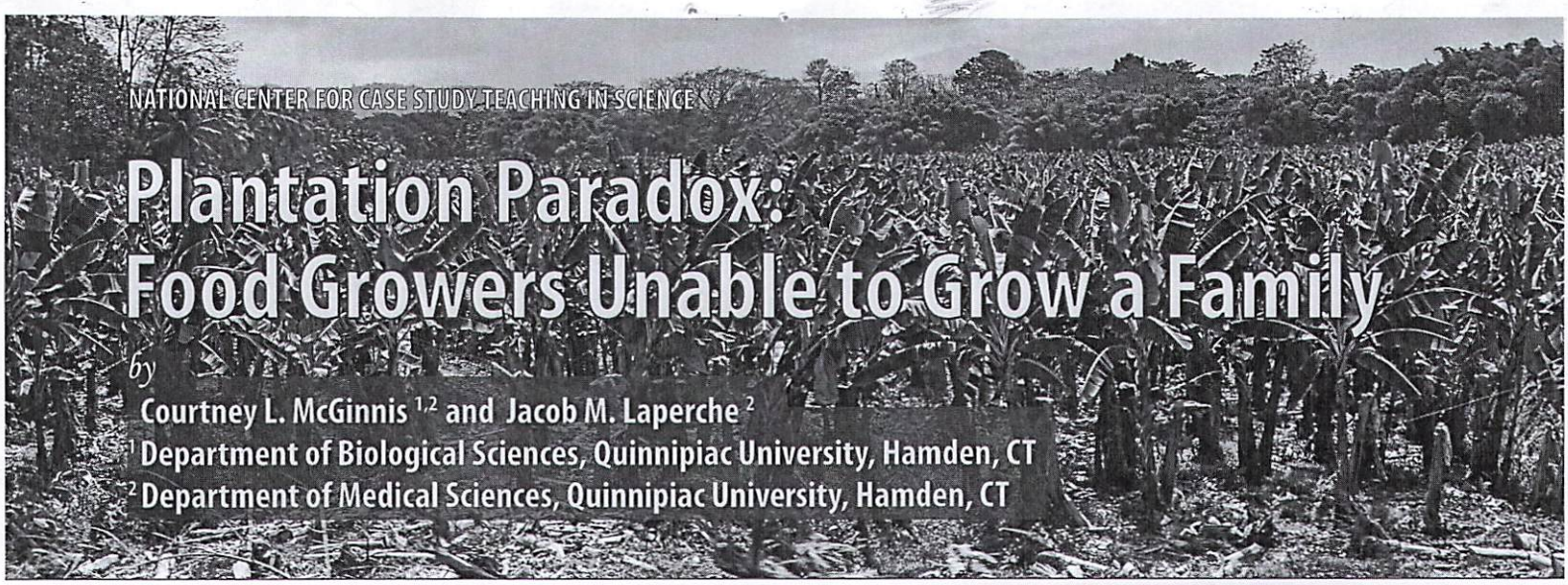

NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

Plantation Paradox: Food Growers Unable to Grow a Family

by
Courtney L. McGinnis [1,2] and Jacob M. Laperche [2]
[1] Department of Biological Sciences, Quinnipiac University, Hamden, CT
[2] Department of Medical Sciences, Quinnipiac University, Hamden, CT

Part I – Luis and Marta

what they need to know about this person,

[redacted]

Luis, a 28-year-old Costa Rican, had worked on a banana plantation as a seasonal employee since he was 17. Luis's father had also worked at the plantation for 25 years until he retired. Like many of the plantation workers, Luis had a sense of pride for the work that he did each day and for the ability to provide for his family, just like his father. A typical day for Luis began at 6 a.m., and he usually worked about ten hours each day until all the bananas had been boxed for the day.

Luis and his wife, Marta, had met at work and had attempted to start a family for three years, unsuccessfully. After that time, Marta decided that they should see a physician. Dr. Martin, the reproductive specialist who met with Luis and Marta, initially discussed their medical history and their hope to begin a family. He then described the various assisted reproductive technologies (ARTs) that could be utilized to help Luis and Marta start a family. The couple left the office with a lot of information on reproductive services and cost, but also with some questions.

Questions

1. What exactly are ARTs?

medical procedures used primarily to adress infertility. using vitro fertilization, intracytoplasmic sperm injection, cryopreservation of gametes or embryos

2. Describe the benefits and risks associated with different ARTs.

Benefits: increased chance of fertilization/pregnancy

risks: headaches, bloating, nausea, ~~you~~ can have twins

3. What could be the cause of Luis and Marta's infertility?

Pesticides

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Part II – Infertility Evaluation

After discussing their questions with Dr. Martin, Luis and Marta decided it was time to move forward with an infertility evaluation. They understood the goal of this stage was to determine the likely cause of infertility and to determine the best approach to fertility treatment.

Luis needed to have a semen analysis to determine the quality of his sperm. Marta needed to have several tests to establish her baseline fertility health. The tests included a blood test to determine levels of follicular stimulating hormone (FSH), estradiol (E2) and anti-Müllerian hormone (AMH), along with a hysterosalpingogram and hysteroscopy. Below are tables of those results.

Table 1. Marta's blood results.

Component	*Marta's Value*	*Reference Range*
FSH (Day 3)	11.0 mIU/mL	<3.0 mIU/mL (<3.0 IU/L) (prepuberty, female); 2.0–12.0 mIU/mL (2.0–12.0 IU/L) (follicular, female); 4.0–36.0 mIU/mL (4.0–36.0 IU/L) (midcycle, female); 1.0–9.0 mIU/mL (1.0–9.0 IU/L) (luteal, female)
LH	12.0 mIU/mL	1.0–18.0 mIU/mL (1.0–18.0 IU/L) (follicular, female); 20.0–80.0 mIU/mL (20.0–80.0 IU/L) (midcycle, female); 0.5–18.0 mIU/mL (0.5–18.0 IU/L) (luteal, female)
Estradiol	210 pg/mL	15–350 pg/mL
AMH	2.3 ng/ml	1.5–4.0 ng/ml
Prolactin	18 ng/mL	4–30 ng/mL
Progesterone (P4)	0.75 ng/mL	≤1.0 ng/mL (≤3.2 nmol/L) (follicular, female); 2.0–20.0 ng/mL (6.4–63.6 nmol/L) (luteal, female)
17-hydroxyprogesterone (17-OHP)	150 ng/dL	<200 ng/dL
Total Thyroxin (T4)	7.3 µg/dL	5.5–12.5 µg/dL
Free Thyroxin (T4)	1.2 ng/dL	0.8–1.8 ng/dL
Thyroid stimulating hormone (TSH)	2.7 mIU/L	0.5–5.0 mIU/L

Table 2. Luis's diagnostic andrology laboratory results.

Component	*Luis's Value*	*Reference Range**
Total sperm count in ejaculate	9 million	39–928 million
Ejaculate volume	2.6 mL	1.5–7.6 mL
Sperm concentration	5 million per mL	15–259 million per mL
Total motility (progressive and non-progressive)	42%	40–81%
Progressive motility	40%	32–75%
Sperm morphology	22%	4–48%
*Reference range values from World Health Organization (WHO)		

Questions

4. Summarize Marta and Luis's lab results. Indicate any abnormalities and hypothesize an explanation for any abnormal finding(s).

Martas are in range & Luis's sperm count in ejaculate as well as sperm concentration are lower than the referenced range. most likely from being around pesticides

5. Describe the components of semen.

Total sperm count in ejaculate and sperm concentration

6. Explain the role of FSH, E2 and AMH in normal female reproductive physiology.

FSH: control of the menstrual cycle. triggers the growth of eggs in the ovaries

E2: receptor binding & cell entry

AMH: developing babys sex organs while in womb

7. Differentiate between a hysterosalpingogram and a hysteroscopy.

HSG: x-ray test to outline internal shape of the uterus

hysteroscopy: a procedure used to examine inside of the womb

Part III – In the Office

The couple sat down in the office with Dr. Martin to review the findings from Marta's and Luis's laboratory tests.

There were no anomalies found during Marta's hysterosalpingogram or her hysteroscopy (Table 1). "This is good news," said Dr. Martin with some excitement. He then turned to Luis, handing him a printout from his semen analysis (Table 2). Dr. Martin walked Luis through his numbers and explained what they meant. In an attempt to understand a bit more about his patient, Dr. Martin asked Luis to describe his daily routine.

"I get up around 5 a.m. to catch the bus to the banana plantation and return home around 6 p.m. each day," answered Luis.

"Ok," said Dr. Martin. "And while you're at work, what types of things do you do?"

"I work in the field, so my responsibilities are with the bananas; monitoring growth, overseeing the application of pesticides, and determining what bananas go to the packing plant each morning for export."

"Do you have to do any heavy lifting?" asked Dr. Martin.

"No, not really, no more than a box of bananas," Luis replied.

"As for the pesticides, do you know what types you are using on the bananas?" asked Dr. Martin.

"Not offhand, but I can find out."

"Okay, that sounds good," said Dr. Martin. "Let's plan to get some additional information on the pesticides that you are using because there are some that are known male reproductive toxins. In the meantime, I'm going to give you a script to have some blood drawn to check a few hormone levels. On your way out, please set up a follow-up visit in one week."

Questions

8. If you were Dr. Martin, what hormones would you be testing for in Luis and why?

testosterone & other antogens s

9. Define reproductive toxin.

a substance or agent that can cause adverse affects on the reproductive system

10. Given Luis's background, describe how he could have been exposed to a reproductive toxin (i.e., routes of exposure).

through pestisides it can damage the structure of cells and impair hormonal balance

Part IV – Pesticides

One week later, Luis informed Dr. Martin that he had a list of some of the pesticides used on the plantation (Table 3).

"It looks like they fall into three categories: insecticide, fungicide, and nematicide. They are applied at different times in the season to ensure there are enough bananas for export. I wrote them down on this paper for you to review," said Luis.

Table 3. Luis's list of pesticides used on the plantation.

Categories	*Drug Name*	*Secondary Use*
Insecticide	Chlorpyrifos ?	Also acts as an acaricide and miticide
Insecticide	Imidacloprid	
Fungicide	Mintezol *	Also acts as a parasiticide
Fungicide	Amistar *	
Fungicide	Mancozeb *	
Nematicide	Nemagon (DBCP) *	

"Okay, great. I know how a few of these pesticides work and suspect that at least one of them may be causing some of your issues," said Dr. Martin. "This list, together with your most recent blood work results demonstrating elevated levels of FSH and LH, are making me think that your work at the banana plantation has caused your reduced sperm counts. So, since we have a pretty good idea what we are working with, how would you both like to proceed?"

Questions

11. Differentiate between acute and chronic exposure. How would you classify Luis's exposure?

Acute: Severe, sudden last a Short time

Chronic: continuously over long time

Chronic they continue to affect Luis hormone levels

12. Are any of the chemicals listed in Table 3 known reproductive toxins? If so, which one(s)?

Nemagon, and Mancozeb are the big ones, all have effects but Clorpyfios is the next dangerous one.

13. What is the mechanism of action for the chemical(s) that you listed in Question 12?

Intracytoplasmic sperm injection or a IUI

which is a artificial inemination

14. Given this new information and considering the benefits of different assisted reproductive technologies, which would you recommend to Luis and Marta? Why is that their *best* option for having a baby?

Part V – Social Justice

DBCP was used in the United States from the mid-1950s until its ban in the late 1970s. In 1979 the US EPA placed a permanent ban on the distribution of DBCP. Despite the ban in the United States, DBCP continued to be produced in the United States by two companies, Shell Chemicals and Dow Chemicals, and was distributed by Standard Fruit Company (now Dole Food Company) to other countries, including Costa Rica until at least 1985. At the time, substantial evidence was available identifying DBCP as a male reproductive toxin linked to male sterility. The pesticides arrived in predominately Spanish speaking countries with no warning labels and precautionary recommendations written only in English. When the workers on these plantations discovered DBCP was a known toxin, they questioned why Standard Fruit Company continued to import the pesticide while knowing the risks DBCP could have on their workers. Affected banana plantation workers were victimized further in the public eye as newspapers portrayed sterile men as drunk, depressed, and divorced. Ultimately in 1984, a group of 81 Costa Rican plantation worked filed a suit in the United States court system against Shell and Dow Chemical companies in Texas. The case was dismissed on grounds of *forum non conveniens* (FNC). Similar cases were brought in Florida and California with the same result. In 2001, the Nicaraguan courts ordered payment by Shell, Dole, and Dow to DBCP sterilized banana workers. No payment has been received by the workers to date (September, 2021).

Questions

15. Should someone be held accountable for what happened to these workers? Why or why not?

absolutly, pestcides can be an endocrine disrupting chemical and most cause infertility these companies should find a different chemical or solution so families are able to grow

16. If someone should be held accountable, who should it be? What do you see as potentially appropriate compensation for affected workers?

most likely the people creating pesticides money to pay for ARTS and maybe a little more this is affecting people with their ability to make a family.

17. How might you be able to instill change to protect workers like Luis?

Find different substutions, for instance some essential oils repel bugs this would serve as a non toxic replacement.