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OPINION

Plant physiology in South America: diagnostics and perspectives

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Abstract This is a short text about a lecture I gave during the XV Congress of the Argentinian Society of Plant Physiology, in Mar del Plata, in September 2014. In this Opinion, I show some scientometrics of science and plant science that have been performed in South America. Plant Physiology, in my opinion, is loosing the battle to the "omics" when it comes to dealing with challenges related to plant science. Plant physiology was born from a systemic understanding of the plant functioning. Therefore, actually, we should work together with other disciplines in order to propose interesting ideas to enhance rates of crop yields increase. Otherwise, we will have to accept more biodiversity destruction to expand lands for agriculture, food insecurity and food inflation.

Keywords Argentinian Society of Plant Physiology · Brazilian Society of Plant Physiology · Plant science · Scientiometrics

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1 Introduction

Thermodynamically, agriculture is unsustainable; and so is plant science.

These sentences were used in my speech during the XXX Congress of the Argentinian Society of Plant Physiology (ASPP) and XV Latin American Congress of Plant Physiology, in Mar del Plata, Argentina, in September 2014. Great scientists participated in that meeting and shared their expertise, which certainly made the audience think about the plant science we have been performing in South America.

Prof. Edith Taleisnik, from Conicet IRFGV (CLAP INTA), Cordoba, Argentina, who is a former President of the ASPP, gave the opening lecture of this Congress and made an unusual and provocative question to the audience, asking us to resolve a doubt until the last day of the meeting: "Is Plant Science or Plant Physiology innovative fields?"

"Unfortunately", I gave the last talk of the meeting and, somehow, felt responsible for giving *some* answers to her question, although, as the president of the Brazilian Society of Plant Physiology (BSPP), I have been studying Plant Physiology and considering it an innovative field since I was an undergraduate student. So, that was my talk, whose title is the same of the present Opinion. Fortunately, Prof. Edith Taleisnik also published her lecture as an Opinion in the present issue of the Theoretical and Experimental Plant Physiology (TxPP). Let's revise my lecture and some answers I could give to her question.

2 Science and plant science in South America

General scientific knowledge produced in South America, or that South American scientists have actively participated in as researchers, has increased tremendously in the last decade (Noorden 2014). Brazil, for instance, has contributed to approximately 80 % of all papers coming from this region. Therefore, South American scientists have been producing a considerable "noise" into the scientific community.

However, the science produced in our region is only a small part of the world's knowledge, expressed as scientific papers. In addition, South America's scholarly impact remains low, with 80 % of the world's average (Noorden, 2014). The snapshot of science produced in our region depicts a robust publication record in Brazil, the first place for Chile as patent depositor, and Argentina as the country showing the highest proportion of its population dedicated to science. Therefore, South America does not bring any unity as a science player, given such disparity, as demonstrated in Noorden's article. If we add the expenditure on research and development (R&D) in this discussion, we find Brazil spending approximately 1.2 % Gross Domestic Product (GDP) and the other countries investing less than 1 % GDP in R&D. Therefore, a natural diagnostic, at least for Brazil, is that we should invest in more "qualified" R&D, i.e., research that return higher scholarly impacts and patent deposits.

Some areas in Brazil exhibit excellence in R&D, such as Physics. Brazilian physics has surpassed the world's average citation rates. In fact, when general Brazilian "scientiometrics" are evaluated, numbers coming from Physics must be taken out because these numbers would become outliers in relation to the rest.

Plant science performed in South America may not be considered the most important in the world, either. We may have great scientists in this field and significant field crop yields, but we are far from playing *trends* in this scientific area. However, South America, but most importantly, Argentina and Brazil, are important producers of crops and commodities, such as soybean, rice, wheat, corn, sugarcane and bioenergy, orange juice, coffee, etc. On the other hand, we do not possess the world's highest impact journals in plant science or agricultural science. This dichotomy may also be related to Plant Physiology. The *ONLY* journal dedicated to plant physiology in *Latin* America is TxPP! Recently, this journal was included in the JCR (Journal Citation Reports) impact factor listing (SCIE) and will have its first impact factor calculated in June 2017. Considering it is the only plant physiology journal in the region, this news could count as exciting information for South American scientific community, but it could also be seen as a drop in the river where local plant scientists navigate.

Plant physiology may be considered the science of plants all together. This is what I tell my students. We do depend on plant biochemists, plant geneticists, plant pathologists, and other plant "-ists" to understand the plant as a live being and its relation to the environment, as well as how we can use them to harvest competitive yields. However, plant physiology was born as a *systemic* understanding of the plant functioning. Recently, the first Symposium on Systemic Plant Ecophysiology, held in Presidente Prudente, Brazil, in December 2014, has highlighted the importance of the concept behind plant physiology. It would be a pleonasm to use the term "systemic" to refer to plant (eco)physiology.

During the XXX Congress of the ASPP, in Argentina, Dr. François Tardieu (INRA, LEPSE, France) demonstrated, for example, that plant stresses may be studied either as harmful or beneficial events to the physiology of plants. It is undeniable that the world requires the development of novel genotypes better adapted to drought and higher temperatures. Resolving this challenges also requires a multidisciplinary task when looking for answers from crop plants. Such multidisciplinary "look" is provided by Plant Physiologists. We are the guys who are trained to have a holistic view of plants, trying to figure out their puzzled functioning net. Therefore, plant physiology is one of the *few* sciences that are able to help us integrate the contribution of (combinations of) genes believed to enhance yields. However, sometimes a few genes totally devoted to increase yield due to an intuitive phenomenon might not work. In my lecture in Mar del Plata, I showed some data that demonstrate that sometimes an intuitive "shoot" from simple mechanisms do not explain why higher yields cannot be achieved, or why those simple mechanisms do not work well. For instance, under some circumstances, improving the mesophyll conductance of some crops might not be useful, especially if it is the "old and good" dry matter redistribution that determines high or low yields. Another example comes from sunlight *interception* and

conversion. Depending on genotypes, with different canopy architecture, these strategies may result in different consequences for yields. Nevertheless, the bright conclusion of all is that these facts, measured as simply as with a ruler or with metabolomics analysis, continue to depend on the work of plant physiologists.

3 Food security and challenges for plant physiologists

Finally, it is widely known that we must increase food production in the near future. For this, we must improve the rates of crop yields increase. These rates have been stagnated for more than a decade; if not, these yield increases have been marginal (Gruissem et al. 2012). In addition, no one may consciously expect that the world population will stop growing. Africa's population, for example, is expected to equal Asia's within the next 80 years (Schiermeier 2014). These facts will demand yield increases.

The BSPP and all societies of plant science are involved in the theme of food security (Habermann and Bressan-Smith 2013). The Global Plant Council (GPC) (globalplantcouncil.org) is a coalition of plant and crop science societies from across the globe dedicated to make general people conscious about the food security challenge. In addition, GPC seeks to bring plant scientists together to work toward solving the food security pressure we face. Needless to say that plant physiologists are (or should be) involved in this "crusade". The BSPP and ASPP have seats (as members) in the GPC and we need to bring our plant physiology community in South America to work together to contribute to increase crop yields. Let's put our physiological ideas in practice!

Therefore, with this speech given in Mar del Plata last September, and considering the above-mentioned ideas, I am positive that the null hypothesis for Prof. Edith Taleisnik's query is out of question!

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References

Gruissem W, Lee C-H, Oliver M, Pogson B (2012) The global plant council: increasing the impact of plant research to meet global challenges. J Plant Biol 55:343–348

Habermann G, Bressan-Smith RE (2013) Will we have enough to eat in the near future? What the Brazilian Society of Plant Physiology and the Global Plant Council have to do with it? Theor Exp Plant Physiol 25:244–250

Noorden RV (2014) The impact gap: South America by the numbers. Nature 510:202–203

Schiermeier Q (2014) World population unlikely to stop growing this century. Nature 513. doi:10.1038/nature.2014.15956