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Agronomic data and the coronavirus epidemic

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Editorial

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Conducting both basic and applied research in agricultural sciences has been challenging during the spring and summer of 2020. Universities, research institutes and laboratories across the globe were shut down overnight to mitigate the serious health risks associated with the coronavirus (COVID-19) and to avoid potential infection and the further spread of the coronavirus. Experiments in growth chambers, greenhouses and research plots were instantaneously terminated, as scientists were not allowed to enter research facilities. In general, these actions have affected all scientists, as everyone has been required to shelter in place at home and has been limited to computer work only. Unfortunately, young researchers have especially been impacted, such as graduate students who are close to finishing their MSc or PhD degrees, Postdoctoral Research Associates supported by term-limited funding of contracts and grants, and beginning faculty members who are preparing for tenure and promotion. Some universities have allotted assistant professors with an extra year to complete their 3-year review or tenure and promotion packet. However, most granting agencies are not providing additional financial support to extend research programmes during the time when scientists have limited access to their research facilities. In early July, The Young Academy of Dutch universities (dejongeakademie.nl) wrote a 'brand brief' or 'fire letter' to the Dutch Minister of Education, requesting €350 M to provide financial support for the next generation of young scientists. Similar funding activities have already emerged in Germany, Sweden, Switzerland and the UK. In the USA, new funding has become available for COVID-19-related research, but these opportunities have mainly focused on health-related issues. So far, there have been no initiatives in the USA to provide supplemental financial support for young scientists whose research programmes have been delayed.

When a shock event, such as the coronavirus, 'freezes' an experimental research programme, there might be alternative opportunities to continue the research, such as using data that have already been collected by other scientists. During the past century, a wealth of agricultural research has been conducted, with most original research results recorded on paper copies stored in filing cabinets that have been discarded into a dumpster upon the departure or retirement of a scientist. With the transition to electronic and computer records, most granting agencies now require that research data are made publicly available at the end of a project. Although this process is already very common and popular in the field of medical sciences, it is going through a very slow adoption process in agricultural sciences. Traditionally, agricultural research has been rather conservative but there are other reasons, including the lack of financial or personnel resources, the absence of rewards and incentives, and a poor computer infrastructure and unpractical software tools for implementation.

Recently, there have been several new and innovative initiatives associated with agronomic research data under the umbrella of the FAIR guiding principle for scientific data management and stewardship (http://www.datafairport.org/). FAIR stands for *Findable*, *Accessible*, *Interoperable*, and *Reusable*. In practice, this initiative means that research data can be found and accessed from a public database and that the data can be easily retrieved in their original or semi-processed format and used for data analytics and new applications. One of the most successful initiatives so far is GARDIAN, the Global Agricultural Research Data Innovation & Acceleration Network, which is one of the main pillars of the Platform for Big Data in Agriculture, a programme of the CGIAR (Consultative Group on International Agricultural Research; http://www.CGIAR.org). GARDIAN currently provides information for over 27 656 data sets and 170 329 publications (gardian.bigdata.cgiar.org; 16 July 2020), with its main focus on the experimental data collected by the 15 CGIAR International Agricultural Research Centers. GARDIAN recently partnered with the Indian Government to provide access to agricultural research data collected in India. The portal of GARDIAN allows researchers/scientists to use keywords to search for data by location, crop or commodity, management practice, research discipline, etc. The search results in a list of data sets or publications that can be accessed using a DOI (Digital Object Identifier).

Most data and publications are not stored in GARDIAN but in other public databases and repositories. For instance, Harvard Dataverse (dataverse.harvard.edu) is a repository that has been used frequently to deposit research data for a wide range of different disciplines, including agriculture. Other data repositories include the DRYAD Digital Repository (datadryad.org) and the Mendeley Data platform that allows for uploading of research data associated with Elsevier publications (data.mendeley.com). Another noteworthy agricultural data resource is Ag Data Commons, a service provided through the United States Department of

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Agriculture (USDA) National Agricultural Library (NAL). Ag Data Commons is a repository and catalogue for scientific data collected by USDA-funded researchers (data.nal.usda.gov).

With the mandate for Open Data by governments such as the USA (http://www.data.gov), UK (data.gov.uk), European Union (data.europe.eu), Australia (data.gov.au) and many others, it is expected and anticipated that research data collected through public and private funding will become more readily available. In parallel, data journals are being initiated that allow for the actual publication of a data set itself. The data journals can provide proper credit through a citation for the authors who have collected the data and can provide the data as a resource for further analysis and applications through modelling, statistics or data analytics. The *Open Data Journal for Agricultural Research* (ODJAR; odjar.org) is an initiative of Wageningen University and Research Centre; this new journal established in 2015 is slowly gaining momentum as a new opportunity for publishing agricultural research data.

In most cases, existing research programmes cannot simply be replaced by data that have already been collected by other researchers during the past century and might already have been published. However, especially for graduate students who are forced to end their experiments, these existing data sets can be a great resource to supplement their ongoing research in lieu of conducting experiments in experimental fields, greenhouses or growth chambers that were closed due to the COVID-19 pandemic. Until recently, many agricultural scientists were not aware of these opportunities for obtaining additional data from repositories that could supplement their own data. I hope that awareness of these efforts will serve as encouragement for agricultural scientists to submit their data to these data repositories once the research has been completed and summarized in scientific publications so that their research data will be available indefinitely in support of future agricultural science.

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