

Texas Tech University, Plant and Soil Science Spring Seminar 2024

Title: Could Biotechnology and Genomics Alone Carry the 21st Century Green Revolution? A Cautiously Optimistic View of a Pragmatic Plant Geneticist

Speaker: Benildo de los Reyes, Ph.D.

Location: TTU Student Union Building – Mesa Room (2nd floor)

Date/Time: Thursday, Feb 15th / 12:00 – 1:00 PM

Abstract

During the Green Revolution of the mid-20th century, the imminent threat of famine and malnutrition amidst poverty and population explosion in the developing world was successfully aborted by the massive success of plant breeding and modern crop management technology. In rice for example, a staple food crop that feeds more than half of the world's population especially in the poor communities relying on subsistence farming across Asia, Africa, and parts of South America, conventional plant breeding led to the new generation of semi-dwarf, photoperiod-insensitive, early-maturing, and inorganic fertilizer-responsive modern cultivars. These cultivars were bred specifically to maximize yield potential under ideal and well-managed agricultural ecosystems with ample supplies of clean irrigation water and nutrients from inorganic fertilizers. Yield potential was maximized by virtue of morphological, developmental, and physiological attributes that were most ideally suited for optimal environments, engineered by what was then considered to be 'modern genetics'. The outcome was net positive gains from efficient photosynthesis and source-sink dynamics under non-limiting environments that ensured superior grain harvest index.

Unlike during the Green Revolution, in the 21st century, utilization of marginal environments including coastal, arid, semi-arid, and polluted lands as well as contaminated water for crop production has become an even more critical component of the new equation for ensuring food security. Climate change and rapid industrialization and urbanization exacerbate the effects of natural resource (most especially water) depletion. This is a new reality that no longer applies just to the developing world. It is a global issue! To further complicate the already grander challenge, there are genuine concerns on whether the yield ceiling of crops that was achieved by genetics during the Green Revolution could be elevated further, given the trend of plateauing yields even among the most elite products of biotechnology-enabled breeding.

Could the progressive shift to biotechnology and genomics paradigm during the last four decades recreate a second Green Revolution? The author believes that the technological power to address such a grand challenge is ripe. However, there appears to be a tendency to overpromise solutions through an overly reductionist paradigm. In other words, scientists appear to be narrowly focused on technology with vague recognition of the complexity of biological evolution that created the range of adaptive capacities across the biodiversity. Looking for simple solutions to a complex problem of making plants produce well under limiting environments appear to be a common thread in today's gene-centric research paradigm. Are we addressing the right problem? Are we addressing the problem right? The answer to the first question is a resounding 'yes', but the answer to the second question is debatable. The author who is a plant geneticist will discuss his personal perspectives on why we do not seem to get closer to the answer to one of the grandest challenges in this century despite the power of modern genetic and information technologies. Such a grand challenge requires bolder yet pragmatic approaches that could re-optimize plant physiology, morphology, growth, and development to adapt to the limiting environments of the 21st century.