



Food and Agriculture  
Organization of the  
United Nations



**The International Treaty**  
ON PLANT GENETIC RESOURCES  
FOR FOOD AND AGRICULTURE

## Documentation of Users' Experiences on DOI Application Feedback analysis

### I. Background

The Global Information System (GLIS) on Plant Genetic Resources for Food and Agriculture was established by Article 17 of the International Treaty. The total number of Digital Object Identifiers (DOIs) assigned to plant genetic resources for food and agriculture (PGRFA), as stated by the participating institutions and projects, exceeds 830 000 at the time of preparation of this analysis. At its Sixth Session, the Governing Body adopted the Vision and the Programme of Work for the period 2016–2022. It also set up the Scientific Advisory Committee on Article 17 (the Committee), whose terms of reference were updated at the Seventh Session.

With Resolution 5/2017, the Governing Body requested the Secretary of the International Treaty to “interact with a broad range of user categories in order to define through user cases the user-oriented entry points in the GLIS web-based Portal and to facilitate, on a voluntary basis, the incorporation of DOIs into the workflow of existing databases and systems” regarding implementation of the Global Information System.<sup>1</sup>

At its third meeting, the Scientific Advisory Committee on Article 17 of the Treaty advised the Secretary to document experiences in the application of Digital Object Identifiers by early adopters. It also advised the Secretary to gather information on expectations from other potential users, as well as on other cases identified.<sup>2</sup> Additionally, in the context of the discussion on the Masterplan for the GLIS Portal, the Committee advised the Secretary to develop model cases illustrating the effectiveness of connecting existing information systems through the GLIS.<sup>3</sup>

At the same meeting, the Committee recalled that use of DOIs is voluntary, as indicated in the Guidelines. It further advised the Secretary on the list of users and stakeholders who should be contacted to document experiences in the application of DOIs by early adopters, and for gathering information on expectations of DOIs by other potential users, as well as on other cases identified.<sup>4</sup> The table contained a list with eight categories of users: national genebanks, CGIAR Research

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<sup>1</sup> The Resolution is available at [www.fao.org/3/a-mv103e.pdf](http://www.fao.org/3/a-mv103e.pdf)

<sup>2</sup> See IT/SAC-GLIS-3/18/Report, available at [www.fao.org/3/CA0526EN/ca0526en.pdf](http://www.fao.org/3/CA0526EN/ca0526en.pdf)

<sup>3</sup> <https://ssl.fao.org/glis/>

<sup>4</sup> Contained in Appendix 2 of the same Report.

Centers, Benefit-sharing Fund projects, multi-country evaluation projects, research institutions, regional genebank networks, priority entry-points at global level, and others.<sup>5</sup>

Accordingly, the Secretary requested inputs from users who have adopted DOIs, and who were included in the list adopted by the Committee. The Secretary also took into account the inputs and submission received from potential users and stakeholders. The collection of contributions and feedback was carried out in the last quarter of 2018 and the first semester of 2019.

The Secretariat developed and distributed via email a questionnaire to facilitate the gathering of feedback from users. This consisted of 25 questions, divided into three main categories: a) identification of the user and type of activities undertaken; b) description of the direct experiences in the adoption of DOIs and the registration process; and c) recommendations and expectations, and any additional feedback.<sup>6</sup>

In response to the advice received from the Committee, this report contains an analysis of the replies and includes a few model cases for the provision of support to users in the context of implementation of the Global Information System.<sup>7</sup>

## **II. Analysis of feedback on the use of Digital Object Identifiers**

### **A. Categories of users**

Feedback was received from eight different types of user<sup>8</sup> as identified by the Scientific Advisory Committee included in Appendix 2 of the Report.<sup>9</sup> Several respondents provided feedback for a group of users that jointly assigned DOIs. The providers of feedback were based in different countries, Costa Rica, France, India, Indonesia, Italy, the Netherlands, the Philippines, Tunisia, Turkey, just to name a few. It also reflects the views of potential users from the North America Region. The Secretary also collected inputs from various projects covering a number of countries, as well as from two regional networks and global databases on plant genetic resources for food and agriculture. The inputs received from 14 respondents documented experiences from users and potential users operating in more than 60 countries, including 48 genebanks and eight research institutions.

The questionnaire allowed the Secretariat to profile users and their responses in the analysis, avoiding the attribution of individual comments. The respondents also provided information on their funding sources, which included: national budgets; CGIAR; the Benefit-sharing Fund of the

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<sup>5</sup> The list also identified some suggested users, who adopted DOIs at an early stage or were involved in the work of GLIS, recommending that the Secretary obtain inputs from at least two users from the first two categories listed: national genebanks and CGIAR Centers.

<sup>6</sup> The questionnaire is available at [www.fao.org/3/ca5763en/ca5763en.pdf](http://www.fao.org/3/ca5763en/ca5763en.pdf)

<sup>7</sup> This report can also be consulted online at: <http://www.fao.org/3/ca6454en/ca6454en.pdf>

<sup>8</sup> National genebanks, CGIAR centres, Benefit-sharing Fund projects; Multi-country evaluation project, Research institutions, Regional genebank networks, Priority entry-point systems at global level, and others.

<sup>9</sup> <http://www.fao.org/3/CA0526EN/ca0526en.pdf>

International Treaty; the European Union; the Global Crop Diversity Trust; FAO, and contributions from member countries paying regular fees.

In addition to the individual inputs, some organizations and networks have sent statements or reports referred to in this document. The views of the private sector have been solicited but not reflected in this document. The public statements and any future inputs will be made available at the Treaty's website.<sup>10</sup>

## **B. Description of main activities**

Most of the early adopters of DOIs from whom feedback was received work on germplasm conservation, plant breeding, or research activities such as characterization, evaluation and genomics. Some of these reported being involved in PGRFA regulation, and in information management of crops, animals and forest species.

Overall, there was a strong focus on conserving and improving germplasm and using quality information to improve the conservation and use of crop diversity for increased food security.

The application of DOIs is not restricted to Annex I material, but they have received a lot of emphasis from the users. With regard to the crops that they manage, the respondents mainly indicated those included in the list of Annex I of the International Treaty, though several other crops were also mentioned, such as coffee, cacao, peach palm, guava and exotic fruit trees.

Several respondents listed farmers, plant breeders, crop researchers, universities, geneticists and bioinformaticians as their stakeholders and final users.

A number of respondents described projects intended to support farmers in developing countries. Notably, several projects contributed to advances in crop diversity research and knowledge, the development of new varieties, increased yields, prevention of the introduction of new diseases, and a reduction of losses due to pests and diseases.

The respondents sent detailed information on their activities. Some provided links to presentations and papers related to PGRFA with assigned DOIs (e.g. genotyping-by-sequencing revealing the origin of the relatives of a cultivated crop). Additional information was provided through links to references related to participating stakeholders, describing the project, institution, or network's purpose and results. These can be found in Appendix I.

## **III. The Global Information System and use of DOIs**

### **A. Benefits resulting from the use of DOIs**

Most respondents indicated that the GLIS and the DOIs have helped their institutions to improve documentation of PGRFA, and its visibility around the world. Several users reported that

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<sup>10</sup> <http://www.fao.org/plant-treaty/areas-of-work/global-information-system/experiences>.

use of DOIs for their materials, and the link to the genebank accessions, had facilitated improvements in their documentation systems, as well as quality-controlled information sharing, and the transfer of plant material. They also reported improved traceability of accessions and interoperability with other systems; the linkage of plant material with publications and results from trials in which materials are tested, and a general increase in visibility of the crop material.

Some projects declared that DOIs helped them to identify landraces more effectively, and clarified the provenance of the material and its linkages to genomic and phenomic research datasets. Respondents from other projects stated that the connection of passport and phenotypic data with DSI/GSD<sup>11</sup> via DOIs appears to be highly promising for integration with these data.

## **B. Increased collaboration**

Most respondents agreed on the impact and usefulness of DOIs for facilitated collaboration among partners and different stakeholders, especially when the transfer of plant material is involved. DOIs also ease information exchange among participating institutions, while improving data quality and the identification of material of different origins in different locations.

Additionally, a regional network is promoting and supporting DOI adoption by presenting its importance in documentation training workshops. It offers a service to assist data providers with DOI registration in the GLIS, in collaboration with the International Treaty. A few users mentioned that it was not yet possible to measure the impact of DOIs with partners and stakeholders, since they only adopted them recently.

## **C. Connection with datasets**

Users were interrogated with respect to whether or not DOIs have facilitated a connection between datasets. There was general agreement that DOIs unambiguously and reliably refer to PGRFA, not only within the institution, but also across institutions because they are unique at global level. Others reported that DOIs are paving the way for adding and connecting extra information to the material, especially publications and trials in which materials are tested.

The European Cooperative Programme for Plant Genetic Resources (ECPGR) network reported that only passport data and phenotypic data are available in their catalogue. However, the connection of these data with genetic information via DOIs shows great promise, and a task for the Global Information System could be to promote use of the accession DOIs as metadata for sequencing/genotyping consortia, thereby improving subsequent integration with these data.<sup>12</sup> The

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<sup>11</sup> Through Resolution 13/2017, the Governing Body clarified that the term ‘digital sequence information’ was taken from decision CBD COP XIII/16, and was subject to further discussion. The Governing Body further recognized that there are a multiplicity of terms in this area (including, *inter alia*, ‘genetic sequence data’, ‘genetic sequence information’, ‘genetic information’, ‘dematerialized genetic resources’, ‘*in silico* utilization’), and that further consideration would be needed regarding the appropriate term or terms to be used.

<sup>12</sup>The submission is available at: <http://www.fao.org/3/ca6502en/ca6502en.pdf>

plans of ECPGR announced the plans to connect to GLIS and to facilitate the registration of DOIs through to the members of Eurisco before the end of 2019.

#### **D. Approaches for applying DOIs suggested by potential users**

One institution declared that the connection between data continues to be made through the accession number rather than through DOIs, so the impact of these latter is still not measurable in their own context.

A joint Statement from the North America Region reported that “at present, the national genebanks of Canada and the United States are not prepared to assign DOIs in addition to the currently used permanent and unique local accession numbers assigned to genebank accessions under their stewardship.<sup>13</sup> In particular, the submission “suggest[s] that genebanks adhere to the first option described on page 9 in the document “Digital Object Identifiers for food crops “(Alercia et al. 2018) which is to “Use the DOI for the material as registered by the provider. This proposed practice would result in much more reliable permanent unique identifiers for PGRFA”. The statement further indicated that the Region has a different concept for the application of DOIS that “by no means prevent others, including those to whom [*they*] provide germplasm, from using the DOIs for this material or derived progeny and to associate the DOI with [*their*] local genebank accession numbers.

The statement also said that DOIs are a useful and powerful tool as permanent unique identifiers, and “the DOI should identify just the specific physical living material. It is not useful to have different DOIs associated with the same material depending on where and by whom that material is held or maintained”. It continued, “A single unique DOI associated with a genebank accession could be useful as a permanent unique identifier. It must be permanently and unambiguously associated with the genetic material, and the same genetic material should have the same DOIs, regardless of where it is maintained.”

In its joint statement, the North America Region acknowledged the efforts made to provide information about the guidelines, the videos, and the documents reviewed by the Scientific Advisory Committee. Finally, it added that “it would be desirable to not restrict such DOIs to material that falls under Annex 1 of the ITPGRFA”, and suggests further discussions on the topic at the next meeting of the Committee.

#### **E. DOIs assigned to material**

Genebank curators of international collections indicated that DOIs are useful to identify genebank material, landraces, crop wild relatives and breeding and elite lines resulting from breeding programmes, particularly when the decision is to conserve those materials in long-term conditions,

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<sup>13</sup> The statement was received from Plant Gene Resources of Canada (PGRC) – Agriculture and Agri-Food Canada (AAFC) and the National Plant Germplasm System (NPGS), United States Department of Agriculture (USDA), Agricultural Research Service (ARS) and it can be consulted online, in the form and language in which it was received, at <http://www.fao.org/3/ca6455en/ca6455en.pdf>

and make them available through the Multilateral System. According to the CGIAR report<sup>14</sup>, the 11 Research Centers have assigned 781 514 DOIs to materials, whereas the European Genetic Resources Search Catalogue (EURISCO) currently contains 51 590 accessions with a DOI (as of 22 May 2019).

#### **F. Tools used by stakeholder to register DOIs**

The majority of respondents used the Excel template developed by the Secretariat, and some of them used the Toolkit. Some respondent indicated that they were considering using the Toolkit in the near future, or their own implementation of the XML Protocol to automate the process as much as possible. It was reported that 11 CGIAR Research Centers would receive support from the CGIAR Genebank Platform to focus on full integration of DOIs into genebank activities.

#### **G. Support received from the Treaty Secretariat**

According to feedback received, there were no major issues during the registration process. Documentation was found to be clear and helpful in facilitating use of the DOIs. Respondents indicated that the technical support provided by the Treaty Secretariat was timely, and helped in understanding the potential, and in mastering the process.

It was reported that some difficulties were encountered at the start of the biennium, with some users unclear as to how to obtain a DOI, or how to complete the Excel template. However, new documentation and technical assistance provided remotely by the Secretariat or during visits to genebanks, together with participation in training sessions organized by the Treaty, made the registration process simpler to understand and implement.

#### **H. The voice of actual and potential DOI users**

Users that have adopted DOIs declare that they would recommend their use to others, while potential users through a public statement indicated the proposed application could still be clarified and improved:

##### **The voice of users**

##### **QUOTE**

*“DOIs give you a way of identifying, describing and structured and scalable resolution of your accessions info and ensure: - Interoperability between different information systems; traceability of your identified objects (accessions, image, publication ...); visibility of your published information.”*

*“DOIs are useful for genebank managers but also to breeders for tracking the use of parental material supplied by the genebank.”*

*“Our Project Coordinator recommended DOIs to other countries and projects of the Near East Region.”*

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<sup>14</sup> <http://www.fao.org/3/ca6498en/ca6498en.pdf>



*“DOIs make easier the management of PGRFA accessions in our collection, and significantly improve the visibility of PGRFA data for a wider community.”*

*“The use of DOIs is fundamental to link the PGR with associated information, to facilitate the material exchanges, to improve the traceability of the PGR developed and to better exploit the resources.”*

*“DOIs are a universal identification that does not change from one country or institution to another...”*

*“We are promoting and supporting the adoption of DOIs by the genebanks in our region by presenting the importance of the DOIs in documentation training workshops and other occasions.”*

*“We organize seminars on the advantages of assigning GLIS DOIs for breeders’ materials, and discussions are ongoing on how to best integrate DOIs in breeders’ work. Other institutions we partner with have made efforts to raise awareness about DOIs and their value among different users beyond CGIAR.”*

### **The voice of potential users**

*“It is not desirable for a recipient to request a new DOI for any material/accession that already has been assigned a DOI. In our view the purpose of the DOI is to uniquely identify the material rather than the material and the holder of that material. [...] Assigning new DOIs to the same material after each distribution from a provider to a recipient will result in a never-ending series of DOIs assigned to precisely the same genetic material.”*

#### **I. Improving user support**

Based on feedback received, the Secretariat of the Treaty identified common activities and use cases according to the size of the PGRFA collections to be registered, and developed functions accordingly. For each use case, a solution was identified to help GLIS users to speed up the process of assigning DOIs. Further details are summarized in Appendix II.

With regards to those stakeholders wishing to register PGRFA of small or medium collections, the best tools are the Web Form or the Excel template. For users registering large collections (thousands of PGRFA), in addition to the Excel template, the Treaty Secretariat recommends using the XML Protocol. If there are just a few DOIs to register, or updates need to be applied to a few existing ones, users can do so manually on the GLIS Portal page.

Regarding data complementarity between different priority entry-point systems such as Genesys,<sup>15</sup> an integration workflow has been implemented. The XML Protocol is used for system-to-system integration. Concerning the regional or thematic PGRFA networks, the Treaty Secretariat staff can assist with adoption of the XML Protocol for DOI registration. In other cases, such as the

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<sup>15</sup> [www.genesys-pgr.org/](http://www.genesys-pgr.org/)

GRIN-Global System, adoption of the GLIS XML Protocol is being considered to help users register or update their material.

One important aspect, which requires more efforts in the view of the respondents, is the citation of GLIS DOIs in publications and datasets released by stakeholders during their research activity. A joint initiative by Crossref,<sup>16</sup> DataCite<sup>17</sup> and the Secretariat is ongoing to raise awareness with authors, editors and publishers on the importance of proper *data citation*.

#### **J. Users expectations on the application of DOIs**

Some users mentioned that a major attraction of the DOI system is the potential to associate GLIS DOIs for PGRFA with DOIs for associated information, such as DOIs for publications and online datasets. This process connects associated information to GLIS, and ensures that it remains associated with the PGRFA it describes.

Several respondents requested additional training and assistance for other users in their countries and partner institutions.

Some users noted the integration between Easy-SMTA and the GLIS DOI Registration Service, and suggested developing an integrated interface or landing page to clarify the available options and functions for those using a single account.

Some comments highlighted the need to assign DOIs to genetic sequences, as the connection of these data with genetic information via DOIs is highly promising. There are three ‘global players’ – National Center for Biotechnology Information (NCBI) GenBank, EMBL- European Nucleotide Archive (ENA) of the European Molecular Biology Laboratory (EMBL) and the DNA Data Bank of Japan (DDBJ) – which synchronize their data daily as part of the International Nucleotide Sequence Database Collaboration (INSDC). One task for GLIS could be to promote use of the PGRFA DOIs as metadata for sequencing/genotyping consortia, thereby improving subsequent integration with these data.

With regards to the acquisition method, some users indicated that more information should be given on the derived lines, when lines were acquired from different genebanks, and the original accessions were purified with two cycles of single seed descent of pure lines.

One user indicated that it would be helpful to be able to export the list of DOIs registered in Excel-compatible format.

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<sup>16</sup> [www.crossref.org/](http://www.crossref.org/)

<sup>17</sup> [datacite.org/](http://datacite.org/)





**Related references provided by the respondents**

These include papers, presentations, websites and PDF documents related to DOIs

<b>National genebanks</b>
<a href="http://www.wur.nl/en/newsarticle/Wageningen-UR-Library-starts-issuing-DOIs.htm">www.wur.nl/en/newsarticle/Wageningen-UR-Library-starts-issuing-DOIs.htm</a>
<a href="http://www.bng.nat.tn">www.bng.nat.tn</a> ; <a href="http://www.slideshare.net/bng_tunisie/national-genebank-of-tunisia">www.slideshare.net/bng_tunisie/national-genebank-of-tunisia</a>
<a href="http://www.tn-grin.nat.tn/gringlobal/search.aspx">www.tn-grin.nat.tn/gringlobal/search.aspx</a>
DOI: 10.1007/s10722-018-0619-4
DOI: 10.1007/s10722-017-0505-5
<b>CGIAR Research Centers</b>
<a href="http://www.bioversityinternational.org/banana-genebank/">www.bioversityinternational.org/banana-genebank/</a> Garming, H., Gotor, E. & Cherfas, J. 2011. <i>The impact of the Musa International Transit Centre</i> . Impact Assessment Brief No. 4. Bioversity International 4 p. <a href="https://hdl.handle.net/10568/74299">https://hdl.handle.net/10568/74299</a>
<a href="https://doi.org/10.1007/s10658-017-1406-3">https://doi.org/10.1007/s10658-017-1406-3</a>
<a href="https://doi.org/10.3389/fpls.2019.00352">https://doi.org/10.3389/fpls.2019.00352</a>
<a href="https://doi.org/10.1111/ppa.12945">https://doi.org/10.1111/ppa.12945</a>
<a href="https://doi.org/10.3389/fpls.2018.01371">https://doi.org/10.3389/fpls.2018.01371</a>
<b>Benefit-sharing Fund projects</b>
<a href="http://www.iwwip.org">www.iwwip.org</a>
<a href="http://bankgen.litbang.pertanian.go.id/doi/report-documents-upload">http://bankgen.litbang.pertanian.go.id/doi/report-documents-upload</a>
Sabran, M., Hidayatun, N. & Kurniawan, H. 2019. <i>DOIs for Indonesia rice germplasm</i> . 20–21 August 2018. IAARD Press, Jakarta, Indonesia.
Widayanti, S. & Kristantini. 2019. <i>DOIs application for rice in Yogyakarta Indonesia</i> . IAARD Press, Jakarta, Indonesia.
<b>Multi-country evaluation project</b>
<a href="http://www.eraCaps.org/joint-calls/era-caps-funded-projects/era-caps-second-call-2014/evolution-changing-environment">www.eraCaps.org/joint-calls/era-caps-funded-projects/era-caps-second-call-2014/evolution-changing-environment</a>
<b>Research institutes</b>
<a href="http://www.catie.ac.cr/productos-y-servicios/colecciones-bancos-de-germoplasmas.html">www.catie.ac.cr/productos-y-servicios/colecciones-bancos-de-germoplasmas.html</a>
<a href="https://bit.ly/2JcwOUL">https://bit.ly/2JcwOUL</a>
<b>Regional genebanks and networks</b>
<a href="https://eurisco.ipk-gatersleben.de/">https://eurisco.ipk-gatersleben.de/</a>
<b>Priority entry-point systems at global level</b>
<a href="https://ssl.fao.org/glis/">https://ssl.fao.org/glis/</a>
<a href="http://www.genesys-pgr.org">www.genesys-pgr.org</a>
<a href="http://www.fao.org/wiews/en/">www.fao.org/wiews/en/</a>

## Appendix II

GLIS use cases		
Use case	Solution	Description
Stakeholders with few PGRFA to register	Web form or Excel	For small collections (< 500 DOIs), we recommend using the web form. However, when the information is stored in a database, it may be more convenient to export it in the Excel format for batch processing. For medium-size collections (< 5 000 DOIs), the Excel-based batch process is recommended.
Large collections with many '000s PGRFA	Excel, XML, or Protocol	When the number of PGRFA to register exceeds 5 000, it may be best to consider implementing the XML Protocol, or adopting the Integration Toolkit. The Excel-based batch registration option can be considered as a short-term solution, to quickly assign DOIs to the entire collection.
Registrants wishing to update existing DOIs or to register a few new DOIs	Web form	If errors in a few existing DOIs need to be amended (e.g. typos or changes to taxonomy), the most convenient solution is the web form. Likewise, when just a handful of new DOIs need to be assigned, it is easier to fill in the web form.
Priority entry-point systems at global level – Data complementarity	XML or Protocol	Like Genesys. An integration workflow has been implemented, whereby when a member institution publishes information about an accession with a GLIS DOI already assigned, the Genesys page on that accession is added to the list of associated links in GLIS, and GLIS updates its DOI descriptors from Genesys. This could also apply to the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (WIEWS)
Regional or thematic PGRFA networks – Assisted DOI registration	XML or Protocol	Regional or thematic networks (such as EURISCO and Web-SDIS) agreed to implement the registration of material using the XML Protocol, supported by the Secretariat. Web-SDIS is a genebank management system of the SADC Plant Genetic Resources Center and its network, with potential to implement a similar workflow.
Pre-standardized protocol: GRIN-Global	XML or Protocol	GRIN-Global is a Genebank Management System (GMS) developed by the United States Department of Agriculture, Bioversity International, and the Global Crop Diversity Trust and now further developed by the USDA and International Maize and Wheat Improvement Center (CIMMYT) for worldwide distribution. Implementation of the GLIS XML Protocol that will allow users of those systems to register new PGRFA and update existing DOIs is under assessment.
A variable number of stakeholders distributing their PGRFA for research and evaluation purposes in different locations	Web form, Excel, XML, or Protocol	Depending on the number and origin of PGRFA exchanged and the number of datasets to be generated, the most appropriate solution is adopted. The purpose is to (i) accurately identify the PGRFA being transferred; (ii) facilitate the acquisition by the recipient of passport data and other information associated to the PGRFA received; (iii) help users to get a graph of the PGRFA changes as they move from one collection to another; and (iv) facilitate linkages between the material and the resulting evaluation datasets.

Stakeholders looking for publications or datasets produced by further research	Web form Excel, XML, or Protocol	Regardless of the solution adopted, the purpose is to assign DOIs to PGRFA to be cited in publications and datasets. This way, such publications and datasets will be made more easily available to users interested in those PGRFA.
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